Advances in Science & Technology

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First Impression: 2020

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ISBN : 978-81-946375-0-9

Rs. 650/- ($18)

Published by:
Empyreal Publishing House

Preface

As its title suggests, this book covers certain areas of advances in science and technology. The contributions by the authors include ***Bio-fuels for Rural Electrification*** in which the writer has highlighted performance of a bio-fuel plant that runs on non-edible esterified Karanja vegetable oil and supplies electricity to far-flung and remote tribal village of Jharkhand state. In chapter **Advances in Cloud Computing**, its author has highlighted the cloud vision and cloud journey.

The chapter **Emerging Trends and Applications in Mobile Ad Hoc Networks** presents the current state of the art of MANET and the problems and challenges related to routing, security, power management, location management and multimedia over an ad hoc networks.

The author has investigated in detail about **Ternary Chalcopyrite** and found that ternary chalcopyrite is the most promising material of this century. Some of the authors have given an overview on **Natural Language Processing**, **Threat to Vultures in Uttarakhand**, **Cracked Madhuca Indica (Mahua) Oil as a Diesel Engine Application**. **An Artificial Neural Network** model has been designed by the authors for predicting the green sand moulding properties. Another Chapter highlight about **Advances in Machine Learning.**

Few authors have highlighted the **Progress in Global Oil and Gas Exploration** and **Recent study of carbon nanotubes and its application.**

Digital India is one of the important initiatives for the new technological world. One of the authors has highlighted the **Digital India: Impact and Challenges on Rural India.**

Through their papers authors have highlighted about the **Advances in Data Mining** and **Advances in Power Electronics**. Few authors has given a review on **Phytoplanktons in Eutrophic Water**, **Wetlands for wastewater treatment and management and Study of pigeon (Columba Livia) on the basis of special reference to Morpho Anatomy, Behavioural, Reproduction, Growth Development.**

Steganography is a better technique for concealing messages in another file format like text, image and videos. In chapter **Design and implementation of Steganographic Method for Digital Images and Visual Cryptography,** its author has highlighted a technique of data hiding using interpolation, least significant bit, digital watermarking and cryptography.

In the chapter **Demosaicking for Artificial Vision -Implementation and Evaluation** the authors illustrated the perspectives in the designing of robotic system which is guided by the vision provided to it through camera. Using MATLAB for color recognition process and embedded coding for functionality of robot, the authors have designed and implemented a vision guided robot that identifies and follows the traffic signals which can be used for autonomous intelligent vehicles for the blind.

The purpose of this book is to highlight the latest advances in science & technology. This edited book contains various materials. I hope this book would be helpful for students, researchers and academicians in the field of science and technology.

Acknowledgements

I gratefully acknowledge all the authors for contributing paper which provides richness of content to this book. I would like to offer my sincere thanks to all the authors.

I am extremely indebted to Prof. (Dr.) Savita Sengar (Vice Chancellor, Jharkhand Rai University, Ranchi), Dr. Piyush Ranjan (Registrar, Jharkhand Rai University, Ranchi), Prof. (Dr.) Sarang Medhekar (Professor & Head Centre for Applied Physics, Central University Jharkhand, Ranchi), Prof. (Dr.) Arbind Kumar (Director & Professor, Birla Institute of Technology, Patna) and Dr. Ram Krishna Sarkar (Assistant Professor Department of Physics, Birla Institute of Technology, Deoghar) as a source of inspiration for me in my academic growth.

I am thankful to Indian Academicians and Researchers Association & Empyreal Publishing House for publishing this edited book.

Dr. Shraddha Prasad

Table of Contents

Bio-fuels for Rural Electrification

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Abstract
India's development in the post-independence era is remarkable. It has made many notable strides in various sectors. However, the technological development of the country is benefitting only 21% of the population and not contributing to the nation as a whole. Presently, far-flung and remote villages particularly near the forest areas in many states of our country have not been connected to electricity grid even after 72 years of independence. Appropriate innovative technology is a complete system approach towards sustainable development and is self-adaptive. It is cost effective, dependable and safe technology for sustainable development. It uses locally available resources and skills to satisfy their needs and aspirations without compromising with their culture. It aims to improve the quality of life by maximizing the use of green energy and helps to generate local employment. This chapter aims to highlight the performance of bio-fuel plant that runs on non-edible esterified Karanja vegetable oil and supplies electricity to one such far-flung and remote tribal village located amidst dense forest in Bokaro district of Jharkhand state. The bio-fuel plant is basically a conventional diesel-generator set that runs on ester of non-edible Karanja oil which is locally available near the village. The study has been made to test the performance and emission characteristics of bio-fuel plant that uses a fuel which has been derived from locally available Karanja oilseeds. The bio-fuel plant operates continuously for 4 hours to supply electricity to Gardih village from 6 p.m. to 10 p.m. in the evening every day. From the test results, it is noticed that with the use of esterified Karanja vegetable oil, the harmful emissions such as carbon monoxide (CO), hydrocarbons (HC) and carbon dioxide (CO_2) were considerably reduced without sacrificing with the engine power output. Thus installation of more such bio-fuel plants must be encouraged in remote and rural areas of the country for decentralized power generation and for local energy security.

Keywords: Bio-fuel plant, Rural Electrification, Esterified Karnja oil, Performance Characteristic and Exhausts Emissions.

Introduction

With increasing demand on the use of fossil fuels, stronger threat to clean environment is being posed as burning of fossil fuels is associated with harmful emissions and are currently the dominant global source of air pollution. Despite this, the fossil fuels are still continued as the major conventional energy source in meeting the faster increasing world energy demand. In India the demand of conventional petroleum fuel is increasing at an alarming rate. If this continues to do so, it will further deteriorate the environment. Hence there are efforts around the globe to protect the environment from further deterioration. The harmful exhaust emissions from engines coupled with the rapid increase in the prices of petroleum fuel and the uncertainties of their supply have jointly created renewed interest among the researchers to search for suitable alternative fuels. Natural gas, propane, hydrogen and alcohol based substances (gasohol, ethanol, methanol and other neat alcohol) all have their proponents. Although these fuels burned cleaner than gasoline or diesel, but their use involves extensive modifications in the engine hardware. The ideal alternative fuel will be one which would burn the fuel more cleanly than conventional petroleum fuel and without involving many modifications in the hardware of existing engines. Vegetable oils have considerable potential to be considered as appropriate alternate as they possesses fuel properties similar to that of diesel. Moreover, the review of literature reveals that with the use of vegetable oils as fuel in diesel engines, harmful exhaust emissions, particularly HC, CO and smoke are considerably reduced compared to diesel. The major problem associated with direct use of vegetable oils is their high viscosity. One possible method to overcome the problem of high viscosity is **transesterification** of potential vegetable oils to produce esters of respective oils. Many researchers have reported that with the use of vegetable oil ester as a fuel in diesel engines, reduction in harmful exhaust emissions as well as comparable engine

performance was achieved (Alfuso et. al., 1993; Peterson & Reece, 1995; Schumacher et. al., 1996; Choi et. al., 1997; Moreno et. al., 1998; Clark & Lyans, 1999 and Raheman & Phadatare, 2004). Most of the esterified oils tried in diesel engines were soyabean, sunflower, safflower & rapseed. These oils are essentially edible oils in Indian context and are yet to attain the self-sufficiency in edible production. With abundance of forest and plant based non edible oils being available in our country such as Karanja, Jatropha, Mahua, Sal, etc., but not much attempt has been taken to use esters of these non-edible oils except Jatropha, as substitute for diesel. In India, the production potential of Karanja and Kusum are 135 and 181 thousand metric ton respectively (Shrivastava & Prasad, 2000; Kaul et. al., 2003). Hence, a study was undertaken by BIT Mesra Ranchi to run diesel engine with bio-fuel such as ester of Karanja oil and the experience and expertise so gained was utilized to provide electricity to a remotely located Gardih village in Bokaro district of Jharkhand state. The bio-fuel plant was installed by the support of Ministry of New and Renewable Energy, Government of India, New Delhi, and Jharkhand Renewable Energy Development Agency, Government of Jharkhand, Ranchi, but is technically supported and maintained by department of Mechanical Engineering, BIT Mesra, Ranchi.

Background

A large part of India's population mostly in remote and far-flung rural areas, does not have access to electricity. Hence, a program for the development of energy from the raw materials which grow in rural areas (non-edible vegetable oil) will go a long way in providing energy security to the rural people. There is a vast potential of non-edible oils in India. A variety of non-edible oil producing trees and shrubs (more than 100 species) has been identified, most of them are found in forest areas of many states. Planning Commission's Report on development of Bio-fuel indicates that the total potential of non-edible oil in India is around 0.1 million ton per annum. It is also estimated that only 10-15% of the available potential is utilized for variety of purposes. The rest of the potential is not tapped and goes waste every year due to non-availability of utility facilities.

Objectives

(i) To provide electricity through non-edible vegetable oils for rural people in far flung areas for lighting, agricultural and other community based needs..

(ii) To test the performance and emission characteristics of bio-fuel plant in the field conditions.

(iii) To study techno-economic parameters for end use in selected rural locations in the country.

(iv) To set up institutional arrangements for collection of oil seeds, their storage, extraction of oil etc. on sustainable basis.

Production of ester of Karanja vegetable oil

Ester of Karanja vegetable oil was produced through transesterification reaction using 0.25 v/v methanol-to-oil ratios (i.e. 6:1 molar ratio) and 0.7% w/v KOH as base catalyst at 60^0C reaction temperature and the reaction were carried out for about 1.5 hours. After the completion of reaction, the reaction products were allowed to settle overnight in a separating funnel. Two distinct layers were formed with ester on the top and glycerol at the bottom, which were then separated. The fuel properties of raw Karanja oil and ester of Karanja oil were determined as per the test code prescribed by ASTM standards.

Karanja oilseeds and Esterified Karanja vegetable oil

Village details

Gardih village is a tribal village, located in the dense forest of Nawadih block of Bokaro district of Jharkhand state. There are 100 kuccha houses with a total population of 541. Under rural electrification program, each house of the village is provided with 02 CFL lamps of 11W, 220V each. The village is also provided with 20 numbers of street lights of 11W, 220V each. The total load on the bio-fuel plant is 2.42 KW. The plant operates continuously for 4 hours in the evening from 6 p.m. to 10 p.m. every day. The plant is being looked after by the village energy committee.

Bio-fuel plant

The bio-fuel plant comprises of a 5 kVA, 415 V, 3-phase conventional diesel- generator set. The diesel engine of 6 KW, 1500 rpm is coupled to an alternator of 5 KVA capacity.

Bio-fuel plant of Gardih village

Performance and emission characteristics of bio-fuel plant

The prepared bio-fuel (ester of Karanja oil) was tested a single cylinder, 4-stroke, DI, air cooled diesel engine having a rated output of 6 kW at 1500 rpm with a compression ratio of 17.5:1. The engine was coupled to an alternator of 5 KVA, 415V, 3-phase, 0.8 PF. The engine tests were conducted as per BIS standards. After the engine reached the stabilized working condition, various parameters such as speed of operation, fuel consumption and power output were measured at different engine loads (i.e. 20, 40, 60, 80 and 100%) at an engine speed of 1500 rpm from which brake power, brake specific fuel consumption and brake thermal efficiency were determined.

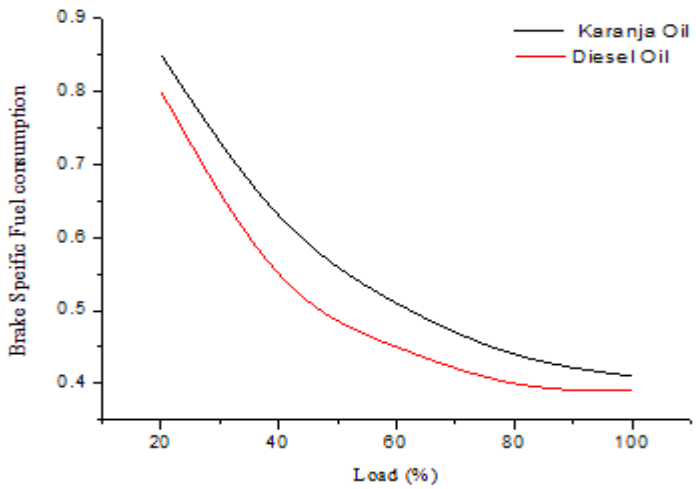
(a) Brake power

The variation of brake power output of bio-fuel plant with variation in load using ester of Karanja vegetable oil was studied. The brake power was observed to increase with the increase in the engine load. This was due to increased fuel consumption with increase in load. The brake power produced by

the bio-fuel plant running on esterified Karanja oil was found to be 1.2% higher than that of diesel oil due to complete combustion of esterified fuel. This may be attributed due to presence of extra oxygen available in the esterified bio-fuel.

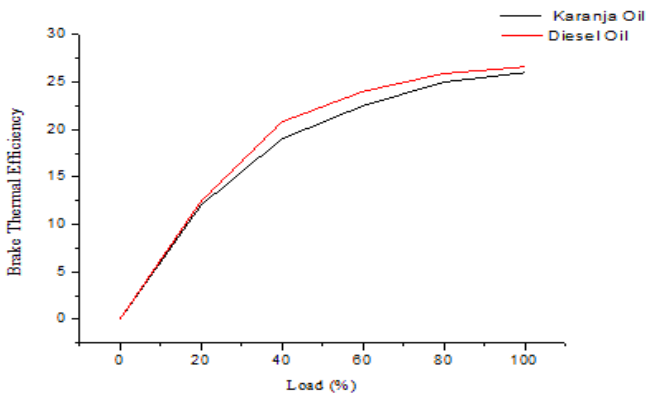
(b) Brake specific fuel consumption

The variation of brake specific fuel consumption with the engine load was studied when the engine was operating on esterified Karnja oil. At all loads, the brake specific fuel consumption decreased with increasing load. This could be due to higher percentage of increase in brake power with load as compared to the fuel consumption. For an engine speed of 1500 rpm (±2%), the brake specific fuel consumption for esterified bio-fuel was 0.8 % higher than diesel. This trend was observed due to lower calorific value of the esterified bio-fuel compared to diesel oil.



(c) *Brake thermal efficiency*

The variation of brake thermal efficiency for different load was evaluated when the engine was running on esterified bio-fuel and it was found that in all cases, the thermal efficiency of the bio-fuel plant was lower than diesel fuel. At lower loads, the % decrease was only 4% but with the increase in load, a total decrease of 9% was observed. This may be attributed to lower value of the calorific value of esterified bio-fuel in comparison to diesel fuel and increase in bio-fuel consumption at higher loads.



(d) *Exhaust Gas Temperature*

The variation of exhaust gas temperature with load was also studied for the bio-fuel plant running on esterified bio-fuel. The exhaust gas temperature varied between 260 and 336^{0}C as compared to 254 and 332^{0}C with diesel indicating not much variation in exhaust temperature. This could be due to nearly same quantity of fuel being consumed per hour for both diesel and bio-diesel blends in each load setting of the engine. Since heat loss to the exhaust on percent basis and mass of exhaust product

were approximately constant throughout the entire load range hence the same quantity of fuel consumed means same heat was rejected resulting in not much variation in exhaust temperature.

(e) ***Bio-fuel Plant Emission Studies***

The emissions from engine exhaust were studied at different loads on the bio-fuel plant at an engine speed of 1500 rpm. After the engine reached the stabilized working condition, the emissions like smoke density, CO, CO_2, HC and NOx were measured. The emissions such as smoke, CO, HC, and CO_2 were reduced on an average by 50%, 86%, 50% and 26% respectively in comparison to diesel fuel operation. These reductions of emissions could be attributed due to complete combustion of esterified bio-fuel however there was on an average, a 5% increase in the emission of NOx were observed at all loads due to higher temperature of the exhaust gases. .

Conclusions

No single source of energy can meet the energy requirements of our country in the most economic and sustainable way. An approximate mix of energy resources will have to be used for energy security and development which is locally available. India is one of a few developing countries who have embarked upon an environmentally conscious path of development for sustainability. Bio-fuels are one such renewable energy resources for rural India where enormous potential exists and can be effectively used as standalone power system for rural electrification of far-off and remote villages. Esterified Karanj oil possesses its fuel properties very close to conventional diesel oil and its performance characteristics at par with the diesel oil. Thus, esterified Karanja oil can be conveniently and safely be used in the conventional diesel engine without any major modifications in the engine hardware for meeting the needs of rural villages. .

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Advances in Cloud Computing

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Abstract
The corporate world is seeing an unprecedented disruption. Dozens of firms that have historically held high ranks in the esteemed Fortune 500 list have inched towards financial distress. Meanwhile, "new kids in the block" have levelled the playing field by challenging existing business models and revolutionizing the way by which they reach their clients, suppliers and employees. Some of these firms have reimagined traditional business constructs and built staggering shareholder value in the process. The trend that is emerging is – every company today is a tech business. If your company hasn't reshaped its functions around a Digital backbone, chances are you are going to be forced to do it or run the risk of going out of work.

Cloud is emerging to be the biggest Digital technology that is reshaping the corporate landscape. Moving to the Cloud is not a "nice-to-have" step for enterprises anymore. It is in fact an essential step and something that is core to the existence of the enterprise itself. A Cloud move comes with various advantages – it is cheaper, more convenient, faster and allows other features that an on-premise solution just cannot offer. But above all, moving to Cloud allows enterprises to free up time and resources from managing expensive infrastructure and focus on business-critical operations.

Microsoft, Amazon and Google lead the pack in terms of providing best-in-class Cloud hosting solutions for companies. These solutions allow their clients the ease of procuring servers & network at the click of a button, cheap pricing and the option to pay as you use.

Once an enterprise decides to start its journey to the Cloud, it is important it engages a trustworthy System Integrator (SI). Deloitte, Accenture, IBM, EY, PWC are a few of the leading SIs in the world. SIs come in with a cloud provider-agnostic point of view. They assess a client's infrastructure and application landscape, help build out a business case for the client to move to Cloud, assist clients in choosing a Cloud solution that works best for them (Amazon vs Google vs Microsoft), and then work very closely with the chosen Cloud Provider to realize the client's cloud vision. Once realized, a Cloud transformation positively alters the way people work and live.

Introduction

Even prior to the advent of the global pandemic that shook the world in 2020, retailers across the developed world were struggling. Sears filed for bankruptcy after being a stalwart of the American brick & mortar industry for decades. This year alone has seen around two dozen US retailers go belly up. And the list has some major names like Neiman Marcus, Pier 1 and JC Penny. Amidst all this economic downturn, Amazon continues a trajectory of meteoric rise and its CEO, Jeff Bezos, is set to become the world's first trillionaire.

If we shift our focus away from Retail and towards Media & Entertainment, a similar story awaits us. Blockbuster - the iconic neighborhood video rental store – is no more. Netflix, on the other hand, continues to dominate the market and grows at a staggering pace.

Let's shift our focus one more time – this time to the Car Rental industry. On May 22 this year, Hertz – one of the most respected car rental companies – filed for bankruptcy protection after nearly $19 billion of debt left its business in financial tatters. On the other hand, at over $75B in valuation, Uber now stands at a net worth that is equal to that of Ford and General Motors combined.

There is a distinct pattern here. While some companies have struggled to stay afloat, there are others which have prospered amid global economic uncertainty. And the one thing that has been common among all these companies – Amazon, Netflix, Uber, and many others – is their ability to build their business models around a Digital core and powered by next gen technologies like Cloud. Cloud

Computing is a game changer – that is an established fact. But what people don't realize, despite the examples cited above, is the magnitude of disruption that Cloud Computing has been driving already. In terms of pure numbers, Cloud related revenue was around $180B in 2018. This is expected to grow to $330B by the year 2022. Cloud Computing is here – and firms have a choice to either get in line or be left on the side.

Cloud Computing

What is Cloud Computing?

The term "Cloud" is probably one of the most misused terms in technology. Multiple definitions exist – and most don't completely encapsulate what Cloud truly is. Cloud has different meanings for different people. When an iPhone user backs data to the iCloud, is that Cloud Computing? Or when a person streams a song on YouTube? Or when a software developer wants to deploy infrastructure at a click of a button? Or when we watch Netflix? Or when we check our Gmail?

The answer to all the above questions is – Yes. Cloud is all of the above and more. The reality is Cloud has various usages – and the way one utilizes Cloud varies from user to user. Therefore, different Cloud companies offer different Cloud services for different users based on the value that particular user group has for the Cloud.

The Cloud's Value Proposition

We just discussed that Cloud has different benefits for different users. However, if we were to try and summarize all possible benefits of Cloud, it could be categorized into 4 broad buckets:

1) *Reduced cost* – For e.g. a company putting its infrastructure on Cloud and paying a subscription for the usage (versus the cost of having to purchase hardware)
2) *Increase Convenience* – For e.g. being able to access your iPhone photos from any device anywhere anytime (versus the inconvenience of putting your photos on a hard drive and being able to only access it when you plug your hard drive into a computer)
3) *Higher Speed* – For e.g. much faster compute times on Cloud (versus slower on-prem hardware)
4) *Enhanced Features* – For e.g. the amount of analytics you can run on Cloud and generate business insights (versus the limited features of expensive, on-prem hardware)

Pretty much any value any user gets through Cloud can be tagged to one of the 4 buckets listed above.

Cloud Computing at an Enterprise Level

Cloud of course has many usages for the personal user. However, what is truly game changing is Cloud's impact at the commercial/enterprise level. Many companies today are focused on providing Cloud services at an enterprise level. What that means is – they essentially offer their clients the option to 'host' their infrastructure while their client focuses on other key business functions. Let's understand this using an example.

Assume there is a big retailer. Their prime job is to sell grocery and other products in retail stores. Now this retailer will have different parts to run their business. This may include buying material in bulk from vendors, paying these vendors when the items have been procured, shipping these materials from the vendors' locations to their own warehouses, picking/packing/shipping these material from their own warehouses to their stores, racking and stacking these materials in stores, running the store operations, managing in-store and online orders, managing fluctuating customer demand and working on fulfillment, managing workforce payroll, benefits and many other functions. Needless to say, this retailer would have a bunch of applications (ERP and non-ERP) to run these complex business transactions. And these applications would be hosted on a bunch of complex infrastructure (servers, network, storage, security etc.). Now imagine that on top of running these business functions (through these applications), the retailer must also spend significant time and money managing its complex infrastructure that make these applications work.

And this is exactly where the Cloud providers play a part. Companies like Amazon or Microsoft would offer to "stand up" the infrastructure for the retailer so that the retailer spends its time on running the core business functions. There are 3 ways of offering this 'stand up' service.

- *Private Cloud* - Some Cloud providers offer a "Private Cloud" solution. What that means is the Cloud provider would stand up the entire infrastructure for a client and the infrastructure would be "dedicated" to the client.
- *Public Cloud* - The other (and more popular) offering is the "Public Cloud" solution. In this option, a Cloud provider has many clients share its entire data center (a concept referred to as 'Resource Pooling'). The Cloud provider allows for 'on-demand' provisioning of servers/infrastructure and the client pays based on the usage of the servers. The Public Cloud option has picked up significantly over the last few years due to its affordability (driven by economies of scale), ease of provisioning (online – and usually at the click of a button) and the advantage of paying only for what you use. Microsoft Azure, Amazon Web Services and Google Cloud lead the pack in providing Public Cloud solutions today. IBM Cloud and Oracle Cloud complete the top 5.
- *Hybrid Cloud* – Many clients also go the "Hybrid Cloud" route – which is essentially a mix of on-prem and public/private cloud components in the client's landscape.

Public Cloud Hosting Options

As mentioned earlier, Public Cloud has been a cloud solution of choice by increasing number of large enterprises across the world. However, Cloud providers offer different deployment options as part of their offering. These are as following:

- *IaaS*: Also called 'Infrastructure as a Service'. This option allows users to provision hardware at a click of a button. Users can go online, choose whatever infrastructure they need (what platform/OS, what RAM, what processing speed, what h/w size, what size of server/network/storage etc.) and provision their infra at a button click.
- *PaaS*: Also called as 'Platform as a Service'. While IaaS just allows a client some infrastructure, PaaS goes a step further and provides clients a full development platform on top of the provisioned hardware for e.g. development frameworks for Python/JAVA etc.). Most ERP products today (for e.g. Salesforce) are PaaS solutions. In simple terms, they are platforms which are ready for enterprise to pick up and start configuring/customizing for their use.
- *SaaS*: Also called 'Software as a Service'. This is like a complete software (working application) delivered to you. It is running and hosted elsewhere – and, as a user, you just access it and use it. For e.g. Netflix, Gmail, Office365, Google Docs, One Drive.

Cloud Security

It is obvious that Public Cloud solutions are a no-brainer. So, the question arises – is this too good to be true? Are there any pitfalls?

And the answer is – yes, there are. Many enterprises fear that their data may be compromised given it is sitting elsewhere and away from them. Other companies feel that since the Public Cloud is a shared space, chances are other competitors may have access to their data. These are valid concerns – and the Cloud Providers have been investing heavily in strengthening Cloud security.

When a client provisions infra on Public cloud, he/she is given a shared space on a data center. The data center has various physical servers. However, the client user experiences his provisioned space as a 'dedicated machine' with a dedicated server, network etc. Such 'emulated' machines are called "Virtual Machines" and are one of the many ways by which a Cloud Provider segregates data between different clients using the same shared space.

The Journey to Cloud – and how a System Integrator can help

We discussed earlier how companies like Microsoft, Amazon and Google are leading the world in providing best-in-class Public Cloud solutions. However, there is much more to an enterprise cloud transformation than just having a Public Cloud solution. Every client is different – and has a different use case to go to the cloud. Moving a client's infrastructure from on-prem to cloud is often a complex, multimillion-dollar program that needs to be evaluated from multiple lenses:

- *Business Case*: Clients needs to understand, ahead of time, the difference in costs between running its infrastructure as-is on premise vs running it on the Cloud. For the client to start a 'journey to cloud', the following needs to hold good: The cost of migration (from on-Prem to Cloud) + the subsequent costs of running the infra on the Cloud << current costs of running the infra on-prem
- *Choosing the right Cloud provider*: Its important that the client's requirement is front and center when choosing a Cloud provider. If left up to the Cloud providers, they would position their own Cloud offering as the best solution a client may get. Which is why it is imperative that aa 'Cloud provider agnostic' point of view is solicited – so that the choice of the Cloud provider is based primarily on what works best for the client's use case.
- *Application Readiness*: While this article has primarily focused on moving 'infrastructure' to the Cloud, it is important to understand that the applications sitting on top of the infrastructure are cloud compatible. There could be many reasons why an app may not be cloud ready for e.g. there could be associated data risks, complexity of the apps etc. It is important to assess how 'cloud ready' is the application landscape before deciding to start the journey to Cloud.

System Integrators (for e.g. Deloitte, Accenture, E&Y etc.) play a key part in the activities listed above. These firms come in with a neutral point of view around which Cloud provider to go with. They assess a client's infrastructure and application landscape, help build out a business case for the client to move to the Cloud, help clients choose a Cloud that works best for them (Amazon vs Google vs Microsoft), help assess what apps can and cannot move, help 'firm up' the target state architecture in the Cloud and draw out a migration plan for the journey to Cloud. Once a Cloud Provider is chosen, the System Integrators work very closely with the chosen Cloud Providers to realize the client's cloud vision.

Conclusions

Cloud Computing will continue to disrupt the way organizations run their business. Enterprises which embark on this journey sooner than later will be able to take a defining lead against their competition. However, its important that such cloud transformations are thought through – and there is a clear ROI that has been established that will be achieved as a result of a comprehensive cloud program. Enterprises need to engage trustworthy System Integrators and Cloud Providers to realize their cloud vision and get going on their cloud journey. Once executed, Cloud Computing will revolutionize the way the enterprise operates and transforms.

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Emerging Trends and Applications in Mobile Ad Hoc Networks (MANETs)

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Abstract
The chapter "Emerging Trends and Applications in Mobile Ad Hoc Networks" presents the current state of the art of MANET and the problems and challenges related to routing, security, power management, location management and multimedia over an ad hoc networks. MANET is a type of ad hoc network which changes the node's position and location and configure itself on the fly. As there is no fixed infrastructure available for MANET with nodes being mobile, routing and security becomes a very important issue. In addition, we have also explained the various emerging applications and future trends of MANET.

Keywords: Ad Hoc Networks, Network Topologies, Bandwidth, Quality of Services, Security, Protection, Routing, Congestion, Eavesdropping, Snooping

Ad Hoc Networks

Ad Hoc means "**for this purpose**". Ad Hoc Networks are often used to deduce the solutions which are developed instantly for any specific task or purpose. In Data Communication and Computer Networking, an ad hoc network is considered as a network connection which is established for only one session and requirement of any router or a wireless base station is not necessary.

Ad hoc networks are just like wireless Local Area Networks (LANs). The devices/nodes communicate with each other directly instead of relying on any base station or any access point as in wireless LANs for data transfer and transfer co-ordination. Each device participates in routing activity, by determining the best route using the routing algorithms and forwarding data to other devices via this route.

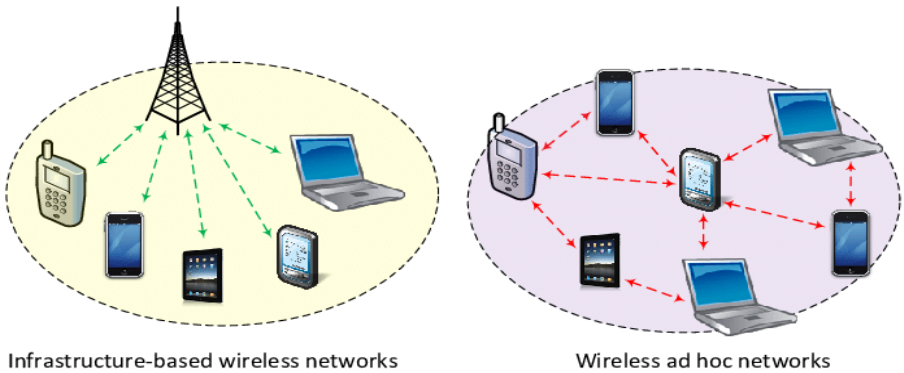

Fig: Comparison between Infrastructure-Based Wireless Networks and Wireless Ad Hoc Networks

Types of Ad Hoc Networks

Ad hoc networks are classified into several types depending upon the nature of their applications. The most prominent ad hoc networks that are commonly incorporated are as follows:-

1. MANET (Mobile Ad Hoc Networks)
2. VANET (Vehicular Ad Hoc Networks)
3. WSN (Wireless Sensor Networks)

1. MANET (Mobile Ad Hoc Networks)

MANET stands for "Mobile Ad Hoc Networks" which means that it can change its location and configure itself dynamically on the basis of current nodes. Connections to various networks are done by MANET using various wireless connection techniques namely standard Wi-Fi connection, Bluetooth connection or some other means of transmission such as cellular transmission or satellite transmission.

In a MANET, infrastructure does not exist and network topology may change dynamically in an unpredictable manner, since the nodes are free to move and each node are having limiting transmitting power, restricts access to the nodes in the neighboring range. MANETs are peer-to-peer, multi-hop wireless networks in which the information packets are transmitted in a **store and forward** manner from the source to any arbitrary destination, via the intermediate nodes as given in the figure:

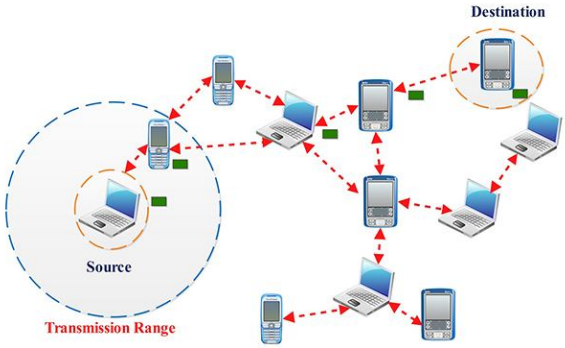

Fig: Transmission in MANET

As the nodes move, the connectivity may change on the basis of relative locations of other nodes. The changes in the network topology known at the local nodes must be passed on to other nodes so that old topology information can be updated with the changed network topology. One major issue is varying the mobility patterns of different nodes. Some nodes are highly mobile, while the others are primarily stationary. It is difficult to predict a node's movement and its direction of movement; numerous studies have been performed for the evaluation of performance using different simulators.

Characteristics of MANET

Following are the characteristics of Mobile Ad Hoc Networks:

i. **Dynamic Network Topologies**: In dynamic network topology the network (nodes) changes frequently and captures the reliability issues and drawbacks. Dynamic network topologies are present everywhere including the Internet, Local Area Networks (LAN), social networks, communication networks and transport networks. In this, the packets at a node can be routed in a come and go fashion. The objects present in the application can also be selected or deleted in the dynamic network topologies.

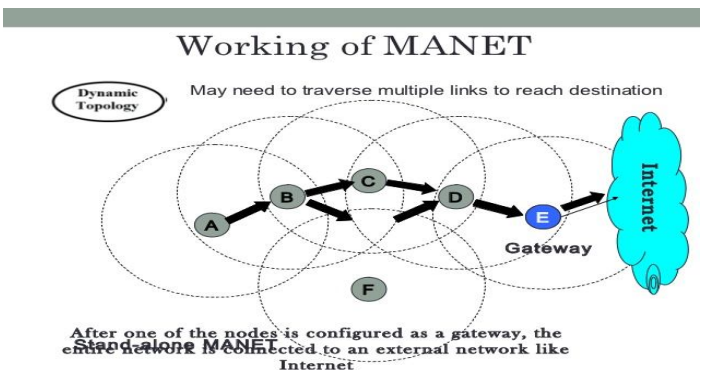

Fig: Working of MANET

ii. **Low Bandwidth**: These networks have lower capacity and shorter transmission range in comparison to the fixed infrastructure networks. The throughput of the wireless communication is lesser than the wired communication because of the effect of the fading, noise, multiple access and interference conditions.

iii. **Limited Battery Power**: The nodes and the hosts operate on small batteries and other means of energy. So, the most important optimization criteria are the energy conservation.

iv. **Decentralized Control**: The working of Mobile Ad Hoc Network depends upon cooperation of participating nodes due to the unreliable links. Thus, it becomes very difficult to implement any protocol that involves a centralized authority or administrator.

v. **Unreliable Communications**: The shared-medium nature and unstable channel quality of wireless links sometimes results in high packet-loss rate, data loss rate and re-routing instability, which is a common phenomenon leading to the throughput drops in multi-hop networks. Thus, the security solution in wireless ad hoc networks cannot rely on reliable communication.

vi. **Weak Physical Protection:** MANETs are more prone to the physical security threats than the fixed-cable nets. Usually the Mobile nodes are too compact, soft and hand-held in nature. Today, portable devices are getting smaller and handy. They could get damaged, lost or stolen easily and misused by any adversary. The increased possibility of the different types of attacks related to MANET should be carefully considered.

vii. **Scalability**: Due to the limited memory and processing power of the mobile devices, the scalability is an important problem when we have to consider a large network size. Networks of 10,000 to 100,000 nodes are envisioned, and scalability is the major design concerns.

Future Trends in MANET

Mobile Ad-hoc networking is an emerging concept in personal communications. Research is going worldwide on this area and many issues are to be addressed in future. These research works focuses on concepts of unipath and multipath routing protocols with respect to their performance in the mobile ad-hoc network (MANET). Multipath routing is a step towards achieving a network with better QoS in the coming future. The present research work in the area of MANET can be extended to develop some new routing protocols to meet following additional desirable features:

• **Robust Scenario**: A routing protocol must work with robust scenarios where the mobility is high, nodes are quite dense, area is large and the amount of traffic should be more.

• **Probabilistic Route Maintenance**: Some more research in the field like probabilistic route maintenance is required in order to identify the probability of route failure before the occurrences of route failures.

• **Quality of service (QoS):** Ad-hoc routing protocols must meet the desired requirements of Quality of Service to achieve some quality during the services in MANET: lower end-to-end delay, improved delivery ratio, reduced routing overhead, high throughput, improved delivery ratio, reduced routing overhead and more energy efficiency.

• **Security:** A major issue that has to be addressed in Ad Hoc Networks is the security. Applications such as military and confidential meetings require higher degree of security against the adversaries and by active /passive eaves dropping attackers. A new protocol must be proposed that should have authentication headers and necessary key management to distribute the keys to the valid members of ad-hoc networks. In future Security routing protocol using genetic algorithms can be developed.

• **Routing Overhead**: Link breakage in mobile Ad Hoc Networks (MANET) occurs in a regular basis due to frequent searching of the route and increase in mobility of the nodes. So, this process of route discovery can't be tolerated as it decreases the throughput and also the Quality of Services (QoS). But this also states that the nodes in MANET are mobile and the packet transmission path selected by the current node might get interrupted. So, the path needs to be rerouted whenever any node changes its

current position. This states that the Routing messages will utilize most of the precious bandwidth of the ad-hoc networks and a new protocol has to be implemented to reduce the routing overhead.

• **Congestion control:** Since there is multiple number of congestion control schemes proposed under MANET, only a little bit of focus is given on the social awareness incorporation into various congestion control techniques. This also leads to motivate the social awareness requirements into the congestion control protocols to improve the performance of the system. It also updates the traditional congestion control schemes into the newer schemes which help in increasing the capacity of the route. We have seen that the area of congestion control is highly unexplored and untouched and needs further research attention in spite of the availability of some congestion control scheme which uses socially aware techniques in reducing the congestion issues.

• This concept can also be implemented in **Qualnet**: Qualnet has faster simulation speeds and most of the time greater scalability is achievable through smart architecture and optimized techniques of memory management of Qualnet.

• An adaptive mechanism based on the **Genetic Algorithm (GA)** is sometimes used to control the flow of data in the transport layer in MANET. Some Genetic algorithms can be used in optimizing the parameters of a transport protocol to maximize the throughput for end-to-end communication over multiple hops.

Newer operational demands on the ad-hoc networks are going to bring in new trends and shifts in the research field towards designing the robust protocols and Mobile Wireless Communication keeps on evolving forever making the research an endless paradigm for the researchers.

Applications of MANET

Ad hoc networking is flourishing day by day due to the increase in number of portable devices and wireless communication. Application of MANET in the military sector, private sectors and commercial sectors are increasing day by day. It allows the users to exchange the information and get accessibility between different nodes regardless of the geographical position and infrastructure. Each and every node in a MANET is dynamic and mobile in nature regardless of the infrastructure networks. MANETs do not require a fixed and static infrastructure; it works on the theory of dynamicity. This nature of MANET gives it a decentralized character with respect to the networks. Decentralization results in the flexibility and robustness of the network.

Military Sector: Military equipment contains some sort of computer equipment required in day to day activities. Mobile Ad- hoc networking allows the military in taking advantages of the common place network technology. Military sector was the first application from which the concept of ad hoc network was derived. It helps in communicating the data and information between the soldiers, vehicles, tanks and military headquarters.

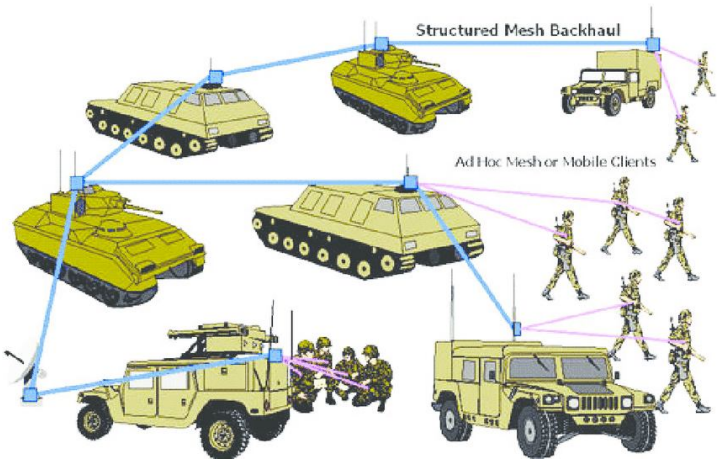

Fig: Application of MANET in Military Sector

Commercial Sector: Applications of MANET is widely used in commercial sectors and in emergency during the rescue operations such as fire, earthquake, flood, cyclone, etc. This is because of the two major reasons:

a) The equipment which was to be used may be destroyed.

b) The region where the rescue operation is needed is too remote for access.

The rescue operation team needs to communicate with their team members so that they can use the resources efficiently and can use their energy in the best possible way keeping safety in mind. The connection which is established between the rescuers and the equipment which they are carrying make their jobs easy. Apart from these examples, some other commercial sector examples are parcel delivery system, mobile communication, law enforcement, etc.

Low Level: The devices which are in home networks having low level of applications, exchanges information directly. In the same way, the applications like sports stadium, boat, taxi, aircraft, and cabs have low level of applications where the devices communicate directly.

Data Networks: If the computers are allowed to share the data and information to other computers, the network will increase drastically, which is much larger than the installed network infrastructure. These networks are easily available for use as the network area is increased for the users.

Sensor Networks: A sensor network is a network which is made up of multiple sensors. It is used in detecting the geographical area in an ad hoc network. The properties which are captured or read by a sensor are temperature, pressure, pollutions, toxins, etc. Since the capacity or power of a sensor is limited to a level, it depends upon other sensors to communicate information from one node to another and to the central computer. This is the reason why most of the sensors results in failure and loss. Mobile ad-hoc sensor networks (MANET) is going to be **"the key to future homeland security"**.

Attacks in MANET

Securing ad hoc networks from various attacks is a very difficult task. In securing the nodes from different attacks, the first step in developing a good security solution is to understand the problem and determine the layer on which the attack is done. Security of the communication network is very important for transmitting the information from one node to another. If the central node or hub is damaged or attacked, then the wireless network becomes insecure in digital/ cyber-attacks than the wired network. There are a number of attacks that affect MANET and are classified below:

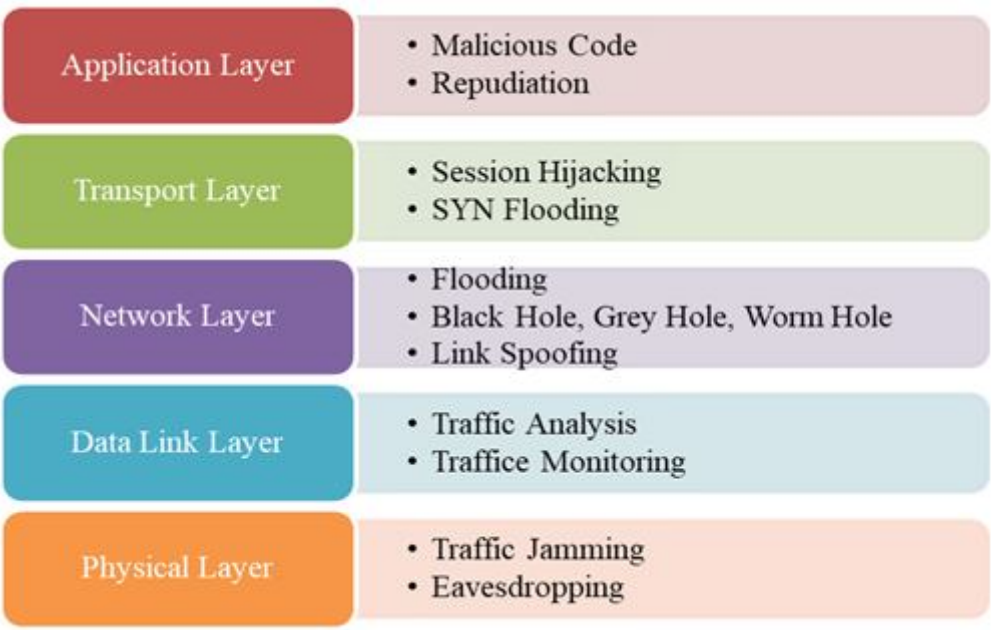

Fig: Security Attack on each Layer of MANET

Attacks on MANETs can be classified into following two categories:

a. Passive Attacks

b. Active Attacks

1. **Passive attack**: This is the type of attack where the attacker/ intruder execute unspecific monitoring of the network connection to get the desired data and information about the traffic without introducing any forged/ fake information. A passive attack presents/ gives out the attacker the information and helps him out to invade the network for attacking any node. Some of the passive attacks are classified as eavesdropping, traffic analysis and snooping:

- **Eavesdropping**: This is a type of passive attack in which the nodes simply observes the confidential information without acting. This information can be used by the malicious nodes at the time of attack. Eavesdropping gives information about any node's location, password, key details (public/ private), etc.
- **Traffic Analysis**: In MANETs the information packets and the approach pattern both are important for adversaries. For instance, tip about the topologies are often derived by analyzing the traffic patterns. It can also be considered as a type of active attack as it destroys the node that simplifies the self-organization of the nodes in a network, resulting in gathering of valuable data and information about the topology.
- **Snooping**: Snooping is a type of passive attack in which another person's data is accessed in an unauthorized manner. This attack is same as the eavesdropping only the difference is that it is limited in gaining access to the data during the transmission process. This includes peeping on to some other's email on the screen and looking after the contents which someone is typing. There are some more sophisticated software programs which monitors the activities of a computer or a network from a distance.

Some hackers uses the technique of snooping to watch the key strokes by others, captures the passwords and login credentials. They also intercept mails and other private communication messages while data communications. Some of the corporations keep an eye on to the employee's use of business computer and the internet usage. Governments also pay attention on the suspects to collect information about crime and terrorism and stop them. Though snooping is a negative aspect, but in technology, snooping asks any program or utility to perform a monitoring function.

2. **Active Attacks**: An active attack attempts to switch or destroy system resources and therefore the data being exchanged within the network by injecting or modifying arbitrary packets. An active attack comprises of information interruption, modification, or fabrication. Active attacks are often either internal or external by nature.

- **Flooding attack**: It is a type of active attack where the hacker exhausts / dries up the resources required for the network connection and transmission such as the bandwidth, data speed. It also consumes the node's resource like the battery power and computational speed of the node which results in the disturbance of the routing operation and reduces the network performance.
- **Black hole Attack**: This is the type of active attack where a malicious node falsely advertises good paths (e.g., shortest path or most stable path) to the destination node during the path finding processes (in on-demand routing protocols) or in the route update messages (in table- driven routing protocols). The intension of the malicious node could be to obstruct the path-finding process or to interrupt all the data packets being sent to the destination node concerned.
- **Wormhole attack**: This is the type of active attack where an attacker receives a packet at one location and redirects them selectively to another location in the network where the packets are resend to the network. This tunnel which is in between two colluding attackers is referred to as a wormhole. It might be established through one long – range wireless link or maybe through a wired link between the 2 colluding attackers. Due to the broadcasting nature of radio channels,

the attackers can create a wormhole even for packets not addressed to itself. Although there is no issue if the wormhole is executed properly for the efficient relaying of packets, it gives the attacker a free hand compared to the subsidiary nodes present in the network, which the attackers uses resulting with the compromise in network's security.

If some necessary steps are not taken to defend the network against these wormhole attacks, a lot of the existing routing protocols will fail in detecting/ finding out the valid route.

- **Gray-hole attack**: It is also called the **routing misbehavior attack** which results in dropping of the messages. Gray-hole attack basically has 2 phases. The first phase states that the node advertises itself as having a legitimate route to destination whereas the second phase states that the nodes drop the intercepted packets with a particular chance of its reoccurrence in the future.
- **Link spoofing attack**: Link spoofing attack states that the malicious node advertises the fake/ malicious links with the far-adjacent nodes to degrade the routing and delay the transmission of the information. In the OLSR protocol, an attacker can consider a fake link with the destination's two-hop neighbors. A malicious node can manipulate the data or the routing traffic by dropping or modifying the routing traffic or performing other types of Denial of Service attacks in the given data.

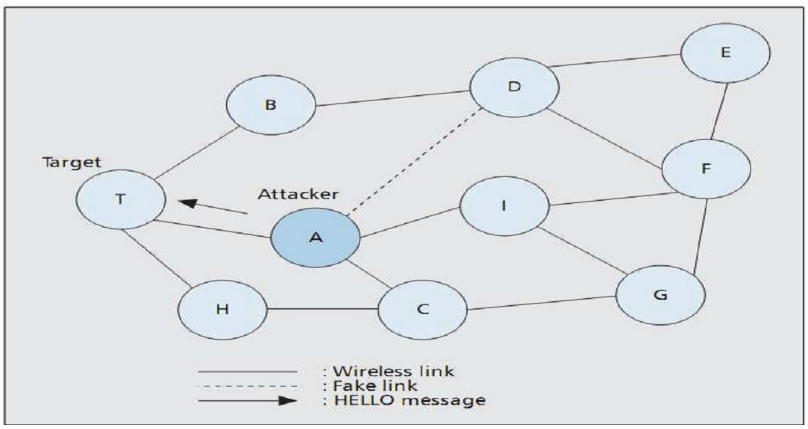

Fig: Link Spoofing Attack

- **Malicious code attacks**: This is the type of active attack in which the code present in software or a script causes undesired effects, such as security breaches and also results in damage of the system. This is a type of application security threat. It is very difficult to control malicious code attacks using antivirus software. Malicious code attacks comprises of a long list of system security terms including viruses, worms, Trojan horses, backdoors, attack scripts and some other malicious active content.

Once inside your environment, if a malicious code enters, the network drives and propagates. Malicious code also results in network and mail server overload by sending email messages; deleting document files, email files or passwords; stealing data and passwords; and even reformatting hard drives.

- **Repudiation attacks**: This is a type of active attack that happens when an application or system could not adopt controls to properly track and log users' actions, resulting in permitting malicious manipulation or forging the identification of the new actions. Repudiation attack can be used to change the authoring information of any action executed by a malicious user so as to log wrong data to log files. Their usages are often extended to general data manipulation within the name of others, in a similar manner as spoofing mail messages. If this attack takes place, the data and the information stored on log files can be considered invalid or misleading.

2. VANET (Vehicular Networks)

Vehicular Ad hoc Networks is a of wireless multi hop network, in which the constraint of fast topology changes due to the high node mobility of the network. With increase in number of vehicles equipped with computing technologies and wireless communication devices, inter vehicle communication is nowadays becoming a promising field for research, standardization, and development. VANETs enable a greater range of applications, like prevention of collisions, dynamic route scheduling, real-time traffic condition monitoring, safety, blind crossing, etc. Another important application of VANETs is the Internet connectivity facility to the vehicular nodes.

Vehicular ad hoc networks (VANETs) are being studied intensively due to their wide heterogeneity of applications and services, such as enhancement of traffic efficiency, passenger safety, and infotainment. With the evolution of technology changes and rapid growth in the number of smart vehicles, traditional VANETs faces several technical challenges in deployment and management of the network due to less flexibility, poor connectivity, scalability and inadequate intelligence. Cloud computing is considered as a way to fulfill these requirements of VANETs. However, next-generation VANETs would require autonomous vehicles having high mobility, low latency, good connectivity and real-time applications, which cannot be resolved by traditional cloud computing. Therefore, merging of the fog computing with conventional cloud for VANETs is stated as a potential solution for several issues in the current scenario and the future scenario of VANETs. In addition to this, fog computing can also be enhanced by the integration of Software-Defined Network (SDN), which provides flexibility, programmability, and global knowledge of the desired network. We present two example scenarios for timely dissemination of safety messages in future VANETs supported fog and a mixture of fog and SDN. We also explained the problems that require being resolved for the deployment of three different cloud-based approaches.

Vehicular ad hoc networks (VANETs) have gained a great popularity in the recent years. Traffic accidents, road congestion, fuel consumption, and environmental pollution have become serious issues due to the large number of vehicles globally. Traffic incident is one of the most persistent problem in both the developed and developing countries, which results in huge loss of life and property. To overcome these issues of transportation and make the journey safer, hassle-free, efficient, and entertaining, Intelligent Transportation Systems (ITS) has introduced VANETs for creating a safer infrastructure or framework for the road transportation. VANETs specializes in road safety and efficient traffic management for public roads, while offering comfort and entertainment for drivers and passengers throughout their journeys. Vehicular communication in VANETs can be achieved by exchanging the data and information using Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications.

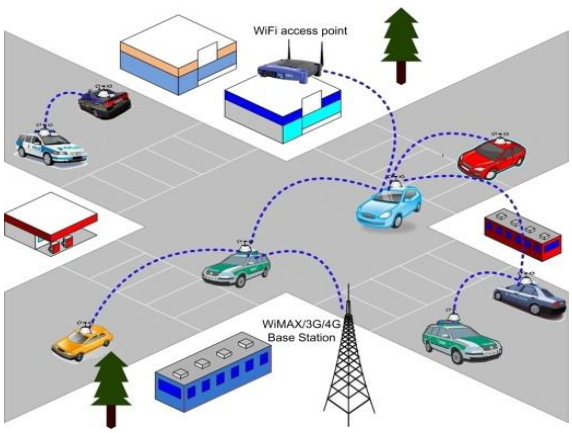

Fig: Vehicular Ad Hoc Networks

3. WSN (Wireless Sensor Networks)

Wireless sensor networks are the interconnected sensor nodes that communicate wirelessly for the gathering of data and information about the encompassing environment. Nodes are generally low

power and are distributed in an ad hoc and decentralized method. Although the WSNs have also got a great amount of popularity, there are some shortcomings while implementing the security imposed by the resources, battery life, limitations of memory and bandwidth. In Wireless Sensor Networks, there is a wide range of attacks which can target privacy, control and availability.

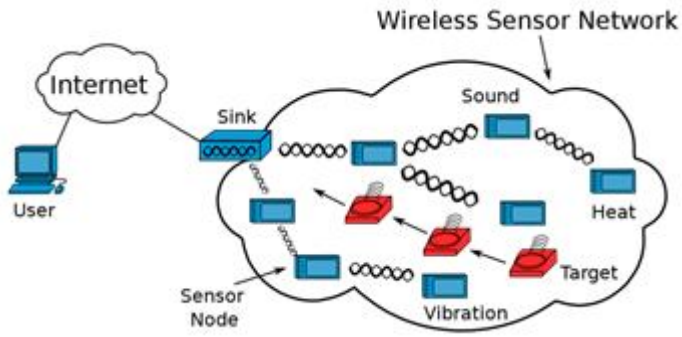

Fig: Wireless Sensor Networks

Conclusions

This chapter discusses the research trends and upcoming challenges, applications and issues in wireless ad hoc networks especially in MANETs. It discussed in detail ad hoc networks, its various types, characteristics and applications. An overview of various attacks in MANET, challenges faced and issues of ad hoc networks have been presented in this chapter. Also some analysis of research efforts to address these issues has also been provided. We have also discussed some of the most recent protocols and models of an ad hoc network. The concluding part of the chapter presents several directions for further research in the field of security and attacks in MANET.

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Ternary Chalcopyrite: Most Promising Material of This Century

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Abstract
The chalcopyrite compounds are the curious compounds from both theoretical and experimental point of view due to their potential applications in solar cells, non-linear optical devices, opto-electronic devices etc. They form a large group of semiconducting materials with varied mechanical, structural, chemical, optical and electronic properties. These compounds were initially studied because of their low thermal conductivity but now they are the promising contenders as solar cells, filters, non-linear optical materials, light emitting diodes, photovoltaic detectors, non-linear optical lasers, bio-sensors and many more. In this chapter, we have tried to highlight the structural and crystalline properties of ternary chalcopyrites along with their applications.

Keywords- Ternary Chalcopyrite, Solar cells, Non-linear Optical devices, Bio-sensors, Chalcopyrite lasers.

Introduction

Ternary Chalcopyrites are considered as the most promising materials of this century because of their extensive range of applications. They have covered almost all sectors of modern science and technology. They are widely used in light emitting diodes, non-linear optical devices, solar energy converters, detectors, photovoltaic devices, opto-electric devices and many other sectors [1-9]. The chalcopyrite structure, named after the mineral copper iron sulfide (chalcopyrite-$CuFeS_2$) due to similar tetragonal structure and also adopted by a number of $A^{I}B^{III}C_2^{VI}$ & $A^{II}B^{IV}C_2^{V}$ compounds, is a ternary compound equivalent of the diamond structure, in which each atom is bonded to four first neighbours in a tetrahedral structure [1]. There are more than 300 compounds belong to the ternary chalcopyrite family. Ternary Chalcopyrite compounds can be classified into two broad categories-

(i) **Ternary Chalcogenide-** They are generally represented by $A^{I}B^{III}C_2^{VI}$ where A=Cu,Ag; B=Al,Ga,In,Tl; and C=S,Se,Te. Ternary Chalcogenide are isoelectric with the A^{II}-B^{VI} compound semiconductors.

(ii) **Ternary Pnictide-** They are generally represented by $A^{II}B^{IV}C_2^{V}$ where A=Zn,Cd; B=Si,Ge,Sn; and C=P,As,Sn. This group of compounds are isoelectronic with the A^{III}-B^{V} compound semiconductors.

The chalcopyrite structure is realized from the diamond structure according to the Grimm-Sommerfeld rule which states that- 'if the average number of valance electrons per atom is equal to four then a tetragonal structure is formed' [1].

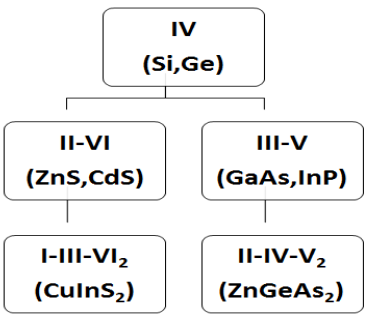

Figure-1 shows the deduction of the chalcopyrite structure from the diamond structure according to Grimm-Sommerfeld rule.

$A^{I}B^{III}C_2^{VI}$ –type ternary chalcopyrite compounds were first synthesized by Hahn et.al. in 1953[10]. In 1954, Goodman and Donglass [11] conferred the probability of semi-conductivity in these materials. Thereafter these materials are known as chalcopyrite type semiconductors. In late seventies Shay et.al. [1] gave a wide-ranging review of chalcopyrite compounds. After that numerous researches have been done on ternary chalcopyrites and even at present various top scientists of the world are working in this field.

Crystalline Structure of Ternary Chalcopyrite

The $A^{I}B^{III}C_2^{VI}$ & $A^{II}B^{IV}C_2^{V}$ type chalcopyrites are ternary equivalent of the diamond structure, in which each atom is bonded to four first-neighbours in a tetrahedral structure. The Bravais lattice of the chalcopyrite is body centred tetragonal (bct) with a tetragonal space group $I\overline{4}2d$. The chalcopyrite structure can be assimilated by doubling the zinc-blende structure along the z-axis and filling the lattice positions [1]. In such compounds due to the different electronegativity of the two classes of atoms, a small distortion produced due to the loss of symmetry. Moreover the bond lengths are not fundamentally identical so the tetrahedron structure is distorted along the crystal z-axis. The reduced symmetry, because of the two kinds of cations, results in a primitive cell of eight atoms within the chalcopyrite structure compared to a primitive cell of two atoms within the zinc-blende structure.The atomic positions of cations and anions in a unit cell of chalcopyrite are as follows-

A (0,0,0); (0,a/2,c/4)
B (a/2,a/2,0); (a/2,0,c/4)
C (4a,a/4,c/8); (-4a,3a/4,c/8);(3a/4,4a,7c/8);(a/4,-4a,7c/8)

The crystal structure of the ternary chalcopyrite belongs to non-symmorphic space group D_{2d}^{12} (eight atoms per primitive unit cell), which is a super-lattice of zinc-blende structure T_d^2(two atoms per primitive unit cell). Each anion is co-ordinated by two A and two B cations, whereas each cation is tetrahedrally co-ordinated by four anions.

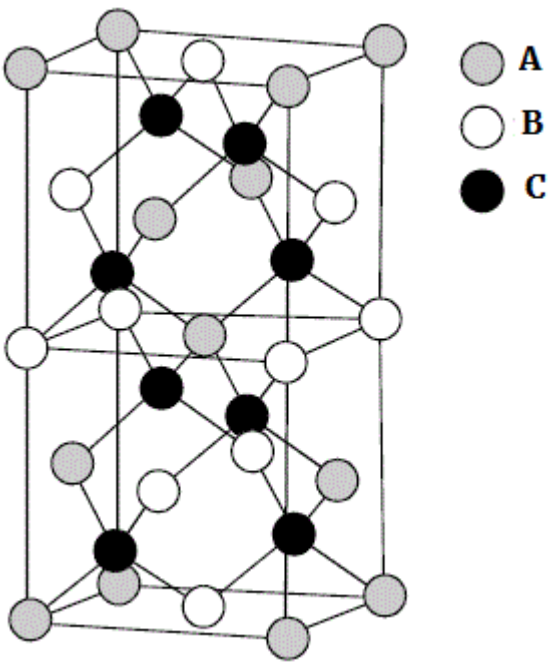

Figure.2. Crystal structure of Chalcopyrite lattice.

There are three substantial structural differences of chalcopyrite structure with zinc-blende structure-

a) First, there are two cation sub-lattices rather than one, prominent to the existence of two basic near-neighbor chemical bond lengths $R_{AC} \neq R_{BC}$.

b) Second, the unit cell is tetragonally distorted by a distortion parameter

$$\eta = \frac{c}{2a} \neq 1 \quad (\eta < 1)$$

c) Third, the anions are displaced from the perfect tetrahedral site by an amount u. The two near-neighbor bond distances are given by,

$$R_{AC} = a[u^2 + \frac{(1+\eta^2)}{16}]^{\frac{1}{2}}$$

And

$$R_{AC} = a[(u - \frac{1}{2})^2 + \frac{(1+\eta^2)}{16}]^{\frac{1}{2}}$$

where a is the cubic lattice constant.

The bond length mismatch is hence,

$$\alpha = (R_{AC})^2 - (R_{BC})^2$$

$$= a^2\left[u^2 + \frac{(1+\eta^2)}{16}\right] - a^2\left[\left(u - \frac{1}{2}\right)^2 + \frac{1+\eta^2}{16}\right]$$

$$= a^2\left(u^2 - \frac{1}{4}\right)$$

and disappears for a zinc-blende like undistorted anion sub-lattice, where u=1/4. Because of the added structure (η,u) and chemical (A≠B) degrees of freedom related to their binary along, the 36 known ternary ABC_2 semi-conductors exhibit a far richer assortment of physical and chemical properties.

Applications of Ternary Chalcopyrites

Ternary chalcopyrites have an extensive range of properties that were recognized in numerous fields where they can be practically used. They have acquired considerable importance because of their potential application in area of solar cells, non-linear optics, light emitting diodes and photovoltaic devices. Even the solid solution of these semiconductors has been used in electro-optic devices. Their mixed crystals are being used for production of lasers, detectors and integrated optic devices such as filters, modulators, switches etc. Some common fields of application of ternary chalcopyrite semiconductors are as follow-

i) In LASERs- Most of the ternary chalcopyrites have direct band gaps and very narrow luminescence bands. These are the satisfactory conditions for obtaining laser action or stimulated emission. $CdSiAs_2$, $CdSnP_2$, $CuGaS_2$, $CuInS_2$, $AgGaS_2$ and $AgGaSe_2$ are some common ternary chalcopyrites which show laser action [1]. The chalcopyrite lasers are one of the popular optical communication light source for data transmission. Chalcopyrite lasers are also known as the 'laser of the future' because of their compactness in size, easy integration, more output power and rapid movement. Chalcopyrite lasers are tunable lasers as their operating frequency can be changed by changing the external parameters to change the band gap.

ii) In Photovoltaic Technology (Solar Cells)- The modern photovoltaic technologies are ruled by ternary chalcopyrites. Most of the ternary chalcopyrites have band gaps in the range 0.7 eV to 1.53 eV which make them ideal for solar cell applications. Recent studies suggest that ternary chalcopyrites have some unique properties which are not found in classical semiconductors and this represent the most advanced technology for thin film photovoltaic. Chalcopyrites like Cu-ternaries are being widely studies as a cost effective alternate to silicon and germanium solar cells for terrestrial applications. Chalcopyrites solar cells are light weighted, flexible in design, have short energy payback time and have very high efficiency. The efficiency of chalcopyrite solar cells is nearly 20% higher than the

classical material based solar cells. Various new technologies relating the chalcopyrite solar cells are still developing. Over the last two decades the power conversion efficiency of ternary chalcopyrite solar cells has been steadily increased. Thin film modules based on copper chalcopyrite characterize the most advanced thin film technology with laboratory cells accomplishing efficiencies above 19%. Modules of $CuInS_2$, $CuGaSe_2$, $CuInSe_2$, $CuGaS_2$ solar cells are in the preliminary production stage at several places worldwide and large modules have grasped efficiencies above 13% and output power of 80W [12]. The high absorption coefficient, wide band gap range and easy conversion to n-p carrier type make the ternary chalcopyrites ideal for photovoltaic applications.

iii) In Electronic Technologies- Ternary chalcopyrites have higher non-linear susceptibility. Also due to the occurrence of two types of bonds they are anisotropic too. The anisotropy leads to higher bifringence in ternary chalcopyrites. The higher bifringence combined with higher non-linear susceptibility makes the ternary chalcopyrites very suitable for phase-matching and efficient second harmonic generator [13]. The II-IV-V_2 type semiconductors have band gaps less than or equal to 1.7 eV, which makes them suitable for light emitting diodes. $CdGeAs_2$, $CdGeP_2$, $CdSiAs_2$ and many other chalcopyrites are used in constructing memory and switching devices. They are replacing classical semiconducting materials almost from every field of electronics. Gradually they are becoming the base materials for the production of diodes, transistors, IC's and numerous electronic devices.

iv) In Medical Science- Ternary chalcopyrites are used in the production of bio-sensors, multimodal imaging systems, chemotherapy systems, phototherapy systems and many other systems of medical technology. $CuInS_2$, $CuInSe_2$, $AgInS_2$, $AgInSe_2$- are some common chalcopyrites used in these purposes [14,16]. The high optical absorption coefficient, high photo stability, high quantum yield, long luminescence decay time, large stokes shifts and other properties of ternary chalcopyrites make them ideal material for in vitro and in vivo targeting, detection/ imaging and therapy of cancer cells and tissues. Ternary chalcopyrite based leasers are used for effective synergistic phototherapy against tumors with negligible toxicity. The bio-sensors made from ternary chalcopyrites are cadmium free, cost effective, highly stable, low toxic and highly sensitive.

Some common ternary chalcopyrites and their uses are as follow-

Ternary Chalcopyrite	Uses
$AgGaSe_2$	The narrow band gap of $AgGaSe_2$ makes it suitable as infrared detector including applications in photo-voltaic solar cells and also in light emitting diodes. It is also used as laser active material [15].
$AgGaS_2$	It is widely used as non-linear optical material.
$CdGa_2SO_4$	It is used in tunable filters and ulta-violet photo-detectors.
$CdGaS_4$	It is used as laser active material.[16]
$CuInSe_2$	It is widely used in thin film solar cells.
$CuInS_2$	It acts as a good solar cell absorber material.
$CuSbS_2$	It is used in dye sensitized solar cells.[16]
$CdSnP_2$	It is used in lasers.[15]
$CdSiAs_2$	It is used to obtain stimulated emission.[15]
$ZnAl_2Se_4$	It is used in opto-electronics.
$ZnSiAs_2$	It is used as harmonic generator.
$AgGaTe_2$	It is used in up and down converters.
$CdGeAs_2$	It is used in parametric oscillator.
$CdSnP_2$	It is used in making lasers.[15]
CuCdS	It is used in solar cell devices.
$CuGaS_2$	It is used in making lasers.[15]
Ag_3AsS_3	It is used in making of frequency matching devices such as parametric oscillators, harmonic generators, up and down convertors.
$CuGaS_2$	It is used in making lasers.[15]
$CdAl_2S_4$	It is used in making tunable filters and UV-photo-detector.

$CdAl_2Se_4$	It is used in opto-electronic devices.
$CuGaSe_2$	It is used in thin film solar cells.
$CdSnP_2$	It is used in making lasers.[15]
$ZnGeP_2$	It is used in making converters, harmonic generators and oscillators.
$CdAl_2S_4$	It is used in opto-electronic devices.
$CdGeP_2$	It is used in making frequency mixing devices.

Conclusions

Hopefully this study has demonstrated growing activity and confidence in the applications of the ternary chalcopyrite semiconductor compounds. From the above discussions it is clear that the ternary chalcopyrites have all the abilities to replace the classical semiconducting materials. Proper research and device application of these compounds will help in cost effective solution of many modern science and technology related problems. They may be considered as the 'super materials' of this century as they have touched each and every sector of modern technology.

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Natural Language Processing: An Overview

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Abstract
The article presents an overview of the Natural Language processing (NLP) which is a subfield of Computational Linguistics (CL) and Artificial Intelligence (AI). It has been elaborated upon that NLP is a method of communicating with an intelligent system. The advent of NLP will make it easy to work with computer system as the instructions can be given in one's own language to get the desired result. NLP combines the verbal and sensory information in a uniform manner. It reveals how syntax, semantics, phonetics and phonology work and also its significance about converting samples of human language into more formal presentation, which is easy for a computer system to manipulate. The various levels of language analysis have been taken into accounts which are relevant for understanding Natural Language (NL). Phonetics and phonology which is important for speech based systems plays an important role in understanding NL. Morphological, Syntactic, Semantic, Pragmatic, Discourse and World knowledge are other levels for language analysis. The representation of language must be precise and unambiguous and also must capture the intuitive structure of NL which it represents. Under the article different phases of NL generation have been deliberated upon. Text determination, the first phase deals with identification, extraction and representation of information used for NL generation. The second phase text planning sets relations among objects to achieve the desired goals. The third phase text realisation involves mapping of the structured components. The evaluation of NLP is significant because it has to measure the qualities of an algorithm or a system whether they are answerable to the goal of the designer or the need of the user. Evaluation may be intrinsic vs extrinsic, black box vs white box or automatic vs manual in nature. Some significant applications of NLP are automatic summarisation of text, Information extraction and retrieval with Natural language components, Machine Translation, Optical Character Recognition, spelling checkers, etc. It is surmised that the NL is loaded with more realistic world problem like ambiguity and complexity.

Keywords: Computational Linguistics (CL), Natural Language Processing (NLP), Artificial Intelligence (AI), Phonetics, Text determination.

Introduction

Natural Language Processing (NLP) is a subfield of Computational Linguistics (CL) and Artificial Intelligence (AI). Natural Language Processing (NLP) is a method of communicating with an intelligent system using a Natural Language such as Hindi, English etc. The goal of Natural Language Processing (NLP) is to design and build a computer system that will analyze, understand and generate natural human languages (Michael Zock 1990, 1991, Kukich K 1988, Lee Fedder 1990). In other word we can say that we want our computers to understand the language that we speak in our day to day life. Natural Language understanding will try to analyze the text and produce the knowledgebase which will try to incorporate the information found in the text and finally constructing a Natural Language text in order to meet specified goals of communication. By doing so it will become easy for a common man to work with the computer system as he/she can give the instructions in his/her own language and get the results as desired. This will avoid the need to learn different computer based languages and thereby decrease the complexities in working with the computer systems. But for this the computer systems must be intelligent enough to understand the language of the common man and generate the output as required by him. That is some sort of Artificial Intelligence is required with the computer systems. .

The problem of communicating with computer systems in natural language has always been a challenging task. In spite of the number of programming languages and graphical user interfaces available to interact with computers, building a system of understanding and generating Natural

Language Processing is a broad area of research. But with the advent of new technologies in Artificial Intelligence and the expanding requirement of the users it has become the need of the hour to explore into NLP. This is because natural language has the following advantages:

Advantages of Natural Languages

- Natural language combines verbal and sensory information in a uniform manner.
- The understanding of Natural Language not only reveals of how the language works (in terms of syntax, semantics, phonetics and phonology, etc), but also about how human minds and human brain process language.
- Natural language is the language which has evolved naturally and is very expressive and computationally very tractable.
- Natural Language is simple and powerful system because it allows achieving a uniformity of representation and reasoning.
- Natural language understanding system converts samples of human language into more formal representations that are easier for computer programs to manipulate.
- Natural Languages can be easily parsed and convey the taxonomic knowledge.
- Natural language mixes the object level and meta-level description which make it simple.

Levels of Language Analysis

A Natural Language uses considerable knowledge about the structure of the language itself, including what the words are, how words combine to form sentences, what other words mean, how words meaning contribute to sentence meanings and so on. We cannot account for linguistic behaviour without taking in account another aspect of what makes humans intelligent – their general world knowledge and their reasoning abilities. For example, to answer a question a person must know the structure of the language being used for communication as well as the world in general and conventional setting in particular. Some of the different forms of knowledge relevant for Natural Language understanding are:

(i) Phonetic and phonological knowledge

It is how the words are related to the sounds that realise them. This type of knowledge is important for speech based system.

(ii) Morphological knowledge

It is how the words are constructed from more basic meaning units called morpheme for example the meaning of the word friendly is derivable from the meaning of the word friend which is a noun, but the suffix –ly transforms the noun into an adjective.

(iii) Syntactic knowledge

It is putting the words in correct sequence so that a a proper structure of the sentence is derived. It determines the structural role each word plays in the sentence and what phrases are subparts of what other phrases.

(iv) Semantic Knowledge

It is concerned basically with the meaning of the words and how these meanings combine in sentences to form sentence meanings. The meaning of the sentence is free of the context in which it is used.

(v) Pragmatic knowledge

It is about how sentences are used in different situation and how their use affects the interpretation of the sentences.

(vi) Discourse knowledge

It is the concern of how the immediately preceding sentence affects the interpretation of the next sentences. This information is especially important for interpreting pronouns and for interpreting the temporal aspects of the information conveyed.

(vii) World knowledge

This includes the general knowledge about the structure of the world that language users must have in order to maintain the conversation. It includes what each language use must know about the other user's beliefs and goals.

Representation of Understanding

To represent the meaning we must have a more precise language. The tools to do this come from mathematics and logic and involve the use of formally specified representation language. Useful representation languages have the following two properties:

(i) The representation must be precise and unambiguous. That is each sentences must have distinct meaning and a distinct formula for representation.

(ii) The representation must capture the intuitive structure of the natural language sentences that it represents. For example the sentences that appear to be structurally similar should have similar structural representations, and the meanings of the two sentences that are paraphrases of each other should be closely related to each other.

Phases of Natural Language Generation

Natural Language is generated in three phases namely, content determination, planning and realization.

(i) Text Determination

Text determination is the first phase that deals with the identification, extraction and representation of information that is to be used for the Natural language generation. It focuses on the information which it wants to include in achieving the particular communicative goal. It is the input phase for a domain is a crucial job. The role of world knowledge and commonsense knowledge along with the domain knowledge enhances generation of natural language text. Knowledge of a task guides the choice of what information to include. Text determination requires huge amount of domain dependent data. The entire knowledge sources needed for identifying the input and the input components identified should have uniform representation, by means of which, easy access to information can be provided. Knowledge sources include domain knowledge, world knowledge and commonsense knowledge.

(ii) Text Planning

In the physical world a plan is sequence of actions, that if followed will change the relations among objects so as to achieve the desired goal. One way to represent a plan is by way of a sequence of assertion additions and deletions that reflect physical moments. Plan creation is performed by searching for a sequence of operators that lead from the assertions that describe the initial state of the world to assertions that describe the goal. To perform planning, the various actions have to be captured. A planner starts with the overall task, which must then be reduced to primitive actions. Planning continues until primitive acts are satisfied. When the concept of planning is applied to solve AI problems, generally possible routes to the solution are generated as plans. Plans generated are thus composed of operator schemata, provided to the systems for each domain of application. However, while building any natural language generation system, organization of the content, plays an important role. While organizing the content of any document or text, various types of knowledge such as domain knowledge, social goal knowledge etc have to be incorporated. Moreover, planning for natural language generation involves the knowledge of the user at various levels. Hence, planning for natural language generation is different from AI planning.

(iii) Text realization

Text realization is the final phase which involves mapping the structured component obtained by text determination and text planning process with the linguistic component. The output of realization will be a choice among pre-determined set of alternatives. When a choice is made a well-formed structure is constituted to meet the schematic description. The realization component depends on sophisticated knowledge of the language's grammar and rules of domain, which typically constructs a syntactic description of the text.

Evaluation of NLP

The goal of NLP evaluation is to measure one or more qualities of an algorithm or a system in order to determine if the system is able to answer to the goals of its designer or the needs of the users. In recent times NLP evaluation has been one of the broad areas of research. A set of evaluation criteria which includes mainly evaluation data and evaluation metrics is used to give solution to NLP problem. The various types of evaluation techniques used for NLP are:

(i) Intrinsic vs. extrinsic evaluation

For intrinsic evaluation an isolated NLP system is considered and its performance is characterised mainly with respect to some correct result also called gold standard which is pre-defined by the evaluators. Extrinsic evaluation also called *evaluation in use* considers the NLP system in a more complex setting, either as an embedded system or serving a precise function for a human user. The extrinsic performance of the system is then characterized in terms of its utility with respect to the overall task of the complex system or the human user. For example, consider a syntactic parser that is based on the output of some new part of speech (POS) tagger. An intrinsic evaluation would run the POS tagger on some labelled data, and compare the system output of the POS tagger to the gold standard (correct) output. An extrinsic evaluation would run the parser with some other POS tagger, and then with the new POS tagger, and compare the parsing accuracy.

(ii) Black-box vs. glass-box evaluation

Black-box evaluation requires one to run an NLP system on a given data set and to measure a number of parameters related to the quality of the process (speed, reliability, resource consumption) and, most importantly, to the quality of the result (e.g. the accuracy of data annotation or the fidelity of a translation). Glass-box evaluation looks at the design of the system, the algorithms that are implemented, the linguistic resources it uses (e.g. vocabulary size), etc. Given the complexity of NLP problems, it is often difficult to predict performance only on the basis of glass-box evaluation, but this type of evaluation is more informative with respect to error analysis or future developments of a system.

(iii) Automatic vs. manual evaluation

In many cases, automatic procedures can be defined to evaluate an NLP system by comparing its output with the gold standard (or desired) one. Although the cost of producing the gold standard can be quite high, automatic evaluation can be repeated as often as needed without much additional costs (on the same input data). However, for many NLP problems, the definition of a gold standard is a complex task, and can prove impossible when inter-annotator agreement is insufficient. Manual evaluation is performed by human judges, which are instructed to estimate the quality of a system, or most often of a sample of its output, based on a number of criteria. Although, thanks to their linguistic competence, human judges can be considered as the reference for a number of language processing tasks, there is also considerable variation across their ratings. This is why automatic evaluation is sometimes referred to as *objective* evaluation, while the human kind appears to be more *subjective*.

Statistical NLP

Statistical natural-language processing uses stochastic, probabilistic and statistical methods to resolve some of the difficulties discussed above, especially those which arise because longer sentences are highly ambiguous when processed with realistic grammars, yielding thousands or millions of possible analyses. Methods for disambiguation often involve the use of corpora and Markov models. Statistical NLP comprises all quantitative approaches to automated language processing, including probabilistic modelling, information theory, and linear algebra. The technology for statistical NLP comes mainly from machine learning and data mining, both of which are fields of artificial intelligence that involve learning from data.

Application areas of natural language processing:

- Automatic summarisation of text
- Information extraction and retrieval with Natural language components

- Machine Translation
- Optical Character Recognition
- spelling checkers,
- grammar checkers,
- style checkers,
- on-line monolingual and bilingual dictionaries, and dictionary access systems
- automatic indexing systems,
- Speech Recognition
- Spoken dialog system etc.

Sub-problems in NLP

(i) Speech segmentation

In most spoken languages, the sounds representing successive letters blend into each other, so the conversion of an analog signal to discrete characters can be a very difficult process. Also, in natural speech there are hardly any pauses between successive words; the location of those boundaries usually must take into account grammatical and semantic constraints, as well as the context.

(ii) Text segmentation

Some written languages like Chinese, Japanese and Thai do not have single-word boundaries either, so any significant text parsing usually requires the identification of word boundaries, which is often a non-trivial task.

(iii) Word sense disambiguation

Ambiguity is one of the major issues in NLP. Many words have more than one meaning, we have to select the meaning which makes the most sense in context.

(iv) Syntactic ambiguity

The grammar for natural languages is ambiguous, i.e. there are often multiple possible parse trees for a given sentence. Choosing the most appropriate one usually requires semantic and contextual information. Specific problem components of syntactic ambiguity include sentence boundary disambiguation.

(v) Imperfect or irregular input

It can be foreign or regional accents and vocal impediments in speech typing or grammatical errors, OCR errors in texts.

(vi) Speech acts and plans

A sentence can often be considered an action by the speaker. The sentence structure, alone, may not contain enough information to define this action. For instance, a question is actually the speaker requesting some sort of response from the listener. The desired response may be verbal, physical, or some combination. For example, "Can you pass the class?" is a request for a simple yes-or-no answer, while "Can you pass the glass?" is requesting a physical action to be performed. It is not appropriate to respond with "Yes, I can pass the glass," without the accompanying action (although "No" or "I can't reach the glasst" would explain a lack of action).

Limitations and problems in NLP

Natural-language understanding is sometimes referred to as an AI-complete problem, because its recognition seems to require extensive knowledge about the outside world and the ability to manipulate it. The definition of "understanding" is one of the major problems in natural-language processing. Though Natural Language Processing seems to be a very attractive method of human-computer interaction it is loaded with more realistic real world problems like ambiguity and complexity.

Conclusions

With the aim of understanding Natural language Processing, the key concept associated with this field has been defined. It is an effort to show that NLP is a very live and developing field of linguistics, with its many challenges still to overcome due to Natural Language ambiguity. Some common problems in NLP are speech segmentation, text segmentation, word disambiguation, syntactic ambiguity, imperfect or irregular input and speech acts and plans. Different levels of the Natural Language has been defined such as morphological level, pragmatic level and others with the concept that a language that is natural in its way, at morphological level, the same may play different morph syntactic roles relative to the context in which they appear, causing ambiguity problem. The organisation of the content along with generation system plays an important role in building any NL system. The context presented here is to develop an understanding in NLP since it has a broad scope in research. The emphasis is to create awareness in NLP that will help in developing new techniques to overcome the existing shortcomings in NLP.

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Cracked Madhuca Indica (Mahua) Oil as a Diesel Engine Application: An Overview

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Abstract
In this chapter, biofuel output from Madhuca indica oil that has high free fatty acid was reviewed. The reported oil was detected using heterogeneous catalysts as opposed to conventional trans-esterification method, because the latter improves the fuel properties better than the former. For diesel engine applications, the production of hydrocarbon fuel from Madhuca indica oil was characterized by the assessment of essential fuel processing parameters. Hence attention was taken in the use of heterogeneous catalysts along with Coal Fly Ash (CFA) for the biofuels manufacturing process. It has been found from this review the performance results such as BTE for B25 blend indicate slightly lower sole fuel value at all loads and NOx emissions for B100 blend indicate substantially lower value than sole fuel. Smoke emissions for B25 demonstrate the upward trend of other blends. However, CO, HC emissions for B25 show small increases as compared to the sole fuel and B25 blend's combustion study showed nearly identical pattern in sole fuel.

Keywords: Madhuca indica oil, biofuel, coal fly ash, heterogeneous catalyst, B25 (25% biofuel with diesel)

Introduction

Energy is a primary commodity that every modern country really needs. Currently the world's oil and gas reserves are falling and predicted to be depletion in the immediate future as global cost of energy is growing each year. At the same time, the proof of global warming makes it compulsory to reduce greenhouse gas emissions into the ecosystem. These two considerations together have established a great encouragement for the search for sustainable alternative, ecologically responsible fuels which can assure continued energy supply. Specifically, alternative and renewable liquid fuels are important since they could re-establish petroleum-derived fuels used in internal combustion engines in transport, agriculture and the power sector [2].

Renewable sources are widely divided into two main categories, along with oils based on minerals and oils based on the biological sources. The fossil fuels based on minerals are unsustainable but biofuels are sustainable and environmentally sound. The organic based alternative energy sources named biofuel were known long before the other promising alternative fuels were explored [3]. In fact, the biofuel is biodegradable, non-toxic, environmentally friendly and, therefore, renewable and its physical and chemical properties are stronger than fossil fuels. Straight vegetable oil, however, may be considered an option suitable for diesel fuel. The studies discovered that the long-term use of SVO (straight vegetable oil) in diesel engines results in injector shock, extreme engine deposits, filter clogging issues, piston ring locking and lubricating oil thickening. Generally, edible vegetable oils prices are higher than diesel fuel prices. As such, waste vegetable oils and crude vegetable oils that are not edible have been considered as possible raw materials for biofuel production. In the synthesis of biofuel many edible and non-edible oils from oleaginous plants found in various regions have been successfully exploited. Used were soybean oil, sunflower oil, canola oil, jatropha oil, palm oil, olive oil and cottons oil. Despite significant increases in the edible oil economy, large-scale biodiesel production based on edible oil has resulted in food shortages in many parts of the world [4]. One of the promising approaches for biodiesel production is use of non-edible oils as the source of triglycerides. Many oil-bearing, non-edible plants were investigated for biodiesel production, such as Mahua, Jatropha Curcas, Cinophyllum, Pongamia pinnata, Castor, Mohua, Neem, and so on. They need very little fertilizer and water, and can also live under poor soil conditions such as stony, gravely, sandy or saline soils. Most importantly, with a high seed yield, they are growing quickly and will flower and bear fruit throughout the year. One of the major drawbacks is the high content of free fatty acid (FFA)

and water in waste oil which promotes ester saponification and hydrolysis when used with non-edible oils. The use of biofuel in the automotive fuel market will rise quickly in the next decade, due to its environmental merits. There are many reasons why both the developing and developed countries should recognize biofuel as important technologies. Biofuel provides explanations for energy efficiency, environmental considerations, foreign-exchange savings and rural-related socioeconomic issues [5].

Jatropha, Karanja, Rubber, Mahua, Silk cotton, Jojoba, and Calphyllum inophyllum are commonly used in production of biodiesel in India. The use of vegetable oils in the new diesel engine indicates a marginal drop in thermal efficiency compared to petrol with minimal amounts of power loss when using vegetable oils. Despite a decrease in NOx, the particulate levels of vegetable oils are higher than those of petrol. Methyl esters from vegetable oil provided better efficiency and emission characteristics compared to diesel. Thus, they can be considered as replacements for diesel fuel. With some minor changes, the raw vegetable oil can be used as fuel in diesel engines [6].

Impact of vegetable oil fuels and their methyl ester (fresh sunflower oil, raw cotton seed oil, raw soybean oil and its methyl esters, refined corn oil, distilled poppy oil and refined rapeseed oil) on a directly injected four-stroke single-cylinder diesel engine output and exhaust pollution. From the efficiency perspective, the findings showed that both vegetable oils and their methyl esters were promising alternatives as diesel fuel. Despite its many advantages, biodiesel's characters make it more resistant to long-term oxidation than petroleum diesel. The exposure varies depending on the presence of natural antioxidants and the storage conditions, depending on the raw material. There are several methods to convert vegetable oils into biofuels; they are pyrolysis, gasification, processes of transesterification, thermal cracking, and catalytic cracking. Among those methods, many researchers have widely studied the catalytic cracking of vegetable oils to produce biofuel. Biodiesel can be produced via the transesterification process but, on the other hand, it has many drawbacks such as low ignition point, incomplete combustion and should be combined for use with fossil fuels [7]. Homogeneous base catalysis (Ethanol, Methanol, and NaOH or KOH) is commonly used to turn inedible oil into biodiesel. The alternative chemical conversion of triglyceride-based feeds, mainly hydrocarbon-rich in paraffins, is under intensive work worldwide to solve these problems and to achieve better quality. Therefore new catalytic routes and catalysts are under study to improve biofuel competitiveness. Work in recent years has concentrated on appropriate heterogeneous catalysts that could achieve high yields while reducing the cost of production. Therefore, this chapter deals on the catalytic cracking of vegetable oil and the selection of the carbon fly ash catalyst with the emphasis on biofuel development. The way biodiesel is produced is by catalytic oil cracking at lower temperatures (450–500 ° C) which gives extremely selective hydrocarbon. By choosing less expensive feedstock such as non-edible oil, waste cooking oil, and animal fat, and also by selecting a less expensive catalyst, the total cost of biodiesel can be cut. Madhuca indica oil is one such form of oil that is non-edible, has a high content of free fatty acids, and is toxic in nature. This is readily accessible and can well expand in the Indian climate, as well as in degraded lands where water is scarce. Coal fly ash (CFA), the main inorganic waste, occurs at a coal-based thermal power plant by coal combustion processes. In addition, the presence of SiO_2, Al_2O_3 and Fe_2O_3 prompts its possible applicability as a support for low-cost catalysts.

Sl.no	Properties	Formula	Structure	Value (Wt %)
1	Arachidic Acid	$C_{20}H_{40}O_2$	C20:0	0.0–3.3
2	Linoleic Acid	$C_{18}H_{32}O_2$	C18:2	8.9–13.7
3	Oleic Acid	$C_{18}H_{34}O_2$	C18:1	41.1–51.0
4	Palmitic Acid	$C_{16}H_{32}O_2$	C16:1	16.0–28.0

MATERIAL AND METHODS

Madhuca indica oil

Madhuca indica is the botanical name in Hindi for Mahua, and Bangali for Mohul. This is kind of a tropical tree found in the northern plains and central forests. This is most likely named as a mohul or

Mahua (Madhuca Indica) and grows to a height of 55–75 feet and belongs to the family of sapotaceae. Madhuca Indica oil is tree-based seed oil that has an annual production potential of 181 thousand metric tons in India. The drying and decoration yields 70 percent kernel of seed weight and even the seed kernel contains around 50 percent of oil and yellow in color and its raw Madhuca indica oil composition. Madhuca indica oil is traditionally used for joint ach reliever for the body madhuca indica keep an important role in Ayurveda like skin caring, antidiabetic activity, mosquito repellent with good smell it's a multipurpose plant. It is abundantly available in Jharkhand, Bihar, Assam and West Bengal. Desi liquor are also get from fermentation of madhuca indica flowers [8].

Figure 1 madhuca indica

Figure 2 madhuca indica seeds

Coal fly ash catalyst (CFA)

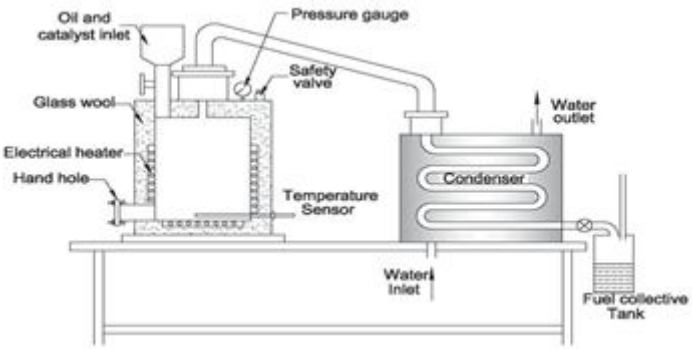
Coal fly ash generally collected from the any of the thermal of steel plant where coal as a fuel is used. In general, the fly ash formed by the combustion of pulverized coal in a coal-fired furnace is a fine-grained, powder particle size material conducted in the exhaust gases and typically collected from the exhaust gases by means of electrostatic precipitators, bug houses or mechanical collection device. When suspended in the exhaust gases, the particles solidify and consist of a mixture of glassy crystals with different visible crystalline phases such as quartz, mullite, and different iron oxides [9]. Pulverized coal burning produces two primary solid by-products: bottom ash, and fly ash. Bottom ash remains at the bottom of the furnace; Fly ash, which forms between 60 and 88 wt percent of the solid waste, is considered a pollutant if discarded and needs disposal. The main source of CFA is thermoelectric power plants which burn coal. Clean (untreated) coal fly ash primarily consists of silica (SiO_2), alumina (Al_2O_3) and iron oxides (Fe_2O_3). Oxygen, oxygen, mercury, iron, calcium, magnesium, sodium, potassium, sulphur, and carbon are the most common elements contained in the CFA [10].

The physio-chemical properties of fly-ash in a number of catalytic reactions, and its applications for heterogeneous catalysis as a catalyst supply or catalyst. Catalysts assisted by fly-ash have demonstrated strong catalytic activity for hydrocarbon oxidation and hydrocracking, which is comparable to catalysts used commercially. Fly ash may also be useful as a catalyst by itself for the gas phase oxidation of volatile organic compounds, organic aqueous phase oxidation, solid plastic pyrolysis and organic solvent-free synthesis. The raw CFA usually belongs to heterogeneous catalysis, the assisted catalysts are commonly used and their catalytic activity depends on the active component and the relationship between the active component and the support. The most commonly used for involving catalyst operation are metal oxides such as Al_2O_3, SiO_2, TiO_2, and MgO. For CFA, the majority of chemical compounds are Al2O3 and SiO2, furthermore it is found that they have been treated at a much higher combustion temperature, exhibiting excellent thermal stability, highly heterogeneous, low-cost catalyst help and offering good efficiency as catalyst operation.

Madhuca indica oil Catalytic Cracking

Catalytic cracking is the process in which, in the presence of an effective catalyst, the different oils are converted into usable fuels or compounds at a much lower temperature than is needed for catalytic cracking. The thermally decomposed vegetable oil's liquid fractions are likely to exceed diesel fuels. The broken vegetable oils contain acceptable quantities of Sulphur, water and sediment and contain acceptable values of copper corrosion; however, they also contain inacceptable quantities of ash, carbon residue, and pour level.

The schematic diagram of catalytic cracking reactor with accessories and instrumentation is shown in Figure 3. The cracking reactor is a 1300 mm long, cylindrical vessel made of titanium. A thin cylindrical layer encircles the reactor. The insulator for the glass wool is mounted between the reactor vessel and the thin sheet to prevent heat loss. A safety valve, a pressure gage, an oil inlet with an airtight stop cock for the vegetable oil and an outlet connected to a water-cooled condenser are installed at the top of the reactor. The safety valve can with-stand up to 600 kg / m^2 of pressure. With the aid of an electrical coil the reactor is heated until the oil reaches a temperature of 450–500 ° C.



An electric controller regulates temperature. The reactor temperature is determined using a thermocouple that is given at the bottom of the reactor. The condenser consists of a refrigerated coil and a water jacket. The condenser consists of the 1800 mm thick, stainless steel coil with a diameter of 20 mm. Within the water jacket the cooling coil is held with a diameter of 300 mm and a height of 500 mm. To extract the waste hydrocarbon residue after cracking with vegetable oil, a drain hole is provided with an air-tight stopcock at the reactor bottom.

Table 2 Properties of diesel fuel, cracked madhuca indica and raw madhuca indica oil

Properties	Measurement Standards	Diesel	Cracked Madhuca indica oil	Raw Madhuca indica oil
Specific gravity @ 27°C	ASTM D1298	0.8234	0.8452	0.922
Kinematic viscosity at 40°C	ASTM D445	3.06	6.10	37.63
Flash Point (°C)	ASTM D93	75	129	230
Gross calorific value (kJ/kg)	ASTM D240	44000	39400	37614
Cetane number	ASTM D976	52	46	50
Color	-	Yellow	Light blackish with red	Dark yellow

The catalyst used directly without any treatment in this experimental segment add raw coal fly ash with Madhuca indica oil and make it into the catalytic reactor as a slurry with the aid of stirrer and Fed and it is heated to 450–500°C. Catalytic cracking reaction is conducted on heating and gaseous hydrocarbon is released from vegetable oil, it comes through the condenser, is cooled and collected in the form of liquid hydrocarbon. Table 2. Shows the properties of cracked oils were analyzed.

Analysis of cracked oil

Gas chromatography-mass spectroscopy (GC-MS) and Fourier transforms infrared (FTIR) techniques help to analyze the chemical properties of cracked oils. The research GC-MS is used in complex mixtures to qualitatively classify and quantitatively quantify organic compounds. In GC-MS, a compound is converted into fragments and then the total abundance of ions is measured and plotted against time or a chosen ratio of mass to charge (m / z). A weight range of selected ions collected as a mass chromatogram during a chromatographic test. GC-MS is a powerful identification tool. It can also record a mass spectrum for each compound, in addition to distinguishing the volatile portion of

complex mixture. The instruments provide the sample GC retention time and electron ionization mass spectra with two separate dimensions of knowledge about the component.

GC-MS of cracked Madhuca indica oil

Even in gas chromatography of broken Madhuca indica oil shown in Figure 3, with four major peaks found observed. The oven temperature worked in this program started at 70°C for 3 minutes and increased at 9°C / min to 300°C and 99.9995 percent purity of helium as the carrier gas with a flow rate of 1.6 ml / min with a time range of 50–500 ionizations.

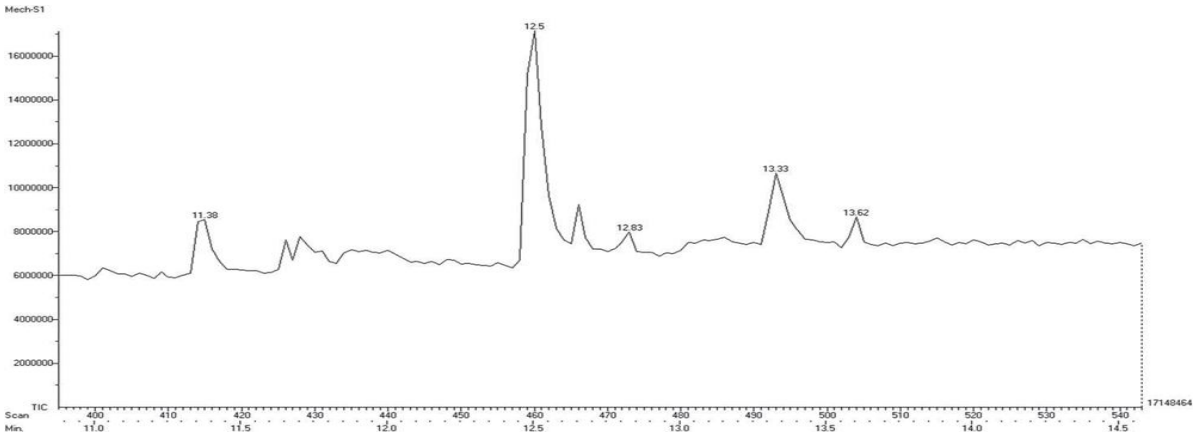


Figure 4 GC-MS spectrum of Madhuca indica oil fatty acid

The machine is equipped with a high resolution spectrometer, electron effect double focus and gas carrier for chemical ionization. The instrument is able to analyze compound structural elucidation, mechanical tests, and molar mass and structural analysis of bio molecules. Through the chromatogram of gas it can be shown that the mixture comprises different esters. Examination of the base peak and fragmentation pattern of the individual mass spectra supports the esters. Such functional groups of cracked Madhuca indica oil also affect the properties of the liquid. Fatty acid identification has been verified by running the standards under the same experimental conditions and comparing the respective retention time confirmed by the study of mass spectrometry [13].

FTIR analysis

In this FTIR spectrometry the broken Madhuca indica oil was analyzed. The analyzing samples radiate in this IR, and the transmission associated with molecular absorbance is reported. Molecular absorbance will only occur when the radiation frequency precisely matches the molecule's vibrational frequency.

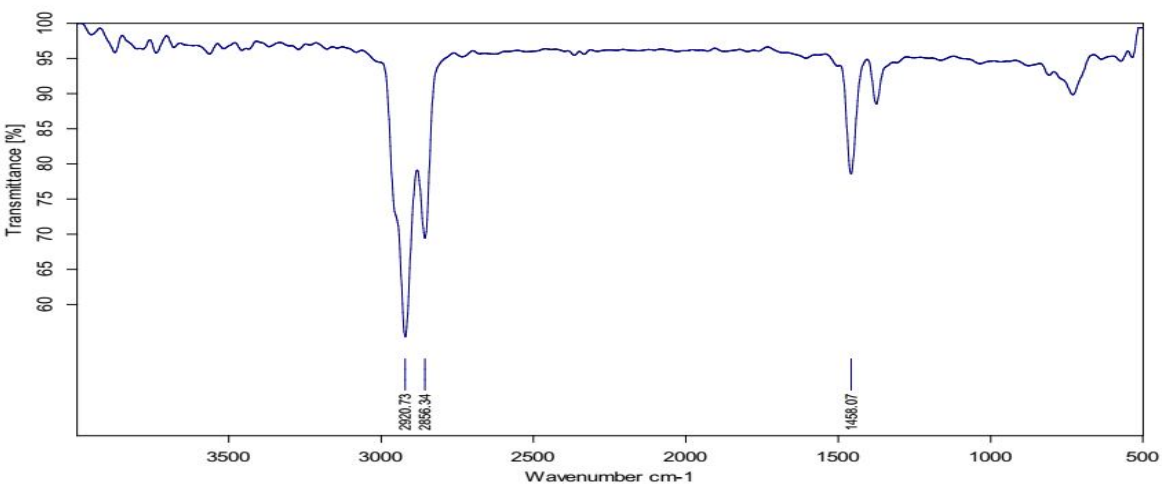


Figure 5 FTIR Spectrum of pure diesel

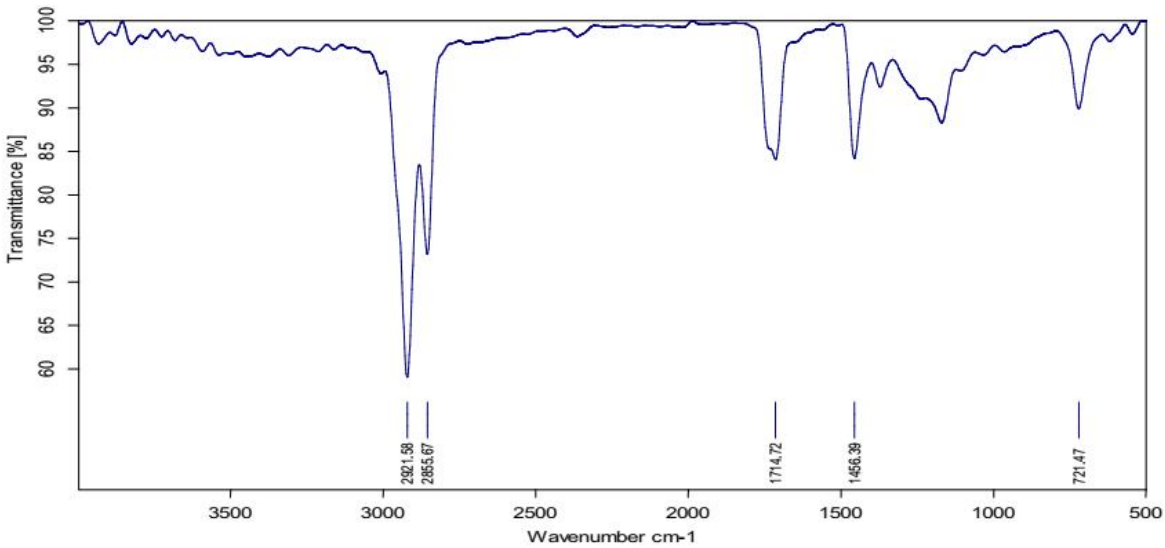


Figure 6 FTIR Spectrum of cracked madhuca indica oil

Molecular activity may be bonding or stretching. Stretching vibration involves continuous changes in the internal atomic distance between two atoms, while bending vibration describes a change in the angle between two bonds. The y-axis frequently indicates linear transmission, but a modern computer-based spectrometry can produce spectra that can be absorbed linearly. The IR area covers near IR (wave number: 12,800–4000 cm^{-1}), mid IR (wave number 4000–500 cm^{-1}), and far IR (wave number: 200–10 cm^{-1}). FTIR characterizes broken Madhuca indica crude, opposed to smooth diesel. The functional groups and bands corresponding to the different stretching and bending vibrations of smooth, broken Madhuca indica oil are defined by the FTIR spectrum shown in the Figure5 and 6. The diesel and cracked oil range is very similar because the two components have almost the same chemical groups; however, certain variations can be separated. IR spectrum of cracked Madhuca indica oil showed regular stretching of C=O, a characteristic of 1741.28 and 1714.72 cm^{-1} methyl ester respectively. The absorption of neat diesel, Madhuca indica oil at 2921.20 and 2921.58 cm^{-1} suggests the high stretching frequency of C = H and the observation of an absorption peak at 752.59 and 721.47 cm^{-1}, respectively, reflecting the C – H bond and implied rocking of CH_2. The instruments classify this in the different functional groups; ethers, alkanes, alkynes, alcohols , aldehydes , ketones, alkenes, fluoride, carboxylic acid, esters, amides, anhydrides, amines, and benzenes. In Table 3, the wave-length and identified diesel, cracked Madhuca indica oil compounds are given.

Diesel		**Cracked madhuca indica oil**	
Wave length (cm^{-1})	**Compounds identified**	**Wave length (cm^{-1})**	**Compounds identified**
752.59	Strong signal of alkyl halides with C-F stretch	721.47	Strong signal of alkyl halides with C-F stretch
1375.32	Strong signal of Fluoride with C-X stretch	1456.39	Medium signal of amides ($RCoNR_2$) with C=O stretch
1459.56	Strong signal of C-H bending	1714.72	Strong signal of RCO_2Ri – ester with C=O stretch
2921.40–2853.56	Strong signal of C-H stretching	2921.58–28855.67	Strong signal of RCO2H-carboxylic acid with monomer and dimers

Table 3 the wave-length and identified diesel, cracked Madhuca indica oil compounds [13]

From FTIR spectral data, it is properly mentioned that cracked madhuca indica oil contains an excellent amount and quality of functional group of carboxyl group and alkanes esters, and the presence of C – H hydrocarbon groups denoting that cracked fluids could be used as fuel sources [13].

RESULTS AND DISCUSSION

In the first step, the Madhuca indica vegetable seed oil is cracked by catalytic cracking method at 450 ° C to 500 ° C in the presence of catalyst (CFA), and these biofuel blends – diesel is used to power the engine. In the second step, the engine was run in diesel, a blend of Madhuca indica oil bio-fuel and diesel modes at a speed of 1500 rpm for various load condition. Biofuel-diesel blends are evaluated in the third phase of the work for efficiency, pollution, and combustion. In the last phase of the work, various biofuel blends with diesel fuel are used to increase performance and lower emissions. In all the above phases the parameters of combustion, emission, and efficiency are compared with the parameters of diesel fuel.

Variation of Brake thermal efficiency

The finding indicates that BTE decreases compared to diesel fuel by rising the Madhuca indica biofuel blends. The BTE for B25 at 20 percent load was very close to diesel fuel because of its improved fuel properties and the pattern of B100 at 20 percent load indicates a 3.2 percent reduction in thermal efficiency compared to smooth diesel and a significant reduction in BTE for almost all blends. It is partly due to the poor formulation of a mixture due to low volatility, higher viscosity and higher biofuel density. Among the blends, thermal efficiency for B25 blends at 100 % load provides higher efficiency compared to other blends, namely B50, B75 and B100, due to lower calorific value compared to smooth diesel [14].

Variations of Smoke opacity

Emissions of smoke are due either to fuel–air mixtures that cause too much auto ignition, or to support propagation flame or fuel–air mixtures that are too rich to ignite. The smoke opacity of Madhuca indica biofuel is observed to increase with increased engine loads. Around 40 per cent load, however, B25 exhibits the same smoke opacity as diesel fuel operation equivalent. The smoke strength for B25 and B100 increases to 66.8 and 85.7 HSU at full load, respectively [15]. Nevertheless, except for B25, higher smoke opacity was observed for all other Madhuca indica biofuel blends, and this is due to the explanation that could be related to the heavier molecular structure and high viscosity of cracked Madhuca indica biofuel and its mixtures.

Variation of HC emission

It is observed that when compared to diesel fuel the HC emission increases consistently with an increase in the proportion of biofuel blends. The growing trend in HC emissions is mainly due to fuel and air mixing problems and largely unaffected by the overall equivalence ratio between air and fuel. The emission of hydrocarbon from cracked Madhuca indica oil blends is higher for all loads compared with neat diesel [13]. At 20 percent load, the HC emission of B25 is similar to the diesel fuel value of about 37 ppm but at full load, the HC concentration reached a high value of about 48 ppm. This is primarily a weak mixture forming pattern of biofuel mixtures. In further noticed that, the lower BTE of these blends is also responsible for this trend.

Variation of CO emission

In general, CO emissions are influenced by the ratio of air fuel equivalence, type of fuel, configuration of the combustion chamber, atomization rate, and start of injection timing, injection pressure, engine load and speed. It is observed that all biofuel blends have consistently increased CO emissions with increasing the blends of biofuel. Among the blends B25 shows the lowest emission at 20 percent load than other blends, but diesel produces the lowest emission of CO compared to biofuel blends [15]. The low injection pressure and atomization rate affect the primary combustion process and thereafter generate high CO emission concentration with increasing proportion of Madhuca indica biofuel blend.

CONCLUSIONS

The manufacture of Madhuca indica oil biofuels by catalytic cracking method demonstrates a possible alternative. Biofuel yields generated are heavily dependent on the heterogeneous catalyst herein, coal ash is an inexpensive catalyst and because Madhuca indica oil is inedible oil, the overall fuel production cost is considered to be lower. It is clearly known from FTIR spectral data that cracked Madhuca indica oil contains a good quality and quantity of carboxylic acid esters and the functional group of alkanes and the presence of hydrocarbon groups C–H. It is observed from the GC spectrum

that the broken oil contains traces of paraffin, olefins, and unsaturated acids such as palmitic, oleic, linoleic, stearic and lauric acid as dominant peaks. Last, in a diesel engine, cracked Madhuca indica oil blends with diesel and the results showed engine efficiency and parameters for combustion. BTE for B25 was very much comparable to diesel fuel at 20 percent load of broken Madhuca indica oil, but B100 at 20 percent load trend indicates a 3.2 percent reduction in thermal efficiency compared to diesel. NOx emission for B25 at 20 percent load almost closer to diesel fuel and further observed that, higher blends of cracked Madhuca indica oil B100 showed significant NOx emission reduction at maximum load about 131 ppm when compared to diesel. Smoke opacity was observed while increasing the load. Nevertheless, the 40 percent load blend B25 exhibits the same smoke opacity value has been observed. Emissions of CO and HC rose with changes in blend percentages for all loads other than diesel. Heat release rate for B25 showed the maximum heat release rate as compared to other mixtures. However, it is less than the diesel

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ISBN: 978-81-946375-0-9

Prediction of Green Sand Moulding Properties using Artificial Neural Network

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ABSTRACT
Sand control has been practiced through the development of different sand tests, control graphs and correlations between the physical properties and variable factors. In the present investigation an attempt has been made to develop an Artificial Neural Network (ANN) model for predicting the properties of moulding sand mixture. Experiments have been conducted by varying clay content, moisture content, amount of coal dust and the mulling time. For each sand mixture, the moulding properties such as Green Compression Strength, Permeability, Shatter Index and Green Hardness were measured. An Artificial Neural Network model has been designed for predicting the green sand moulding properties. Standard Back propagation multilayer feed forward algorithm has been used in developing this model. The model so developed is trained, tested and validated using the data collected from the experiments. The results obtained from the developed model are comparable with what is expected from the green sand moulding process.

Keywords: Green Sand Moulding, Sand Mix Composition, Artificial Neural Network, Back-propagation

NOTATIONS

α	:Momentum Factor
η	:Learning Rate
E	:Error function
δ_j	:Error gradient in the units of hidden layer
δ_k	:Errors gradient in the units of output layer
W_{ij}	:weights between units i in input layer to unit j in hidden layer.
W_{jk}	:weights between unit j in hidden layer to unit k in output layer.
x_i	:actual value of the unit i in the input layer $x_0 = 1$
h_i	:Activation value of unit i in the hidden layer
O_k	:Activation value of unit k in output layer
y_k	:Target value of unit k in the output layer
MSE	:Mean Square Error

1. INTRODUCTION

Green sand moulding remains a single most important method of producing castings over the years. The popularity to this process is obtained by the characteristics of producing the castings with required finish, good collapsibility, high permeability and low cost. Since it is the cheapest method of producing the castings, green sand moulding is employed by most of the high production shops in all ranges upto several tons in weight. The economy of green sand stems for four major factors **[1]** are: (i) Ease of preparation of sand mix, (ii) Less expensive molding materials since they can be reclaimed easily, (iii) Easy to prepare the moulds and (iv) Easy to shake out.

In green sand molding, the mould is filled with molten metal while the sand is still moist. Mould cavity in this process is made of sand bonded by a mixture of clay and water. Some other materials such as additives are also added to the sand mix to achieve specific properties. The mould lacks permeability and strength due to the presence of moisture, which may result in defects such as blow holes and pin holes in the casting. In spite of this drawback, green sand moulding is the most popular molding method, which accounts for more than 90% sand molded castings.

Quality of castings produced depends to a large extent on the technology of mould making and the properties of moulding materials. Practical experience and production data **[2]** clearly indicate that on an average 40-70% of casting defects occur due to improper mould properties. Thus it is imperative for the foundry man to have a sufficient knowledge over the proper selection of moulding materials and control over the mould properties.

The sand control operation in foundry industry continues to remain a critical problem for the foundry man. During the past years many laboratory tests and control graphs **[3, 4]** have been devised and used to improve the control of foundry sand system. However, with the fast development of high pressure moulding, a better understanding of the system sand has become vital for the foundry engineers. This leads to the development of new control techniques for foundry process control. Dietert **[5]** suggested a mechanical-electrical based system with computer directed to make decisions of bond and water additions to the sand mixture. Luckenbaugh and Sharkus[6] developed programmable logical controllers to control various foundry equipment and processes.

Many sand control programs **[7 - 9]** have been developed and implemented with the available data which is obtained by daily and weekly tests in foundries. In USA a SILICA Program test series has been developed for the determination of sand composition in terms of MB clay, combustible materials, and flux materials, as inert fines and as Oolitics, metallic and silica. Although, the past investigations were helpful in identifying the variable factors, the optimum formulation of the sand mixture remained a critical problem for the foundry man. In view of these observations, the optimum design of clay bonded sands by the application of Neural Networks seems to be quite useful **[10].** Artificial intelligence has been claimed to yield revolutionary advances in manufacturing. Neural Networks, one of the artificial intelligent techniques is gaining importance in recent days in the hope of achieving in many fields of engineering. Some of the work already completed in the metallurgical fields includes predicting the properties of grey cast iron **[11],** TTT diagrams **[12, 13],** cupola melting **[14],** semi-solid extrusion Process **[15],** green sand control **[16]** , and Co_2 moulding properties **[17],** which could also be useful for the computer integrated manufacturing system **[18].** The present investigation is an attempt made to model the green sand process parameters using back propagation neural network technique.

2. ARTIFICIAL NEURAL NETWORKS

Neural networks is defined as massively parallel interconnected networks of simple elements (processing elements) and their hierarchical organizations which are intended to interact with the objects of real world in the same way as the biological neuron system do **[18].** A properly modeled network has the potential to generate the acceptable results from the information what might be incomplete and non-specific. Their parallelism, speed and trainability makes the neural network fault tolerant, as well as fast and efficient for handling large amounts of data **[12].**By training a network with a particular pattern of data, it can subsequently recognize the similar patterns with generalization **[11].** The special features of learning and generalization makes neural network distinctly different

from conventional algorithm, processing computers along with their potential property of operational speeds realized through inherent parallel operation. Neural network models are specified by the network topology and training procedure.

2.1 *Back-propagation Algorithm*

The Back-propagation algorithm is the probably the most widely used learning rule among the current available neural network systems. The back-propagation algorithm is a multi layer feed forward network with different transfer functions in the artificial neurons. The back-propagation is a kind of gradient descent technique with backward error propagation, which is the back propagation rule, varies the connection weights in a manner that reduces the error as rapidly as possible. This is an interactive gradient algorithm designed to minimize the mean square error between the actual output and the desired output of a multilayer feed forward network. The detailed back-propagation algorithm **[19]** is given in **Appendix A.**

The network will be trained with the input vectors and their corresponding output vectors until it can approximate a function, associate an input vectors with specific output vectors, or classify input vectors in an appropriate way as defined by the user. A properly trained back-propagation network tends to give reasonable results. Typically a new input will lead to an output similar to the correct output for the input vectors used in training that are similar to the new input generated. This generalization property makes it possible to train a network on a representative set of input/target pairs and get good results without training the network on all possible input/output pairs. The back-propagation neural network consists of one input layer, one output layer and one or more hidden layers. The number of neurons in the input and output layer are selected on the basis of the number of parameters affecting the process and the complexity of the relation existing between them. There is no rigid rule for calculating the number of hidden layers and the number of hidden neurons in each layer. Normally number of neurons or the processing elements in the hidden layer is selected taking into account the number of data points available for training the network and also the complexity of the relation existing between the input parameters and the output parameters.

3. DEVELOPMENT OF ARTIFICIAL NEURAL NETWORK MODEL

First of all, experimental data have been generated for developing the ANN model for green sand moulding process. By considering the features of green sand moulding process, the green compressive strength, permeability, shatter index and green hardness are chosen as the output parameters, while the amounts of clay, water, coal dust and mulling time are chosen as the input process parameters of the neural network model. A standard procedure has been followed to generate data for modeling. Sand mix was prepared by mulling the dry ingredients for a minute in a Simpson high-speed muller followed by water addition. The Muller is allowed to run for a sufficient period of time depending on the required mulling time. The mould properties are measured for the test samples of 2 inch in diameter and 2 inch height.

Table 1: Sample Data for Training the Proposed Neural Network Model

x_1	x_2	x_3	x_4	y_1	y_2	y_3	y_4
4	0	3	4	814	223	79.45	84
4	0	3	6	920	240	76.70	86
4	0	3	8	1020	239	77.12	86
4	4	3	4	797	148.5	56.00	87
4	4	3	6	894	193	69.33	85
4	4	3	8	924	196	72.50	86
4	4	4	4	772.5	183	74.00	83
4	4	4	6	814	215	77.35	84
4	4	4	8	870	212	79.00	86
4	6	5	4	790	165	77.40	83
4	6	5	8	814	195.5	82.37	84
4	6	6	4	737	170	82.53	84
4	6	6	6	744	170	82.74	85

6	0	6	4	807	221	87.67	83
6	0	6	6	790	226	85.87	83
6	2	3	6	1175	226	75.10	87
6	2	3	8	1240	256	77.50	86
6	4	4	6	1090	195.5	73.35	86
”	“	“	“	“	“	“	“
“	“	“	“	“	“	“	“
“	“	“	“	“	“	“	“
8	2	3	4	884	142	40	84
8	2	3	8	1149	241.5	67.85	87
8	2	4	4	967	178	51	87
8	2	4	6	1194	223	66.8	88
8	4	3	8	974	93	34.47	86
8	4	4	4	734	86.5	29.03	85
8	4	4	6	1040	117	54.8	86
8	4	5	4	1107	165	66.7	87

x_1 = Clay content ; x_2 = Moisture content ; x_3 = Coal dust content; x_4 = Mulling time (Minutes); y_1 = Green Compressive Strength (g/cm^2); y_2 = Permeability; y_3 = Shatter Index; y_4= Green Hardness

In the present work 144 sets of data are generated by varying the amounts of clay, water, coal dust and mulling time. The variations of these parameters are as follows: clay (sodium based bentonite) 4, 6 and 8 percent; moisture in the ranges of 3 to 6 percent with four variations; coal dust in the proportions of 0, 2, 4 and 6 percent by weight of sand, and these tests are repeated for 4, 6 and 8 minutes of mulling time. The specified ranges of input parameters for experiment are selected based on the past investigations **[20-27]** and industrial feasibility. The mould properties such as green compressive strength, permeability, shatter index and green hardness are measured for each sand composition. Out of the total data generated from the experiments, 16 sets of data are selected randomly for testing and another 16 sets of data are selected for the validation of the developed neural network model. The remaining data of 112 sets are used for training the proposed neural network model. The developed neural network model consists of four input parameters namely (i) amount of clay, (ii) amount of moisture, (iii) amount of coal dust, and (iv) mulling time representing the four neurons in the input layer. The four neurons in the output layer represent the four output parameters namely (i) Green Compressive strength, (ii) Permeability, (iii)Shatter Index, and (iv) Green Hardness. The number of hidden layers and the number of neurons in each hidden layer are determined by the numerical experiments conducted during training. The weights of the ANN are stochastically initialized in the range of -0.5 to 0.5. A C++ source code has been compiled for developing the back-propagation neural network model. The developed neural network model is trained until the desired error limit of 0.001 has been achieved. Further the connection weights are stored in a text file and subsequently used for the prediction of output parameters. After successful training of the network, the architecture of the neural network obtained is shown in **Figure 1.** A sample set of data used for training the network is given in the **Table 1.**

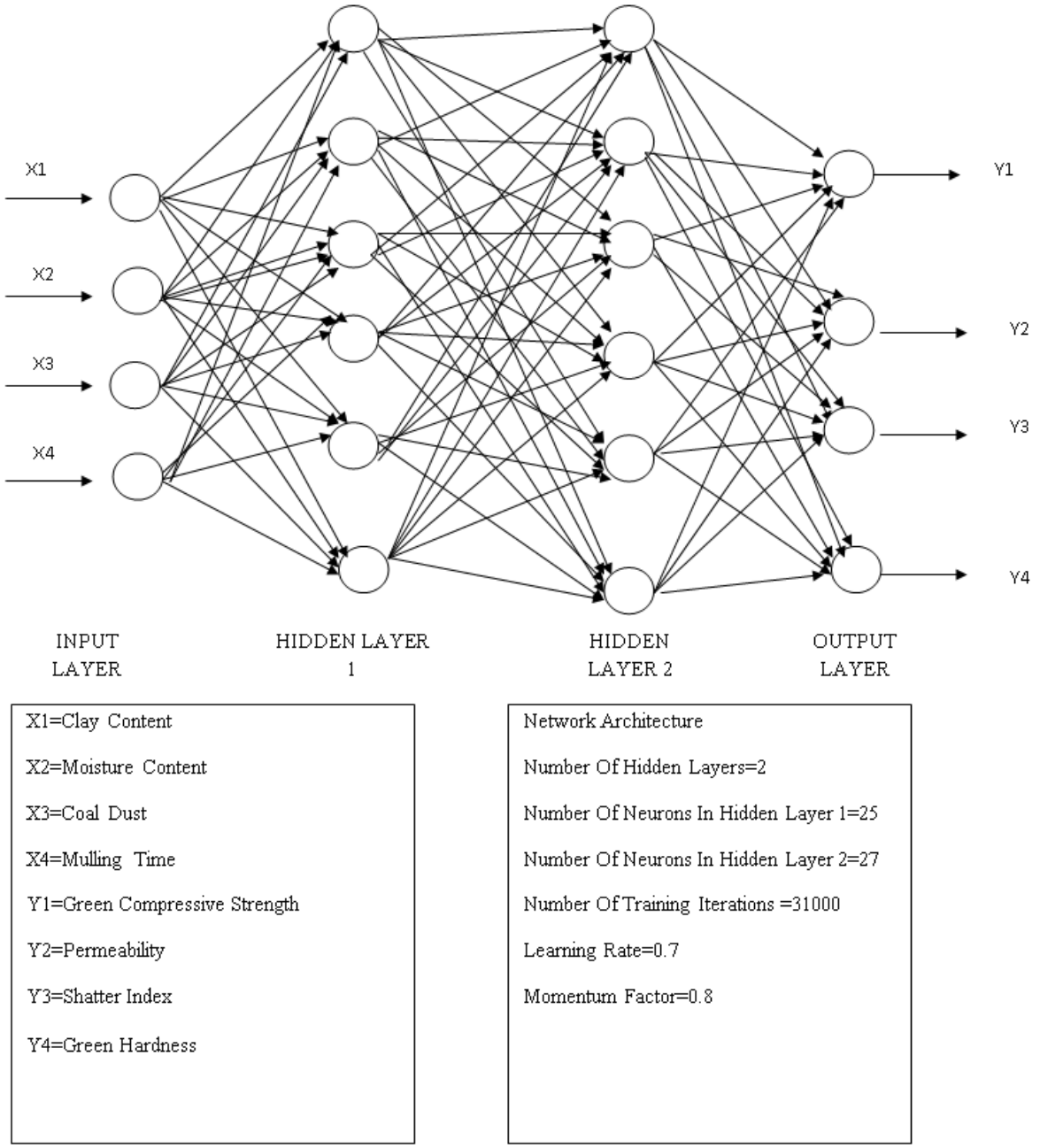

Figure 1: Four layer back-propagation network topology.

4. RESULTS AND DISCUSSIONS

4.1 *Performance of the Network with Different Network Parameters*

The performance of the neural network depends on the network parameters such as number of neurons in each hidden layer. As for determining the number of neurons in the hidden layer, first an attempt is made to take minimum neurons in the hidden layer and measured the mean square error of the network. In order to study the effect of network parameters, the number of neurons is varied from 3 to 31 in the second hidden layer and from 3 to 25 in the first hidden layer with an increment of 2 neurons. The effect of the number of neurons in the hidden layer 1 and 2 on the network performance is shown in **Figures 2,** and **Figure 3** respectively. From **Figures 2** and **3** it can be observed that as the number of neurons increases the Mean square Error (MSE) at first decreases and then increases. The optimum number of neurons that gives the minimum error in the 1st hidden layer is 25 and in the 2nd hidden layer are 27.

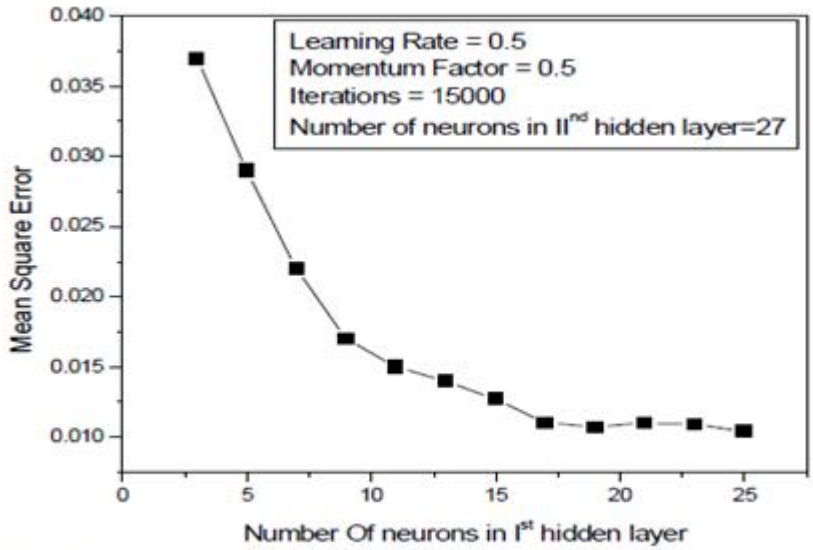

Figure 2 Influence of number of neurons in hidden layer 1 on the Mean Square Error of the network

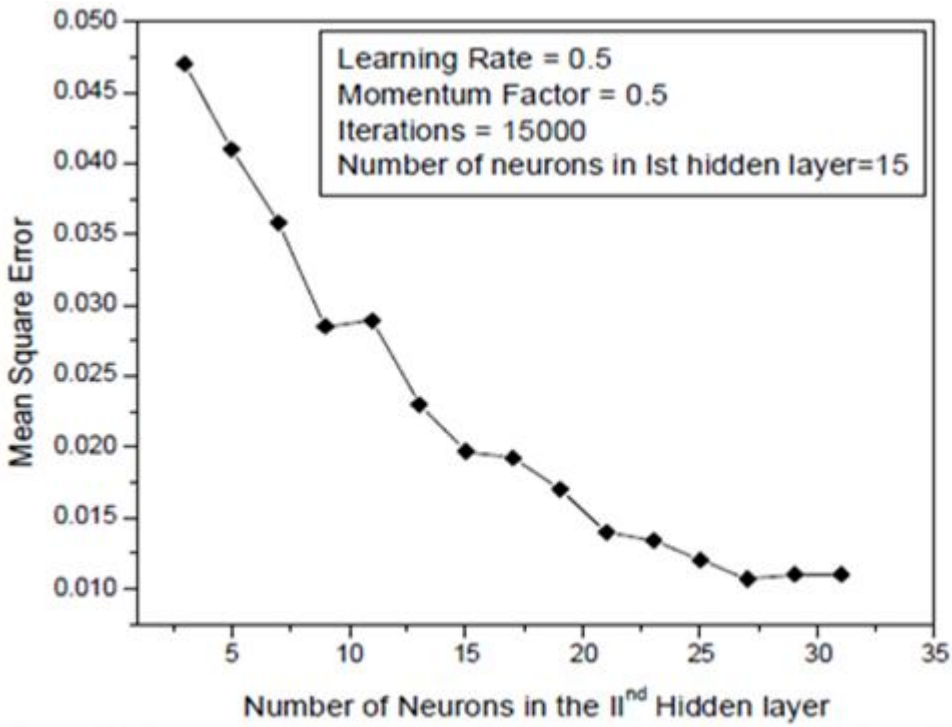

Figure 3 Influence of number of neurons in hidden layer 2 on the Mean Square Error of the network

4.2 Performance of the Network with Different Learning Parameters

In addition to the number of neurons in the hidden layer, the network performance also depends on the number of training iterations, learning rate (n), and momentum factor (a). In order to study the effect of these parameters, the number of training iterations is varied from 3000 to 31000, the learning rate is varied from 0.1 to 0.9 with a step of 0.1 and momentum factor is varied from 0.1 to 0.9 with a step of 0.1. The MSE of the network for different learning parameters are shown in the **Figures 4-6.** It has been observed from the graphs that the number of training iterations that can give the best possible error are 31000, learning of 0.7 and momentum factor of 0.8. The minimum error that is obtained after training is found to be 0.0078. The knowledge parameters saved after training the network can be used to predict the moulding properties. The knowledge parameters are nothing but the connection weights of the developed model of minimum error. From **Figure 4** it is clear that as the number of training

iterations increases the MSE decreases till 31000 iterations. From **Figure 5** it appears that at lower learning rate, the MSE is quite higher, as the learning rate increases the MSE decreases till the optimum learning rate has been reached, and then there is no further improvement in the MSE. From **Figure 6** it is clear that the momentum factor affect the network performance considerably. The MSE is found to be minimum for an optimum value of the momentum factor of 0.8.

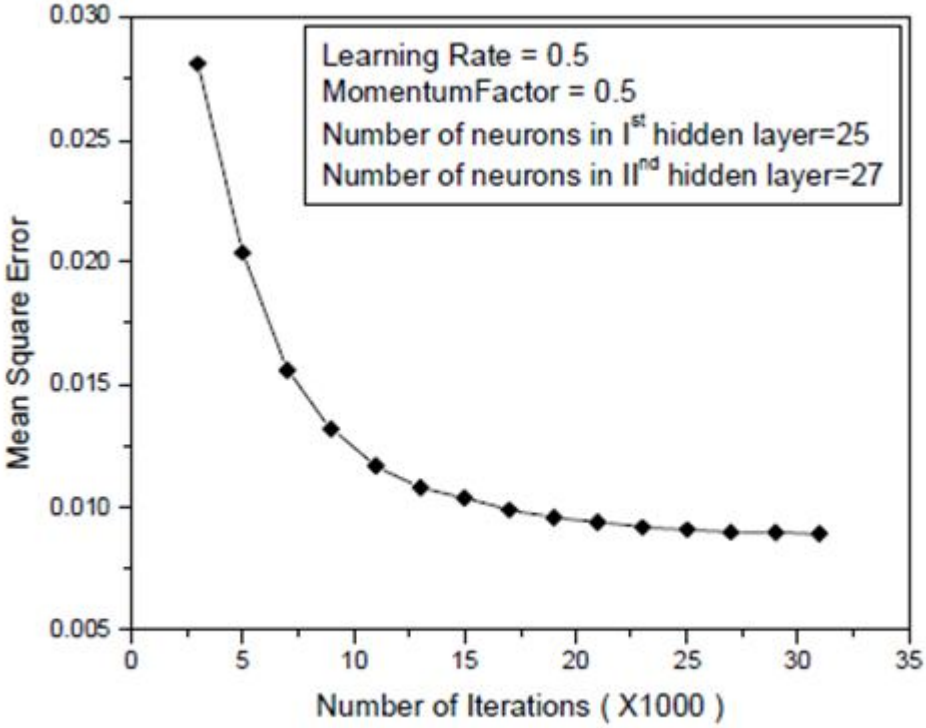

Figure 4 Influence of number of training iterations on the Mean Square Error of the network

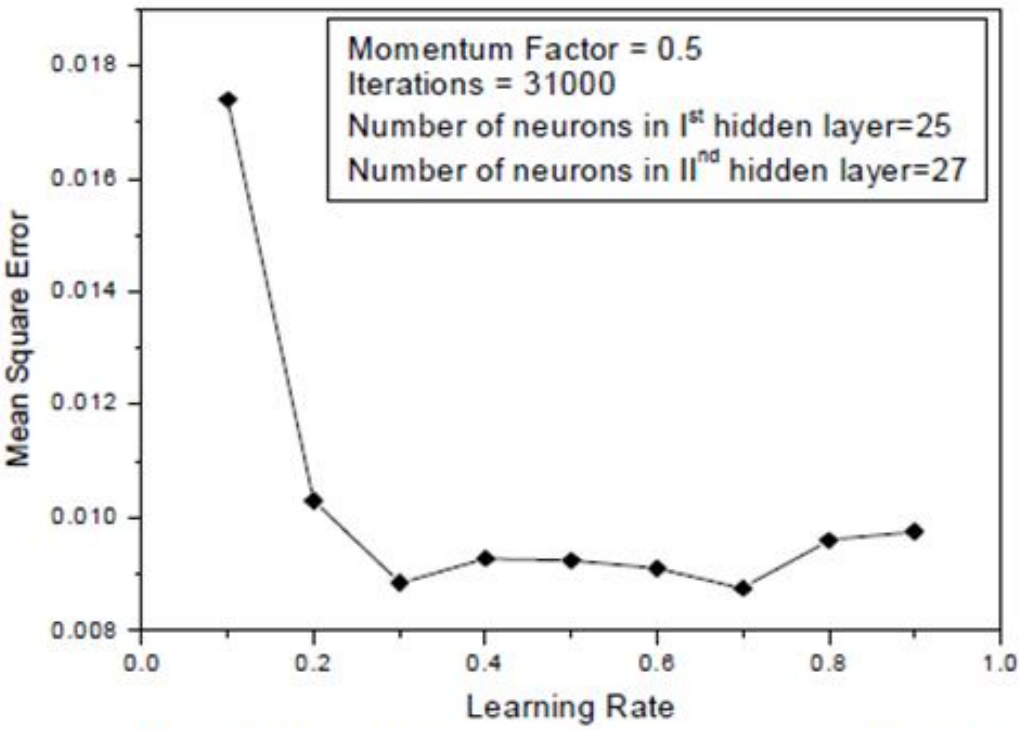

Figure 5 Influence of learning rate on the Mean Square Error of the network

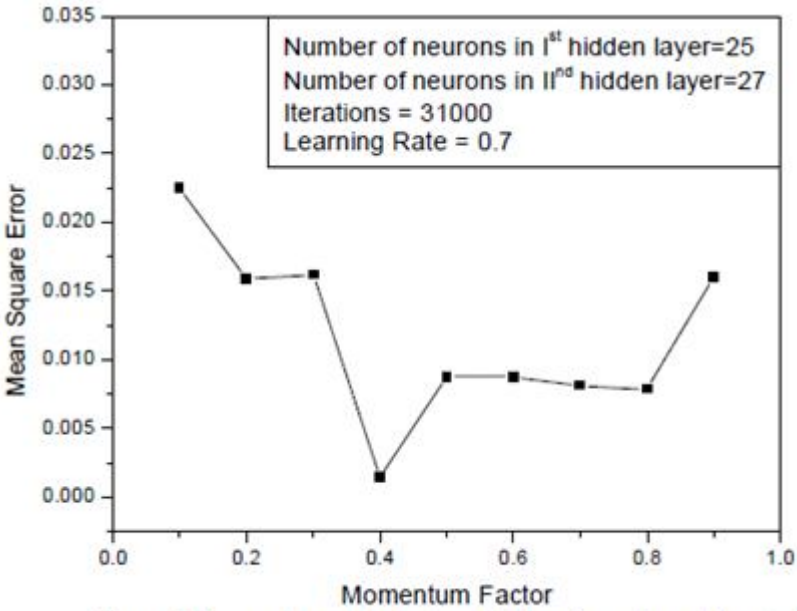

Figure 6 Influence of momentum factor on the Mean Square Error of the network

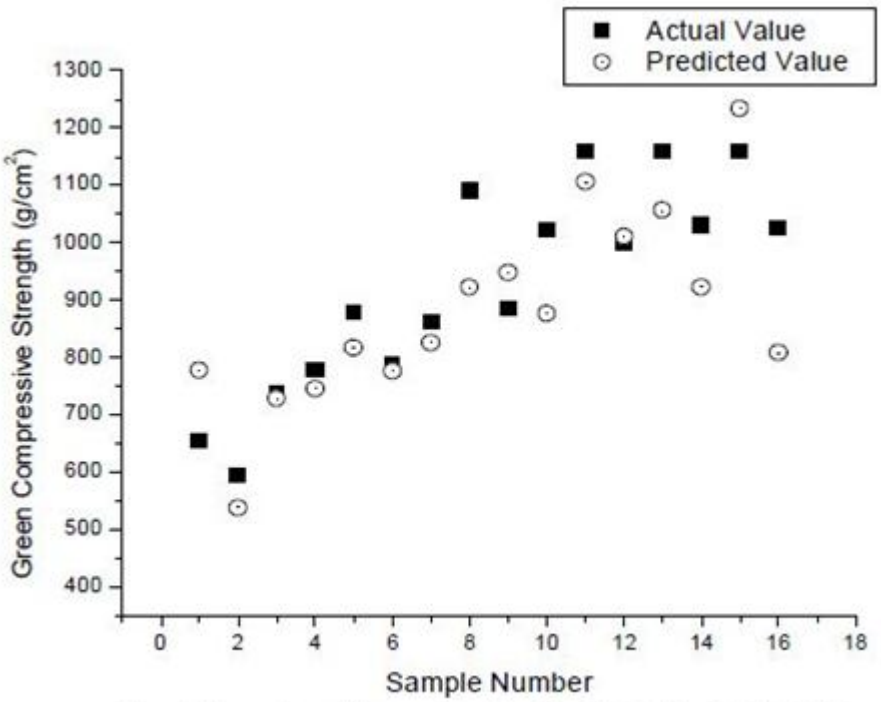

Figure 7 Comparison of the experimental and predicted values for the test data

4.3 Testing the developed Neural Network Model

After the successful training of the network the performance of the network is tested with the test data sets. Sixteen different sets of data, which are not included in the training, are selected randomly as the test data set. The responses of the network are accessed by comparing the predicted values of the network with those of the experimental values to determine the predictive capability of the network. The network can predict the best possible results when the input parameters selected are within the limits set by the user while experimental results are generated. The predicted results and their percentage error are given in the **Table 2.** The **Figures 7-10** depict the comparison between the predicted values and actual experimental values for Green Compressive Strength, permeability,

Shatter index and Green Hardness respectively. It can be inferred from the graphs that the developed neural network methodology is able to predict the moulding properties to a high degree of accuracy.

Table 2 Test Results

x_1	x_2	x_3	x_4	Green Compressive Strength (g/cm^2)			Permeability			Shatter Index			Green Hardness		
4	0	4	4	654	777.21	18.84	248	236.29	4.718	81.8	87.5	6.97	82	84.01	2.45
4	0	6	8	595	537.08	9.73	219	247.75	13.12	85.38	86.86	1.74	78	82.14	5.31
4	2	5	4	737	727.47	1.29	248	249.04	0.42	85.55	89.9	5.08	83	84.99	2.39
4	4	5	6	777	745.04	4.11	226	222.98	1.33	84.3	84.6	0.427	84	80.72	3.9
4	6	4	4	880	816.45	7.22	144	122.8	14.72	64.75	67.13	3.74	85	84.19	0.95
4	6	6	8	787	775.58	1.45	173	167.94	3.093	83.65	82.72	1.1	83	85.6	3.14
6	0	5	6	860	824.97	4.07	269.5	303.85	12.74	86.6	84.95	1.9	83	85.79	3.36
6	2	3	4	1090	921.29	15.4	212	233.06	9.936	60.5	50.48	16.5	85	87.08	2.44
6	2	6	6	885	947.62	7.07	275	252.8	8.069	87.1	86.89	0.23	82	85	3.65
6	4	6	4	1020	876.36	14.08	231	250.18	8.3	85	86.72	2.02	86	84.97	1.19
6	6	4	8	1160	1105.3	4.71	162	180.51	11.42	63.34	70.32	11.02	86	85.86	0.15
8	0	4	4	1000	1011.1	1.11	231.5	253.54	9.52	68.3	73.05	6.96	85	83.52	1.73
8	2	3	6	1160	1056.1	8.95	192	189.62	1.23	61.45	66.39	8.05	89	88.51	0.54
8	2	6	4	1030	921.93	10.49	235	247.15	5.17	92.7	90.35	2.53	85	86.55	1.82
8	4	4	8	1160	1233.5	6.33	148	172.93	16.84	59.82	51.01	14.72	87	83.89	3.56
8	6	3	6	1025	808.14	21.15	88	84.63	3.83	54.6	46.84	14.21	86	81.11	5.67

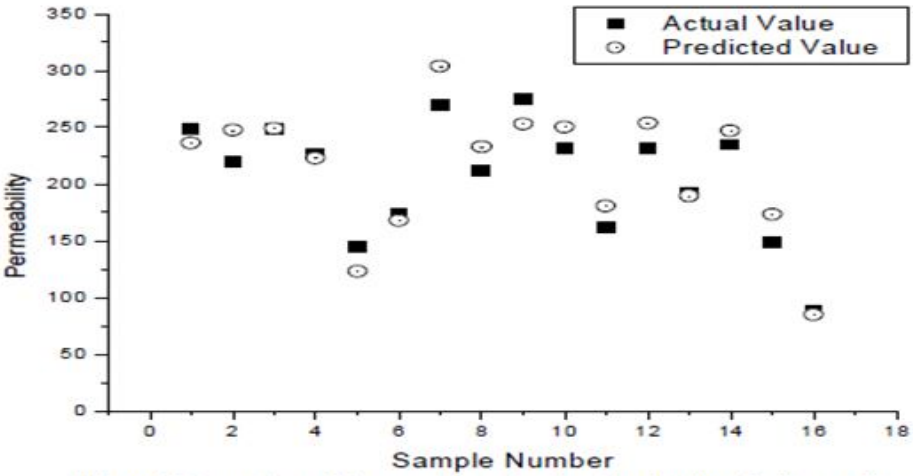

Figure 8 Comparison of the experimental and predicted values for the test data

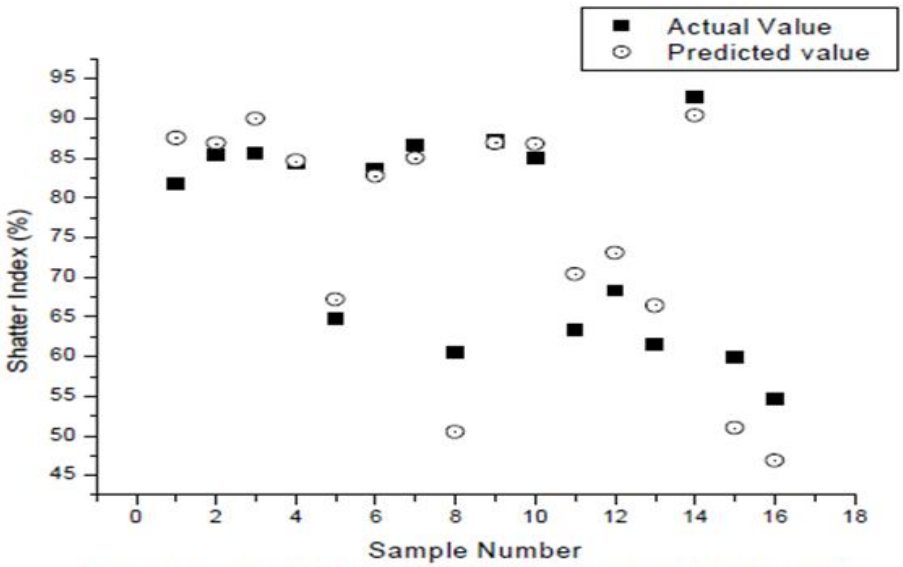

Figure 9 Comparison of the experimental and predicted values for the test data

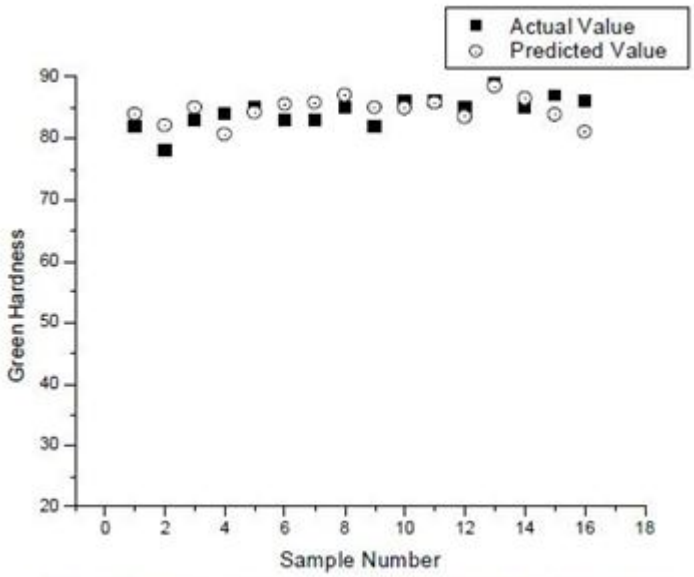

Figure 10 Comparison of the experimental and predicted values for the test data

4.4 Application of the developed Neural Network Model

After successful training and testing the network model for minimum errors, the developed model can be used in foundry for specific application. In the present investigation, the developed model may be used to predict the properties of sixteen different sets of sand mix composition. As per the basic rule, all the sand compositions are selected within the best possible ranges of the input process parameters. The predicted values of the moulding properties are validated with the experimental data collected for the sand mix composition. The results of the validation data has been given in **Table 3.** The percentage error in the above case is hardly exceeding 20%, but in most of the cases it is less than 10%. **Figures 11-14** shows the analysis of the developed neural network response in predicting the properties. It uses a linear regression between the neural network output and the corresponding experimental values. The coefficients of correlation (R^2) values for all cases are above 0.8. This means that a good performance of developed neural network model has been achieved and the developed model can be used predicting the properties of moulding sand mix.

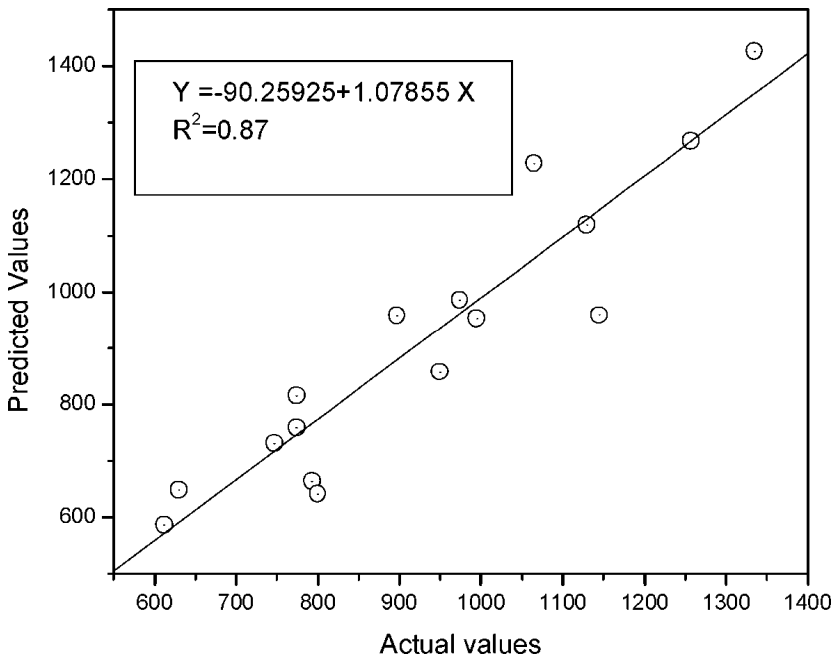

Figure 11 Performance of the Neural Network for simulation of Green Compressive Strength

Table 3 Validation Results

x_1	x_2	x_3	x_4	Green Compressive Strength (g/cm^2)			Permeability			Shatter Index			Green Hardness		
				Actual	Predicted	% Error	Actual	Predicted	% Error	Actual	Predicted	% Error	Actual	Predicted	% Error
4	0	5	6	612	586.66	4.14	243	223.51	8.02	84.11	83.51	0.704	80	79.24	0.944
4	2	4	4	774	758.23	2.037	235	238.38	-1.44	81.15	81.44	-0.358	82	83.1	-1.353
4	2	6	6	630	648.58	-2.95	229	228.23	0.33	87.22	87.41	-0.221	80	82.73	-3.41
4	4	6	8	747	730.98	2.14	226	218	3.53	83.7	86.56	-3.42	81	83.54	-3.134
4	6	5	6	774	815.03	-5.3	181.5	192.57	-6.1	81.11	81.44	-0.407	85	84.38	0.72
6	0	4	4	897	958.77	-6.88	264	244.91	7.22	74.76	81.53	-9.087	86	85.8	0.223
6	0	6	8	793	664.11	16.25	262	309.43	-18.1	86.3	86.18	0.14	86	85.15	0.988
6	2	4	6	1065	1227.9	-15.3	235	232.64	1	81.45	78.41	3.72	87	88.77	-2.042
6	4	3	8	1130	1119	0.95	156	179.97	-15.37	58.15	70.23	-20.78	86	89.88	-4.516
6	6	3	6	950	857.69	9.71	110	104.51	4.99	55.82	36.1	35.3	86	83.29	3.145
6	6	6	4	974	986.4	-1.27	170	217.42	-22.01	81.53	80.97	0.68	84	83.46	0.637
8	0	5	6	995	953.94	4.12	275	257.11	6.5	82.86	82.58	0.33	87	86.2	0.914
8	2	4	8	1257	1267.3	-0.82	247	224.03	9.29	70	70.42	-0.607	89	83.6	6.06
8	4	3	6	800	641.13	19.85	85	100.68	-18.44	31.7	26.27	17.11	85	80.61	5.16
8	4	6	4	1145	959.78	16.17	222.5	198.32	10.86	87.17	86.58	0.67	87	86.32	0.78
8	6	4	8	1335	1427.1	-6.89	178	178.33	-0.185	74.21	78.96	-6.41	88	84.89	3.52

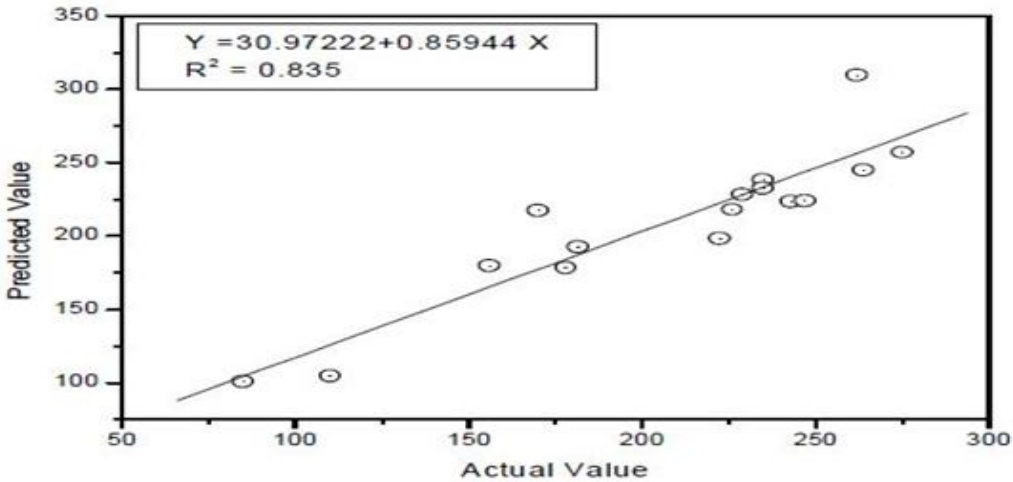

Figure 12 Performance of the Neural Network for simulation of Permeability

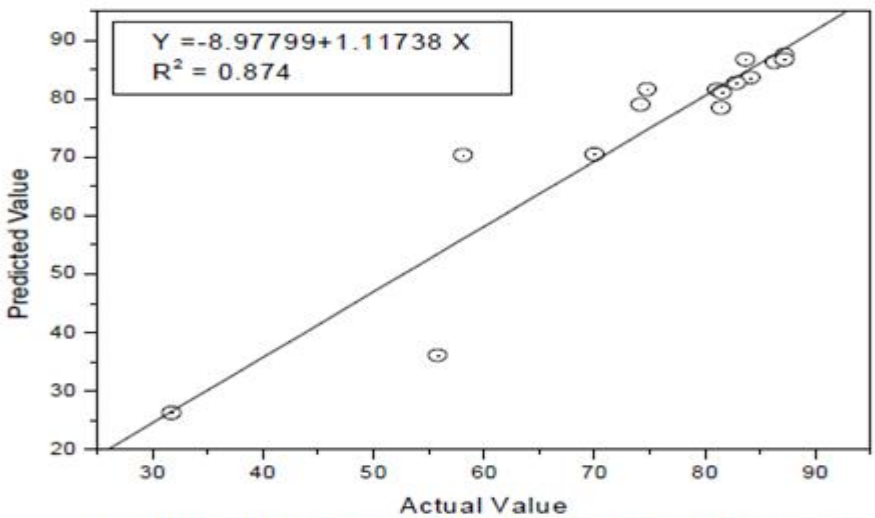

Figure 13 Performance of the Neural Network for simulation of Shatter Index

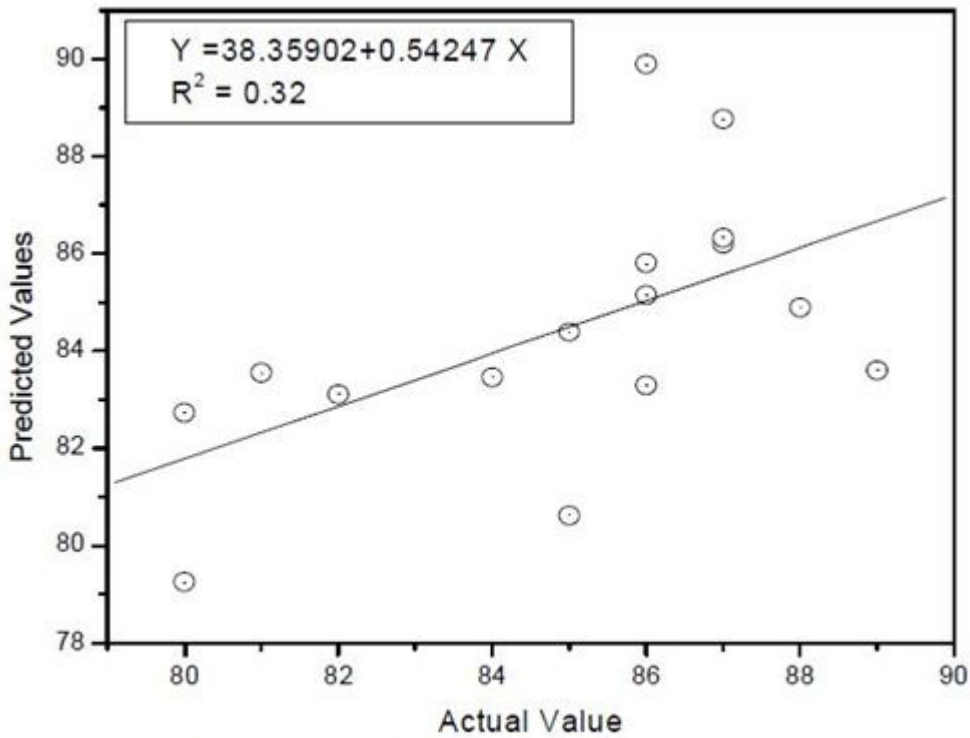

Figure 14 Performance of the Neural Network for simulation of Green Hardness

5. CONCLUSIONS

In the present work a four layered Artificial Neural Network model with four neurons in the input layer, four neurons in the output layer, 25 neurons in the first hidden layer and 27 neurons in the second hidden layer has been developed. The proposed Neural Network model has been trained, tested and validated to predict the properties of moulding sand mix composition. The results obtained from the developed Neural Network model are comparable with the experimental results of green sand moulding process. It may be concluded from the investigation that ANN can be successfully applied in the green sand moulding process in foundry to predict the properties of moulding sand mix. This may reduce or eliminate the time consuming task of repetitive experimentation for finding the optimum sand mix for green sand moulding process.

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APPENDIX A

Back-propagation algorithm

Steps involved in the learning process of back propagation technique are

i) Weights Initialization: Initially weights connecting input and hidden units and weights connecting the hidden and the output units are assigned to random values.

ii) Calculation of Activation: Activation values for units in the input layer to units in the hidden layer are calculated by

$O_k = 1/(1+e^{-\sum_i W_{ij}.\ x_i})$.

Activation from units in the hidden layer to units in the output layer are propagated using

$O_k = 1/(1+e^{-\sum_i W_{jk}\ .\ h_i})$

iii) Error gradient

Errors in the units of output layer δ_k are computed using

$\delta_k = O_k\ (1-O_k)\ (y_k-O_k)$

Errors in the units of hidden layer δ_j are determined by

$\delta_j = h_j\ (1-h_j)\ \sum_i \delta_i W_{ij}$

iv) Weight Adjustment

Start at the output units and work backwards to the hidden layers recursively, Adjust the weight by

$W_{ji}\ (t+1) = W_{ji}\ (t) + \Delta W_{ji}$

$W_{ji}(t)$ is the weight from unit i to unit j at time t (t th iteration) and ΔW_{ji} is the weight adjustment

Weight adjustments between hidden and output layer is given by

$\Delta W_{kj} = \eta.\ \delta_k.h_j$

Where η is trail independent learning rate, $0 < \eta < 1$

Convergence is sometimes made faster by adding momentum factor (α)

$W_{ji}\ (t+1) = \Delta W_{ji}(t) + \eta\delta_j.\ O_i + \alpha[W_{ji}(t)-W_{ji}(t-1)]$

Where $0 < \alpha < 1$.

And the weight adjustment between input and hidden layer is given by $\Delta W_{ji} = \eta.\ \delta_j.\ x_i$

In the back-propagation algorithm, the activation function chosen is the sigmoid function, which compresses the output value in to the range between 0 and 1. The sigmoid function is advantageous in that it can accommodate large signals without saturation which allowing the passage of small signals without excessive attenuation. Also it is a smooth function so that gradients can be calculated which are required for a gradient descent search.

Advances in Machine Learning

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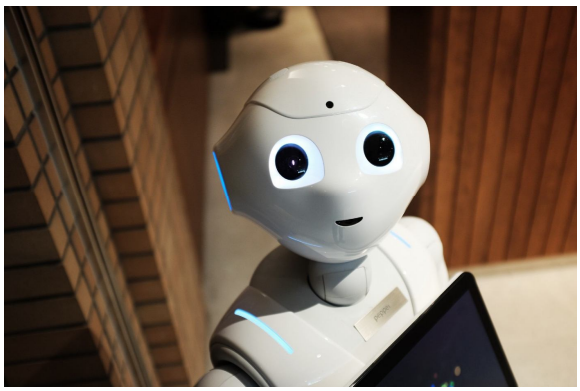
Abstract
The field of Machine learning is experiencing exponential growth today, especially in the subject of computer vision. Today, the error rate in humans is only 3% in computer vision. This means computers are already better at recognizing and analyzing images than humans. What an amazing feat! Decades ago, computers were hunks of machinery the size of a room; today, they can perceive the world around us in ways that we never thought possible. Now this achievement — made possible with advancements in machine learning — isn't just a celebration for computer geeks and AI experts, it has real-world applications that save lives and make the world a better place.

Keywords: NLP, Digital, Logistics, Customised, Atomic

Introduction

One essential application for computer vision given by Jeff Dean is in diabetic retinopathy — which is a diabetes complication that affects the eye. Now to diagnose it, an extensive eye exam is required. In third-world countries and rural villages where there is a paucity of doctors, a machine learning model that uses computer vision to make a diagnosis will be extremely beneficial. As with all medical imaging fields, this computer vision can also be a second opinion for the domain experts, ensuring the credibility of their diagnosis. Generally, the purpose of computer vision in the medical field is to replicate the expertise of specialists and deploy it in places where people need it the most.



NLP and Transformers

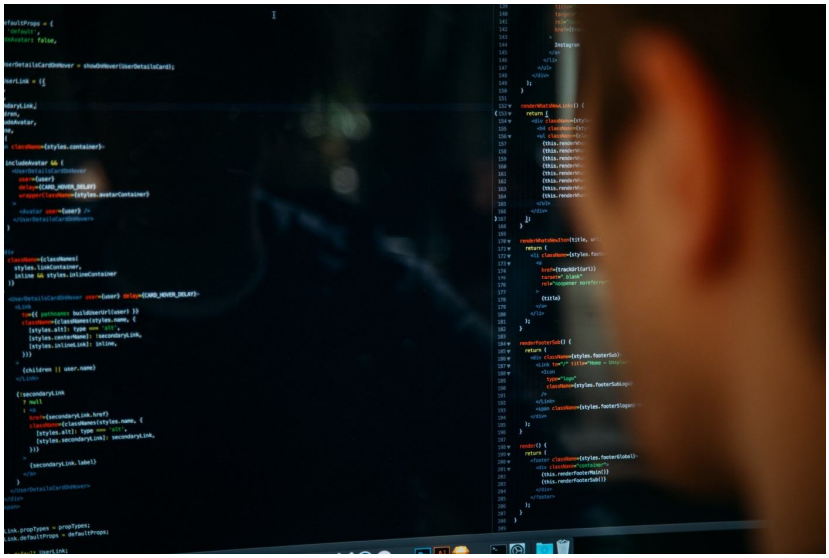
Language models are algorithms that help machines understand the text and perform all kinds of operations such as translating text. According to Jeff Dean, a lot of progress has been made in language models.

Today, computers can understand paragraphs of text at a much deeper level than they could before. Even though they aren't at the level of reading an entire book and understanding it the way we humans do, the ability to understand a few paragraphs of text is fundamental to things such as improving the Google search system.

The BERT model, the latest Natural Language Processing (NLP) model that Google announced has been put to use in their search ranking algorithms, This helped enhance the search results for myriads of different kinds of queries that were previously very difficult.

The problem with ML today

In the keynote, the Google Senior Fellow mentioned atomic models that Machine Learning developers use today to perform all kinds of unit tasks. He believes these models are inefficient and computationally expensive, and more effort is required to achieve good results in those tasks.



To elaborate, in the ML world today, experts find a problem that they want to solve and they focus on finding the right dataset to train the model and perform that particular task. Dean argues that by doing so, they basically start from zero — they initialize the parameter of the model with random floating points and then try to learn about everything that tasks from the dataset.

To elaborate on this matter, he gives an excellent comparison that goes like this:

"It's akin to when you want to learn something new, you forget all your education and you go back to being an infant, and now you try to learn everything about this task"

The Holy Grail of ML

Jeff believes the future of ML lies in a great big model, a multi-functioning model that can do plenty of things. This uber model will eliminate the need to create models that do specific tasks and instead train this one large model with different pieces of expertise. Imagine a computer vision model that can diagnose diabetic retinopathy, classify different species of dogs, recognize your face and be used in self-driving cars and drones at the same time.

He also proclaimed that the model operates by sparsely activating different pieces of the model that is required.

Challenges

Dean believes this uber model is a promising direction for ML and the engineering challenges are very interesting. To build a model like this would engender lots of interesting computer systems and machine learning problems such as scalability and the structure of the model.

Epitome

Computer vision and NLP will continue to play a significant role in our lives. But there are adverse implications to this advancement as well, such as China using facial recognition to implement a rating system on the people (straight out of an episode from the TV show black mirror) and the proliferation of fake news. We must progress in Machine Learning while taking into account of algorithmic biases and ethics that remind us of our place, a creation of God and not creators.

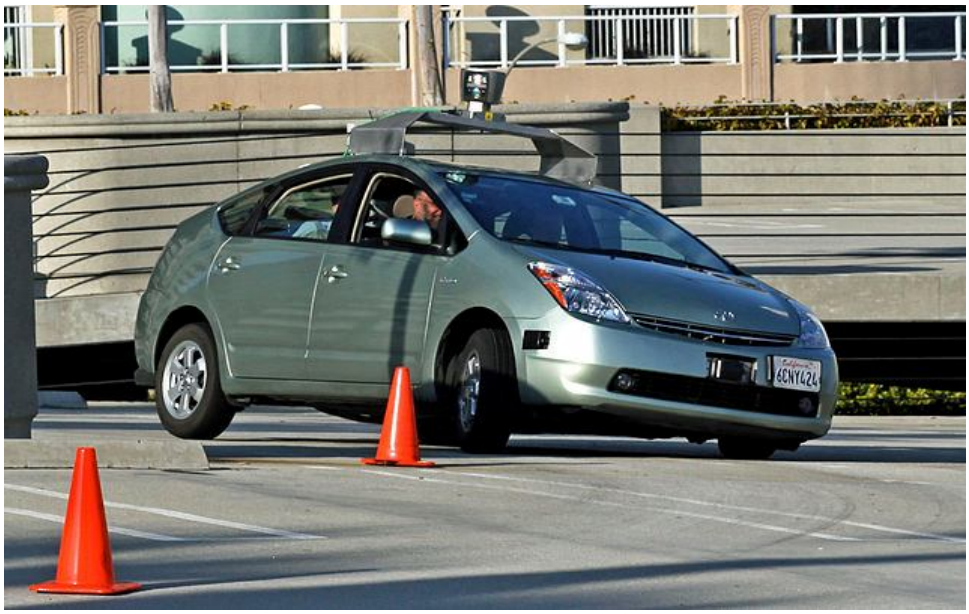
15 ways artificial intelligence and machine learning will impact your everyday life.

1. Intelligent Gaming

Some of you may remember 1997 when IBM's Deep Blue defeated Gary Kasparov in chess. But if you weren't old enough then, you might remember when another computer program, Google DeepMind's AlphaGo, defeated Lee Sedol, the Go world champion, in 2016.

2. Self-Driving Cars and Automated Transportation

The leap into self-driving cars is more complicated. There are more cars on the road, obstacles to avoid, and limitations to account for in terms of traffic patterns and rules. Even so, self-driving cars are already a reality. These AI-powered cars have even surpassed human-driven cars in safety, according to a study with 55 Google vehicles that have driven over 1.3 million miles altogether.The navigation question has already been solved long ago. Google Maps already sources location data from your smartphone. By comparing the location of a device from one point in time to another, it can determine how fast the device is traveling. Put simply, it can determine how slow traffic is in real time. It can combine that data with incidents reported by users to build a picture of the traffic at any given moment.



3. Cyborg Technology

Obviously, our bodies and our brains have built in limitations and weaknesses. According to Oxford C.S. professor Shimon Whiteson, technology will improve to to such an extent that we will be able to augment some of our weaknesses and limitations with computers, thereby enhancing many of our natural abilities.

4. Taking Over Dangerous Jobs

One of the most dangerous jobs is bomb disposal. Today, robots (or more more technically, drones) are taking over these risky jobs, among others. Right now, most of these drones require a human to control them. But as machine learning technology improves in the future, these tasks would be done completely by robots with AI. This technology alone has already saved thousands of lives.

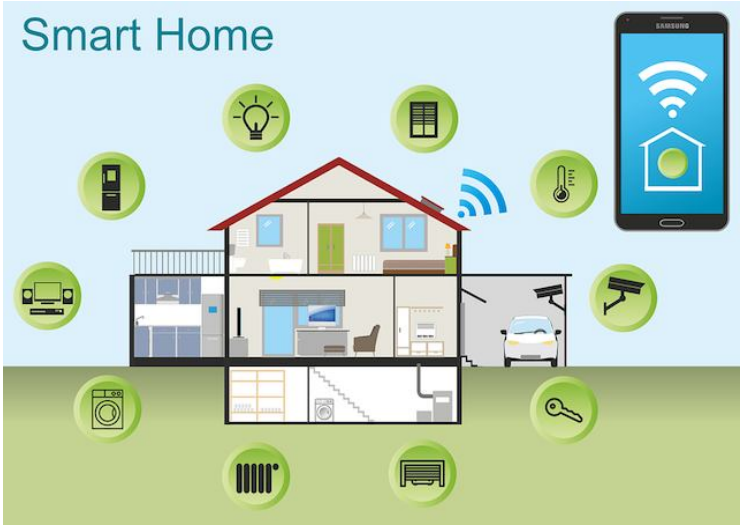
5. Environmental Protection

Machines can store and access more data than any one person could—including mind-boggling statistics. Using big data, AI could one day identify trends and use that information to arrive at h solutions to previously untenable problems.

For example, IBM's Green Horizon Project analyzes environmental data from thousands of sensors and sources to product accurate, evolving weather and pollution forecasts. It allows city planners to run "what-if" scenarios and model ways to mitigate environmental impact.

6. Digital Empathy and Robots as Friends

Most robots are still emotionless. But a company in Japan has made the first big steps toward a robot companion—one that can understand and feel emotions. Introduced in 2014, Pepper the companion robot went on sale in 2015, with all 1,000 initial units selling out within a minute. The robot was programmed to read human emotions, develop its own, and help its human friends stay happy.



7. Improved Elder Care

AI is at a stage where replacing this need isn't too far off, says Matthew Taylor, computer scientist at Washington State University. Elderly relatives who don't want to leave their homes could be assisted by in-home robots. That solution offers family members more flexibility in managing a loved one's care. These robots could help seniors with everyday tasks and allow them to stay independent and living in their homes for as long as possible, improving their overall well-being.

8. Enhanced Health Care

Hospitals may soon put your wellbeing in the hands of an AI, and that's good news. Hospitals that utilize machine learning to aid in treating patients see fewer accidents and fewer cases of hospital-related illnesses, like sepsis. AI is also tackling some of medicine's most intractable problems, such as allowing researchers to better understand genetic diseases through the use of predictive models.

9. Innovations in Banking

AI can also help banks and credit issuers identify fraudulent behavior while it is happening. These machine learning based anomaly detection models monitor transaction requests. They can spot patterns in your transactions and alert users to suspicious activity.

10. Personalized Digital Media

Machine learning has massive potential in the entertainment industry, and the technology has already found a home in streaming services such as Netflix, Amazon Prime, Spotify, and Google Play. Some algorithms are already being used to eliminate buffering and low-quality playback, getting you the best quality from your internet service provider.

11. Home Security and Smart Homes

For the best tech in home security, many homeowners look toward AI-integrated cameras and alarm systems. These cutting-edge systems use facial recognition software and machine learning to build a catalog of your home's frequent visitors, allowing these systems to detect uninvited guests in an instant.

12. Streamlined Logistics and Distribution
Imagine getting a package in just a few hours and at a very low shipping cost. That's the promise of AI in logistics and distribution, with its promise to tame the massive amounts of data and decisions in the trillion-dollar shipping and logistics industry. Amazon has already started experimenting with autonomous drones that blow their already-quite-fast two-day shipping out of the water.

13. Digital Personal Assistants
Digital assistants are getting smarter by the year. Companies such as Amazon and Google are pouring billions of dollars into making digital assistants even better at speech recognition and learning about our daily routines, opening the door to more and more complex tasks.

14. Brick and Mortar and AI
Georges Nahon, CEO of Orange Silicon Valley, foresees a time when people will no longer need to wait in line at a store. Observing how tech and retail are merging, like Amazon and Whole Foods, he says: "Thanks to AI, the face will be the new credit card, the new driver's license and the new barcode. Facial recognition is already completely transforming security with biometric capabilities being adopted…"

15. Customized News and Market Reports
Instead of a generic recap of market performance, your customized report compares how your portfolio performed against the broader market, citing key reasons why. For example: "It's 3:14 pm. The market is currently up 2%, but your portfolio is down 3%. This is attributed in part to the purchase of XYZ stock last week, which has fallen sharply since …"

10 Companies Using Machine Learning in Cool Ways
1. Yelp – Image Curation at Scale
Yelp's machine learning algorithms help the company's human staff to compile, categorize, and label images more efficiently

2. Pinterest – Improved Content Discovery
Today, machine learning touches virtually every aspect of Pinterest's business operations, from spam moderation and content discovery to advertising monetization and reducing churn of email newsletter subscribers.

3. Facebook – Chatbot Army
AI applications are being used at Facebook to filter out spam and poor-quality content, and the company is also researching computer vision algorithms that can "read" images to visually impaired people.

4. Twitter – Curated Timelines
Twitter's AI evaluates each tweet in real time and "scores" them according to various metrics.Twitter's machine learning tech makes those decisions based on your individual preferences.

5. Google – Neural Networks and 'Machines That Dream'
Google has been very busy in recent years, having diversified into such fields as anti-aging technology, medical devices, and – perhaps most exciting for tech nerds – neural networks.

The most visible developments in Google's neural network research has been the DeepMind network, the "machine that dreams."

6. Edgecase – Improving Ecommerce Conversion Rates
Edgecase hopes its machine learning technology can help ecommerce retailers improve the experience for users. In addition to streamlining the ecommerce experience in order to improve conversion rates, Edgecase plans to leverage its tech to provide a better experience for shoppers who may only have a vague idea of what they're looking for, by analyzing certain behaviors and actions that signify commercial intent – an attempt to make casual browsing online more rewarding and closer to the traditional retail experience.

7. Baidu – The Future of Voice Search

Google isn't the only search giant that's branching out into machine learning. Chinese search engine Baidu is also investing heavily in the applications of AI.One of the most interesting (and disconcerting) developments at Baidu's R&D lab is what the company calls Deep Voice, a deep neural network that can generate entirely synthetic human voices that are very difficult to distinguish from genuine human speech.

8. HubSpot – Smarter Sales

HubSpot plans to use Kemvi's technology in a range of applications – most notably, integrating Kemvi's DeepGraph machine learning and natural language processing tech in its internal content management system.This, according to HubSpot's Chief Strategy Officer Bradford Coffey, will allow HubSpot to better identify "trigger events."

9. IBM – Better Healthcare

The inclusion of IBM might seem a little strange, given that IBM is one of the largest and oldest of the legacy technology companies, but IBM has managed to transition from older business models to newer revenue streams remarkably well. None of IBM's products demonstrate this better than its renowned AI, Watson.

10. Salesforce – Intelligent CRMs

Salesforce is a titan of the tech world, with strong market share in the customer relationship management (CRM) space and the resources to match. Lead prediction and scoring are among the greatest challenges for even the savviest digital marketer, which is why Salesforce is betting big on its proprietary Einstein machine learning technology.

Conclusions

The world is definitely changing. Technology is changing, humans are changing, and the earth is changing. With many of these changes, the future is now. The movie Wall-E is a good example of what our world is leading to. It mainly critiques us as humans and our relationship and dependence on technology. Kids today are more "tech-savvy" than most adults. We fail to see is that as technology is improving; we are losing value in ourselves. What technology has done and is doing to our world is allowing humans to sit back as tasks are done automatically. With the energy it takes to power such devices, the earth has to suffer for the luxury of man. The family movie is more than just a love story between two robots; it is about the future of our world and the dystopia of technology.

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Progress in Global Oil and Gas Exploration

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Abstract
With the increasing demand of fossil-fuel, producing gas from unconventional sources (tight gas, coal bed methane (CBM), and gas hydrate) is a great challenge today. With reduce in production from conventional sources; the unconventional source of hydrocarbon is at the forefront of our energy future. A tight gas exists in underground reservoirs with very low permeability and has a huge future potential for production. A tight-gas produces less oil per-well basis compared to gas production from conventional reservoirs. More well are required to get most of the oil or gas out of the ground in unconventional reservoirs. Exploration efforts should also be at unconventional location to look for more reserves like deep ocean basins, structural low, extreme terrains.

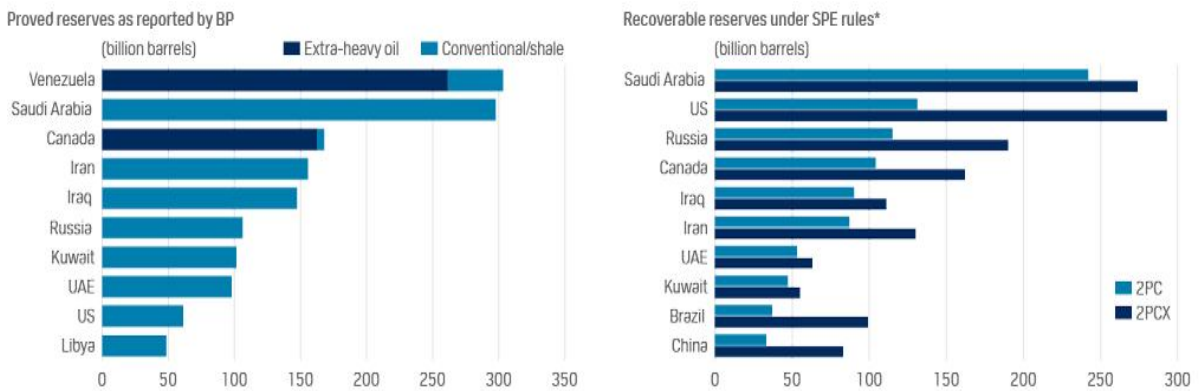
Keywords: Extreme zone, Oil and gas exploration, Unconventional hydrocarbon, Exploration, source Rock

Introduction

Global attention is increasingly focused on the need to migrate to clean energy transitions in order to minimize the risks of climate change. With its largest emissions footprint, the energy sector – including the oil and gas industry – is at the heart of the matter. The world's remaining proved reserves of 1.73 trillion barrels can cover 50 years of current production rates. India is fast-growing population and thriving economy fuel rapid expansion in domestic energy demand, which skyrocketed over the past decade. In 2015, India surpassed Japan to become the world's third largest consumer of crude oil. The country produced 869,000 bopd on average in 2018. India's oil reserves stood at 4.5 billion barrels in 2018. On the gas side, reserves stood at 1.3 tcm (45.9 tcf) in 2018. 27.5 bcm (971 bcf) of natural gas was produced in 2018, and new exploration works have taken place in the Krishna-Godavari and Cambay basins over recent years to increase production.

Global Production

In the present era of the increasing demand for energy has pushed the oil and gas industry to new limits to fulfil the need, reserves and oil-gas fields discovered still keep growing. Global remaining recoverable oil and gas reserves by 2011 amounted to 2 343×108 t and 208.4×1012 m3 , increasing by 35.5% and 23.7% respectively than those in 2001.



*Society of Petroleum Engineers
Note: 2PC = Proved + probable + contingent resources in existing fields. 2PCX = 2PC resources + propective resources in undiscovered fields
Source: BP's Statistical Rewiew of World Energy, Rystad Energy

Over 90% of the newly discovered oil fields are of deep water zones at passive continental margins. In 2010, the global total proved recoverable reserves discovered in 7 new oil and gas fields reached 31.4×108 t oil equivalent.

Global hydrocarbon exploration :

Reservoir as source

Conventional knowledge of hydrocarbon exploration consists of a reservoir rock with some cap rock in trap system that act as primary source of hydrocarbon that has migrated from source rock through primary migration or from other reservoir rock through secondary migration. But now source is rock can also considered as potential reservoir of hydrocarbon. The exploration and production of tight oil and shale gas in the US has proved the potential of source rock as reservoirs. The tight oil yield went beyond 7 000×104 t in 2012 in US, with the production potential of h 1.5×108 t by 2020.

In Indian basins Krishna-Godavary basin, Cauvery basin, Cambay basin, fields of Frontier basins like Vindhyans hold the good reserves in tight reservoirs. Many wells have been drilled in these basins and a good amount of in place reserves have been established.

Table 1 Seven large oil-gas field discovered in 2010

Rank	Name	Region	Type	Country	Proved recoverable reserves (oil equivalent)/108 t
1	Franco	Santos	Oil and gas	Brazil	8.88
2	Libra	Santos	Oil	Brazil	7.99
3	Forooz B3	Rub' Al Khali	Gas	Iran	4.33
4	Leviathan	Levant	Gas	Israel	3.66
5	016/02-06 (Avaldsnes)	Utsira uplift	Oil	Norway	2.43
6	Khayyam1	Zagros	Gas, condensate and oil	Iran	2.08
7	BardaRash1	Zagros fold belt	Oil	Iraq	2.03

Unconventional source

A conventional reservoir have high- to mediumpermeability in which one can drill a vertical well, perforate the pay interval, and hydrocarbon is recovered in economic volumes of oil and gas.But in case of an unconventional reservoir,alow-permeability gas reservoirs feature no trap structures,that does not produce economic volumes of oil and gas without assistance from massive stimulation treatments or special recovery processes and technologies, such as steam injection. Typical unconventional reservoirs are tight-gas sands, coal-bed methane, heavy oil, and gas shales.

Unconventional accumulations

Traditional hydrocarbon exploration focuses on searching structural reservoirs which has extended to lithologic-stratigraphic reservoirs (i.e. subtle reservoirs with low permeabilities) that are separated by lithologic traps or stagnant zones. But unconventional accumulations refer to hydrocarbon accumulations in pervasive unconventional reservoir. Continuous unconventional accumulations features wide spread in basin centres or slopes with local enrichments, no evident trap or caprocks, low or extremely low in porosity and permeability, no migration or only primary short-distance migration, in-source accumulations or near-source accumulations, complicated gas-oil-water contact relationships, and low reserve abundance.

Unconventional hydrocarbon resources

Unconventional hydrocarbon resources are those hydrocarbon resources which have not been fully understood and there are no proved technologies and experience to recover them on a large scale. Some example including tight oil, tight gas (e.gtight sandstone oil and gas, tight volcanic oil and gas, tight carbonate oil and gas), CBM (coalbed methane), shale oil, shale gas, super heavy oil (viscous oil), oil sand, gas hydrate, biogenic gas and dissolved gas and deep basin gas. Global unconventional hydrocarbon resources are very rich. Some researchers predicted that global unconventional resources are 5 to 8 times of conventional resources based on accumulation theories and some believe that the ratio of conventional to unconventional is 2:8 based on published statistics of global conventional and unconventional hydrocarbon resources.

Deep and ultra-deep exploration

In early days shallow oil and even oil coming to the surface (oil seepage) were explored and produced at first. With the progress of exploration and production, the exploration zones become deeper and deeper. At present pay zones mainly concentrate in middle and deep intervals. With the progress in theoretical researches and technologies, more attention has been paid to hydrocarbon resourcesin deep and ultra-deep zones in exploration.

Hydrocarbon types vs. depth

Type	Depth/m		
	Onshore oil and gas	Offshore oil and gas	CBM
Shallow	<2000	<300	<400
Middle	2000-4500	300-500	400-800
Deep	4500-6000	500-1500	800-1200
Ultra-deep	6000-9000	>1500	1200-2000
Extremely ultra-deep	>9 000		>2 000

Abyssal and ultra-abyssal sea source

In 2006, the global proved oil and gas reserves were 1 757×108 t and 173×1012 m3 separately. The Global offshore oil resources were 1 350×108 t and the proved reserves reached 380×108 t. The global offshore gas resources are 140×1012 m3 and the proved 40×1012 m3. In the recent decade, 60% of large oil-gas fields with reserves over 1×108 t are offshore fields, half of which are in abyssal sea areas with water depth above 500 m. Hydrocarbon exploration has extended into abyssal sea and ultra-abyssal sea areas, including the East Sea area in Brazil, Gulf of Mexico, Angola-Niger sea area in West Africa, northwestern sea area in Australia and South China Sea area.

Terrains with extreme conditions

Hydrocarbon exploration in the past mainly concentrated in conventional terrains, like plains, shallow seas, mountainous regions, desert margins, plateaus etc. with relativelygood surface conditions. With the increasing demand in recent years, hydrocarbon exploration has extended into terrains with extreme conditions such as swamps, polar region, tundra, pristine forests, deep desert, etc.

According to evaluation report issued by USGS in 2008, total oil and gas resources in the arctic area amount to 562.21×108 t oil equivalent, that is about 22% of total undeveloped oil and gas resources in the world. The oil reserves in the Sahara Desert reach 44×108 t and the global hydrate resources in tundra estimated by Sloan and Collett are 10×1012−10 000×1012 m3 with a large potential.

Indian Scenario

Tight reservoirs occur in almost all the producing basins of India and in frontier basins viz. Bengal &Vindhyan basin. Exploration of tight reservoir has already started in KG-PG, Cauvery and Cambay basins. Tight reservoirs in Indian sedimentary basins hold a huge potential of hydrocarbon reserves. Rapid economic development has strained oil and gas supply. We should pay attention to those new trends and new ideas in hydrocarbon exploration and properly adjust hydrocarbon exploration strategies to discover more oil-gas fields and guarantee energy security. The following efforts are thereby proposed:

1. More effort is needed into theoretical and technical researcheson hydrocarbon exploration for rapid development of unconventional oil and gas including shale gas and shale oil as tight gas reservoirs have a huge future potential for production.

2. More attention towards exploration engineering and technologies. As hydrocarbon discoveries in deep and low-grade reservoirs and reservoirs in terrains with extreme conditions depend moreon exploration technologies, including geophysical technologies, drilling and completion technologies, well test technologies and fracturing technologies.

3. Explore effective ways of comprehensive hydrocarbon exploration.

4. Strengthen secondary exploration in mature oil-gas fields.

Conclusions

There is no fear of running out of oil or natural gas very soon. Enormous volume of unconventional oil and gas is there to fill the gap once conventional oil begins to decline in the next 5 to 20 years. However, better technology will be required to bring much of those resources to market.

Global hydrocarbon resources are very rich and exploration activities are extending into more challenging areas with greater depth and wider scope, which include source rocks, continuous hydrocarbon accumulations in pervasive reservoirs, unconventional resources, low-lying areas and slopes, deep to ultra-deep zones, abyssal sea terrains with extreme conditions. The major change in exploration domains and strategies will give birth to more discoveries of hydrocarbon resources both in new prospects and mature fields.

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ISBN: 978-81-946375-0-9

Recent Study of Carbon Nanotubes and its Application

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Abstract
Nanotechnology, the future starts from here a component of nanotech is carbon nanotubes which are the units of future technologies. This revolutionary invention was done in 1991. After the discovery of nanotech, the view of many industries and companies has been widened enough. These carbon nanotubes are used in most of the daily life appliance eg.- Capacitors used in fans, polymers, nanomedicine, surgery, metallic surfaces, ceramics, membranes etc. This unique paper talks about Synthesis of carbon nanotubes, Properties of carbon nanotubes and Application of Carbon nanotubes.

Keywords: Nanotechnology, Nanomedicine, Carbon Nanotubes

Introduction

Carbon nanotubes are remarkable objects that look set to revolutionize the technological landscape in the mean future. Tomorrow's society will be formed by nanotube applications just as silicon based technologies dominate society today. Space elevators tethered by the strongest of cables, hydrogen – powered vehicles; artificial muscles, these are just a few of the technological marvels that maybe made possible by the emerging science of carbon nanotubes. Of course this is a hopeful prediction which at the stage of evaluating possibilities and potential. Consider the recent example of fullerene molecules closely related to nanotubes .The anticipation surrounding these molecules, first reported in 1985, resulted in the bestowment of a Nobel Prize for their discovery in 1996. However a decade later, little application of fullerenes have reached the market [2].

Proposing that similarity enthusiastic predictions about nano tubes should be approached with caution. In this paper firstly we will elucidate the growth mechanics, structures synthesis and properties of carbon nano-tubes. Then we will discuss nanotube related nanoobjects, including those formed by reactions and associations of all carbon nanotubes with foreign atoms, molecules and compounds which may provide the path to hybrid materials with even better properties than pristine nanotubes [3]. Finally we will explain the most important current and potential application of carbon nano-tubes, which suggest that the promising future for the carbon nanotubes industry [1, 5].

There are three techniques of synthesizing carbon nanotubes

1. Laser evaporation
2. Carbon arc
3. Chemical vapour deposition method

1. **Laser evaporation method**:- Fig. -1 shows the experimental arrangement for synthesizing carbon nanotubes by laser evaporation.

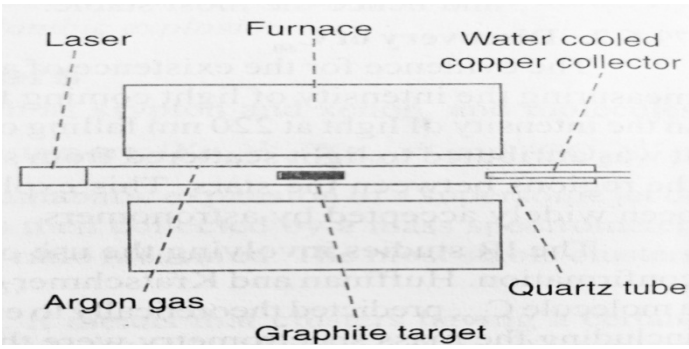

Fig - 1

A quartz tube contains argon gas and a graphite target. The tube is inside a horizontal furnace which maintains at 1200^0C. A water -cooled copper collector is mounted within the tube at one of its ends , lying outside the furnace . The graphite target contains small amounts of cobalt and nickel that acts as catalytic nucleation sites for the formation of the nanotubes. An intense pulsed laser beam is incident on the target, evaporating carbon from the graphite. The argon then sweeps the carbon atoms from the high temperature zone to the colder copper collector on which they condense into nanotube. Tubes 10-20 nm in diameter and 100µm long can be made by this method. Different types of lasers are now routinely used to prepare single-walled carbon nanotubes [4]. The original method developed by researchers at Rice University used a "durable- pulse laser oven" produces.

Several variation of the laser parameters have been tried during the past few years including laser wave length sequencing of different lasers , pulse width, pulse repetition rates, and power density.

2. **Carbon arc method**: - A potential of 20-25 v is applied across carbon electrodes of 5-20 µm diameter and separated by 1mm at 500 torr pressure of flowing helium. Carbon atoms are ejected from the position electrode and form nanotubes on the negative electrode. As the tubes form, the length of the positive electrode decreases, and a carbon deposit forms on the negative electrode. These types of mechanism produce tubes with closed ends.

- Single wall nanotube: - To produce single-walled nanotubes, a small amount of cobalt, nickel, or iron in incorporated as a catalyst in the central region of the positive electrode. This method can produced single -walled nanotubes of diameters 1-5 nm with a length of 1µm.
- Multiwall nano tubes: - if no catalysis are used, multi-walled nanotubes are produced Fig (2) shows a multiwalled nanotubes.

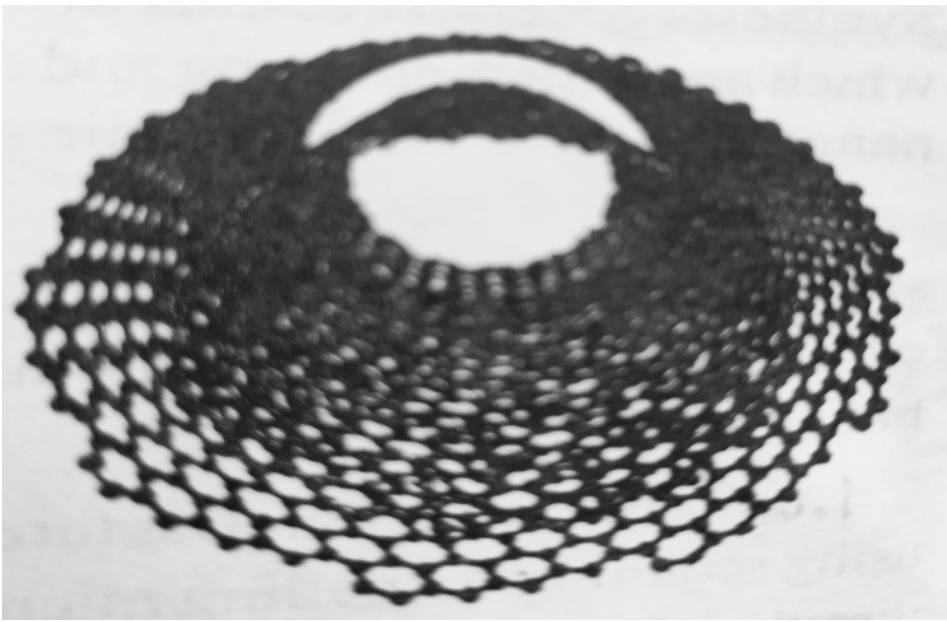

Fig -2

3. **Chemical vapour deposition method**: - this method involves decomposing a hydrocarbon gas such as methane (CH4) at 1200^oc as the gas decomposes, carbon atoms are produced. Carbon atoms then condense on a cooler substrate that contains various catalysts such as iron. This method produced tubes with open ends.

Structure of Carbon Nanotubes: - nanotubes can be formed when a graphite sheet is rolled up about the axis k. m_1 and m_2 are the basis vectors of the two- dimensional unit cell . The Cr vector is called the circumferential vector. Three possible structures of carbon nanotubes constructed by rolling the graphite sheet about the k vector having different orientation in the graphite sheet are shown in (Fig-3).

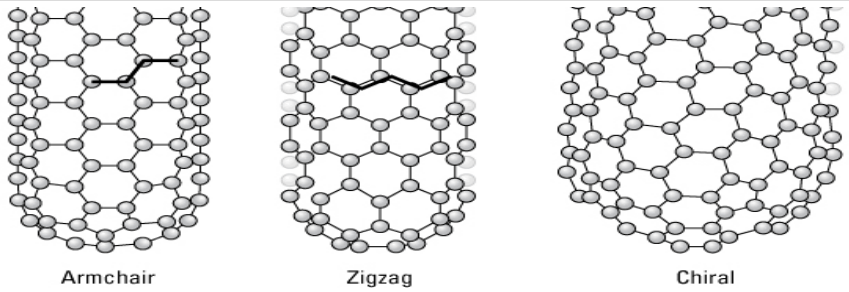

Fig-3

- When the axis vector k is parallel to the c-c bonds of the carbon hexagons the 'armchair' structure is obtained.
- The chiral and zigzags structure are formed by rolling about a k vector having different orientation in the graphite plane, but not parallel to C-C bonds.

Electrical properties of carbon nanotubes

1. The electronic structure of carbon nanotubes is studied using scanning tunneling microscopy (STM) . The data show that the electronic states of the tubes do not, form a single wide electronic energy band, but instead split into one dimensional sub bands. These states can be modeled by a potential well having a depth equal to the length of the nanotubes.
2. Carbon nanotubes are metallic or semiconducting, depending on the diameter and chirality of the tube. Chirality refers to how the tubes are rolled with respect to the direction of the axis vector 'k'. Synthesis generally results in a mixture of tubes two-thirds of which are semiconducting and one-third metallic. The metallic nanotubes have the armchair structure. Fig-4 is a plot of the energy bandgap of semiconducting chiral carbon nanotubes versus the reciprocal of the diameter.As the diameter of the tube increases, the bandgap decreases.

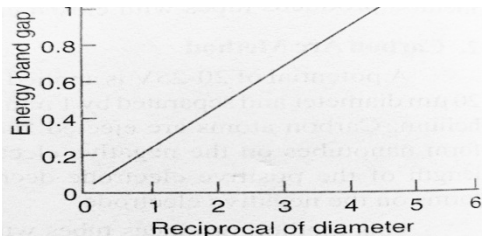

Fig -4

3. In the metallic state the conductivity of the nanotubes is very high. They can carry extremely high current with density $10^9 A/cm^2$ because resistive heating melts the wire. Carbon nanotubes have very few defects to scatter electrons and thus a very low resistance. This is the reason for the high conductivity of the carbon nanotubes. High currents do not heat the carbon nanotubes in the same way that they heat copper wire.
4. The voltage – current characteristic of a single metallic nanotubes placed across two metal electrodes show step-like features. This resembles a field effect transistor(FET) constructed from a carbon nanotubes.
5. Carbon nanotubes are very good conductors of heat , the thermal conductivity being almost twice as large as that of diamond .

Vibrational properties of carbon nanotubes

- A_{1g} mode: A_{1g} mode involves an 'in and out' oscillation of the diameter of the tube.
- E_{2g} mode: E_{2g} mode involves a squashing of the tube where it squeezes down in one direction and expands in the perpendicular direction essentially oscillating between a sphere and an ellipse.

The frequencies of these two modes are Raman-active and depend on the radius of the tube.Fig-5 is a plot of the frequency of the Raman A_{ig} vibrational normal mode versus the radius of the nano tube.It is now a standered practice to exploit this property for measuring the radius of carbon nanotubes.

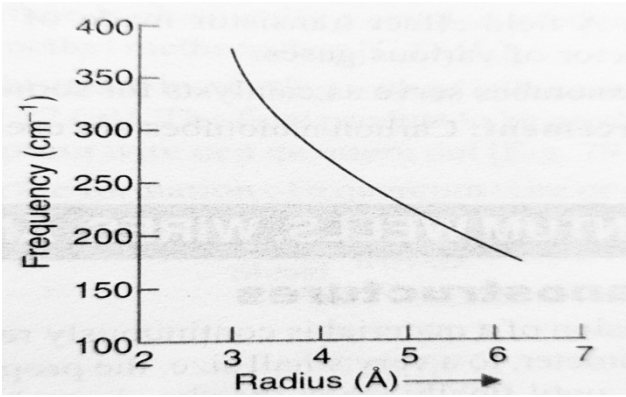

Fig-5

Mechanical properties of carbon nanotubes

1. Carbon nanotubes are very strong.
2. When carbon nanotubes are bent, they are very resilient. They buckle like straws but do not break, and can be straightened back without any damage. Carbon nanotubes have a very low density of defects in the structure of their walls. So they do not fracture when bent severely.
3. The young's modulus of carbon nanotubes ranges from 1.28 to 1.8 TPa. Young's modulus of steel is 0.21 TPa, which means that young's modulus of carbon nanotubes is almost 10 times that of steel.
4. The tensile strength of carbon nanotubes is about 45 billion Pascals. High- strength steel alloys break at about 2 billion Pascals. These carbon nanotubes are about 20 times stronger then steel.
5. Multi-walled nanotubes also have improved mechanical properties, but they are not as good as their single-walled counterparts. For example, multi –walled nanotubes of 200 nm diameter have a tensile strength of 0.007 TPa and a modulus of 0.6 TPa.

Application of Carbon Nanotubes

1. (i) When a small electric field is applied parallel to the axis of nanotubes, electrons are emitted at a very high rate from the ends of the tubes. This effect, called field emission, has contributed to the development of flat panel displays.

(ii) The high electrical conductivity of carbon nanotubes means that they will be poor transmitters of electromagnetic energy. A plastic composite of carbon nanotubes could provide lightweight shielding material for electromagnetic radiation.

2. Computers: carbon nanotubes with diameters of 2nm have extremely low resistance. They can carry large currents without heating. So they could be used as interconnects. Their very high thermal conductivity means that they can also serve as heat sinks, allowing heat to be rapidly transferred away from the chip.
3. Chemical sensors: A field-effect transistor made of the chiral semiconducting carbons nanotubes is a sensitive detector of various gases.
4. Catalyst: Carbon nanotubes serve as catalyst for some chemical reactions.
5. Mechanical Reinforcement: Carbon nanotubes are used to increase the strength of plastic composites.
6. Carbon nanotubes are used in drug delivery for treatment of cancers. And they are reported of targeting of amphotericin b2 cells.

7. Carbon nanotubes used for generation tissues. In recent years carbon nanotubes are based for tissue generation because these are biocompatible, resistant to biodegradation and enhancing the organ generation.
8. Carbon nanotubes are used as energy storage devices
9. Used in artificial implants.
10. Carbon nanotubes having high tensile strength so they are filled with calcium and arranged like a bone , so can act as a bone substitute
11. Carbon nanotubes are antioxidants in nature so they are used preserve drugs that are easily oxidized
12. Used for gene therapy by DNA delivery. Gene therapy is a therapy to cure a damaged gene which can cause harmful disease by introducing DNA into cells.

Conclusions

There is no doubt that carbon nanotubes are extraordinary materials with respect to their amazing properties as well as their morphological textural, nano-textural and structural versatility. However this means that using them in the most optimized way appears not to be an easy talk. As far as MWCNTs are concerned, the abundance of varieties requires a thorough investigation of the materials using advanced characterization technique Such as HRTEM. On the other hand the most unique properties are encounter for SWCNTs whose variability is only structural. They however come with other challenging issues related to various needs such as sorting the metallic from the semi-conductive ones, tailoring their surface interaction with a surrounding medium, preventing them from bundling, comed so on. With all those issues, meta- nanotubes are likely to help. This is what is going to be described in the chapter.

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Digital India: Impact and Challenges on Rural India

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ABSTRACT
This paper deals about the impact and challenges on rural India under the mission of digital India. This 21st century we are living in the digital world. Digital India is a most initiative for the new technological world. So that the prime minister Mr. Narendra Modi creates this mission throughout the India. On that basis we will discuss about the social, economical and environmental impacts and challenges in rural peoples and their difficulties. Let us start about with detailed introduction and also about digital India then the main nine pillars of digital India mission. The most important thing is in rural area is insufficient facilities and illiteracy. So that the detailed vision on the topic is in this paper.

Keywords: Digital India, Nine Pillars, Illiteracy, Difficulties, Challenges and Impacts.

INTRODUCTION
This 21st century we are living in the digital world. Digital India is a thought of initiative from Mr. Narendra Modi 's government. It is an initiative to integrate the government departmentand the people of India. It ensures the Government services are made available to citizens electronically by reducing the paper work. It must be coordinated and implemented by the both central and state. Digital information processing the technology in business transactions to create, collaborate, transform and redefine the relationships for value creation between organizations/individuals.

DIGITAL INDIA
Digital India is a kickstart of digital revolution. It’s a big dream which was created by the Government of India to ensure that government services to all citizens electronically even though in remote areas by improve online infrastructure and by increase Internet connectivity. Digitalization is one of the most fundamental periods of transformation we have ever seen. Digital India was the flagship programlaunched by the Prime Minister of India Mr. Narendra Modi on 1 July 2015. The objective of that program is connecting rural areas with high-speed internet networks and to improve the digital literacy.

PILLARS OF DIGITAL INDIA
There are 9 pillars in digital India program

Broadband Highway
The aim of broadband is to cover 250000 village Panchayats under the National Optical Fiber Network (NOFN) on Dec 2016. Nationwideinternet infrastructure can integrate the network throughout the country to provide high speed internet connectivity to the panchayat level.

Universal Access to Mobile Connectivity
The aim of this universal access to mobile connectivity is to increase the network penetration and also provide mobile connectivity to 44000 villages by 2018 with investment of RS 16000.

Public Internet Access Program
The aim of this is the One Common Service Centre (CSC) should be provided to each grama panchayat and also for the 1, 50,000 Post Office are converting into multi service centers.

E-governance
The aim of e-governance is the information technology can be used to make the delivery of government services effectively. There may be a process of integration service and UIDAI platform, etc., through IT. All the information available in electronic form.

E-kranti
The aim of this e-kranti is electronic delivery of service to people bean fellow of education, health, financial inclusion or justice having individuals.

AllMyGov.in
This is the form of website that launched by government to facilitate a two-way communication between the citizen and government. It is a transforming medium to exchange idea/suggestion with government. The entire citizen has open to access the information through this open data platform.

Electronics Manufacture
The government is mainly focused on zero import of electronics by2020 through the local manufacturing of items like smart energy meters, micro ATM, mobile, consumer and medical electronics. So thatgovernment is taking some steps towards manufacturing and investment in electronics sector.

IT
The IT sector is a most growing one for jobs. The aim of it is to train 10 million people in towns and villages for IT sector jobs within five years.

Early Harvesting Program
The main initiative is government plans to install Wi-Fi facilities in all the universities across the country. All the books are converted into e-books. Bio-metric Attendance System will be installed in all the government offices where recording of attendance will be made online is mandatory.

IMPACTS OF DIGITAL INDIA

Economic impact
In economic wise, India is the second largest telecom marketing in world with 915 million wireless subscribers.And also, worldthird largest Internet marketing with almost 259 million broadband users. There is a huge economic opportunity in India as form of tele-density in rural also. Almost the rural can able to utilize the platform of digital India. Future growth of tele-communication industry in India in terms of number of subscribers is expected to came from rural areas as well as urban areas are saturated with a tele-density of more than 160%.

Social impact
Social sectors like education, healthcareand banking are unable to reach out to citizens due to obstructions and limitations such as middleman, illiteracy, ignorance, poverty, lack of funds, information and investments. They have a led to a balanced growth in rural areas with marked differences in social status of the people. Modern ICT can make it be easier for people to access the services and resources. Education to farmers and fisher-men can be provided through mobile devices. The high-speed network can provide the adaptive infrastructure for online education platforms like massive open online course. Mobile and internet banking can develop the financial development in the country.

Environmental impact
The digital platform create major changes in the technology space will not only brought changes to the economic system also in environmental changes.The next generation technologies will surelyhelp in lowering the carbon footprint by reducing fuel consumption, waste management, greener workplaces and more. ICT sector helps towardsthe efficient management and usage ofresources.

CHALLENGES

There are some major challenges can be in digital India under rural areas,

1. There is no more effective level of digital literacy. Still now the major part of rural can't able to know the level digital platform.
2. In some rural areas have low internet speed issues. And also, unable to know the online services and online facilities.
3. India's some interior areas digital infrastructure is comprehensively inadequate to tackle growing increase in digital transactions.
4. The private participation in Indian government projects is poor because of the long and complex regulatory processes.
5. There is a wide range of digital divide between urban and rural India. still now funds are not deployed effectively to meet the cost of infrastructure creation in rural areas.
6. India has 1600 languages. So that non availability of digital services in local languages is creates a great barrier in digital literacy.
7. Fear of privacy has been deterrent in adoption of digital technologies.
8. Rural India contributes a part of the total net value added in many sectors with an overall 46% contribution to our national income.The Indian economy is predominantly in rural with over two-thirds of its population and workforce residing in rural areas.
9. There is a large amount of lacking to use e-sectors like e-books, e-services etc. So that the need to develop their skills.
10. The insufficient availability of the needed sectors like government offices and platforms that insufficient creates peoples into illiteracy.

TO OVERCOME THE CHALLENGES AS IN EASY WAY

The way to develop and overcome the challenges in digital India on the face rural areas is,

- To implement digital literacy.
- To develop skill building.
- To create digital adoption.
- To defining the role of a private sector.
- Introducethe digital skill programs at an institutional level.
- Increase availability of digital infrastructure at rural locations.

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ISBN: 978-81-946375-0-9

Assessment of Threats to Vultures in Uttarakhand: A Review Note

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Abstract
The vulture is also called as the vultur in Latin and these are birds called as scavengers as they feed on the dead carcass of the animals and keep the environment clean The vultures are one of the important part of the ecosystem and in Indian subcontinent there are 9 species of vultures which are available and these all species are the part of old-world vulture and all the nine species are inhabitable in the Uttarakhand due to its environment. But in the recent past there has been a massive decline in the population of vultures as from millions they are just left in thousands and this situation is caused by several threats/reasons which were responsible for this decline. Thus this is becoming a problem for the environmentalists to conserve them.

Keyword: Vulture, Threats, Uttarakhand and Conservation

Introduction

Vultures a word derived from Latin *vulture* and possibly from *vellere* "to pluck, to tear" (Nodant, 2017). These birds are called as the scavengers as they feed on the carcass of dead and decaying animals and keep the environment clean. There are about 9 species nested in India and the status of Himalaya's states of Uttarakhand is quite unique, as all nine vulture's species have been recorded in the state. The list of vultures founded in the state of Uttarakhand is:

S.N.	ENGLISH NAME	ZOOLOGICAL NAME	ALTERNATE NAME	SCIENTIFIC NAME	IUCN PRESENT POPULATION TREND
1.	White-rumped vulture	*Gyps bengalensis*	White backed vulture, Indian white backed vulture	*Gyps bengalensis*	Critically endangered Decreasing
2.	Long billed vulture	*Gyps indicus*	Indian vulture	*Gyps indicus*	Critically endangered Decreasing
3.	Slender billed vulture	*Gyps tenuirostris*	-	*Gyps tenuirostris*	Critically endangered Decreasing
4.	Red headed vulture	*Sarcogyps calvus*	King vulture, black vulture	*Sarcogyps calvus*	Critically endangered Decreasing
5.	Egyptian vulture	*Neophron percnopterus*	Neophron, scavenger vulture	*Neophron percnopterus*	Endangered Decreasing
6.	Himalayan vulture	*Gyps himalayensis*	Himalayan griffon	*Gyps himalayensis*	Near threatened Decreasing
7.	Cinereous vulture	*Aegypius monachus*	Black vulture, monk vulture	*Aegypius monachus*	Near threatened Decreasing
8.	Bearded vulture	*Gypaetus barbatus*	Lammergeier	*Gypaetus barbatus*	Near threatened Decreasing
9.	Griffon vulture	*Gyps fulvus*	Eurasian vulture	*Gyps fulvus*	Least Concern Stable

(IUCN Downloaded on 2020)

Out of all the species 4 are considered as critically endangered (*Gyps bengalensis, Gyps indicus, Gyps tenuirostris* and *Sarcogyps calvus*), 1 is endangered (*Neophron percnopterus*) (Downloaded on IUCN, 2020).

However, during 1990s and 2000s there has been a drastic decline in the vulture population in the Indian sub-continent, the scavengers were severely affected due to the poisoning of the scavenger food with non-steroidal anti-inflammatory drug (NSAID) including Diclofenac which is treatment of livestock (Green et al; 2004 & 7; Prakash et al., 2007 & 2012; Cuthbert et al., 2011; Prerna S. 2018). There were various surveys being conducted in the different parts of the country initially these were done in 1991-1993 and then were repeated in 2000, 2002, 2003 and 2007 these all reveled that the population of the species of vulture was falling at a higher rate (Prakesh et al., 2012).There was a ban on the veterinary use of the non-steroidal anti-inflammatory drug (NSAID) diclofenac in India was announced in 2006 and the official completion of the banning process was an extraordinary gazette notification in 2008 (Gazette of India Notification No. GSR 499(E) (Prakash et al., 2017). The population of vultures in the country is still declining as per the studies. There are various factors are responsible, the primary and major threat to the vultures has been the unintentional poisoning and that here defines as the use of the banned veterinary drug diclofenac which is considered harmful for the vultures. As after the treatment of the livestock with the drug (diclofenac), if it dies the vulture feeds on the dead tissues of carcass of livestock and due to the presence of drug still in the body it causes a diclofenac induced kidney failure and this has been the major threat responsible for the depletion in the population of vultures. With the change in the course of time there are more threats that are also becoming the responsible part for the death of vultures as the secondary and the potential threats are also a part of it.

As already mentioned earlier there are 9 species of vulture which are generally sighted in India in the entire year, the migratory vultures and the indigenous both are recorded at higher rates from the period of December to April. The vultures in the Indian subcontinent are termed as old-world vultures. (Kanaujia et al., 2013). In present study we will address the threat and conservation measure of vulture in uttarakhand through online secondary data.

Methodology

In this paper the comprehensive electronic study has been performed as per the electronic searches on Google as to identify all the available literature on the vulture present online till December 2018. In addition, the reference has been given to the articles found while the electronic search and study. From each scientific article we have extracted information on threats, conservation, population assessments. Depending upon the keyword of study i.e. threat the entire study is being carried out. It is important to note that an article can contribute to more than one category or keyword of study. The sum of articles across all categories exceeds the total numbers who are reviewed.

Result and Discussion

Vultures are the most important part of the ecosystem as they feed on the dead and decaying carcass of the herbivores and carnivores' animals. But in the past years the environment has lost many vultures due to threats which were responsible for their death. It is believed that (after accomplishment of studies by scientist) in the past years till 1980s it is said that India had the population of 80 million vultures of the *Gypes* in India but today these birds are left in several thousands. These are the major and the secondary threats which are held responsible for the depletion of vultures in the country. The vulture plays a very important role in the ecosystem as they feed on the dead carcass as mentioned earlier and prevent the spread of diseases and contamination of environment.

In the entire study and after referring to the studies conducted on the vulture the major reason by many research scholars is said as the ever-increasing use of the diclofenac in the country even after its ban in 2006. Diclofenac is defined as non-steroidal anti-inflammatory drug (NSAIDs) which is used for the treatment of the cattle's in many parts of the country. The diclofenac remains in the tissues of the treated animal even after its death and this is then when the vulture feeds on the carcass of the dead

animal the drug is transferred into the body of the bird and this phenomenon also has a name called as 'biomagnification' and as mentioned earlier once the drug gets in the body of the vulture it slowly starts killing the vulture from inside as this drug affects the kidney and causes the diclofenac induced kidney failure and diclofenac has always been the main reason but in the course of time not only diclofenac but there are several other factor/threats which has been the responsible factors for the vulture depletion. The other factors/threats are:

Major threats

- Unintentional Poisoning. (NASIDs)
- Collision with energy infrastructure/electrocution.
- Unintentional Poisoning. (Poison bait)

Secondary/Potential threats

- Decline of food availability
- Human disturbance
- Habitat loss and degradation
- Climate change

These are the various factors/threats as mentioned held responsible for the deaths of vultures in all over state as well as country. Even today after all the possible conservational methods adapted by the breeders, conservationists, environmentalist, the work is going in vain as the threats are ever-increasing with the time and the all works by the governments are just getting wasted.

There are many reported cases of vultures dying after their accidental collision with the energy infrastructure, this is because with the ever-increasing population the requirements for the energy are also increased and all the power transmission towers/systems are having a path through the forests and for setting these things their has been deforestation and somewhere or the other the inhabitable or nesting trees of these birds are being destroyed. During this process which has led their path towards the places where humans have settled but as mentioned earlier the population is increasing and with this there has been a lot of human disturbance in the areas where there were forests earlier. This untimely increase of human population and increase in the loss of habitat and degradation of environment is also one of the causes of their unfortunate deaths and had led their way towards the endangerment and extinction, as there are very few tall left which are used by these birds for making their nests and also used for roosting, but as mentioned human disturbance has destroyed a natural habitat of these birds.

With increase in the pollution and greenhouses there is climate change taking place in all parts of the world which causes a problem to the migratory birds as they visit the Indian subcontinent and these are all the actual factors causing trouble but there are still species alive, but all the old-world species of Indian subcontinent and the African subcontinent are brought in the scale from least concerned to nearly extinct. There has been the increase in the competition for the vultures as the other scavenger or omnivorous species are also a part of it which results in the decline of food for the vultures. With the escalation in time if these all threats continue to grow then there shall be no vultures left for defrayal of the dead carcass which will just keep toxifying the environment. But with no vultures this work can be done by the competing animals and birds that includes the eagles, hawks, dogs, cats, etc. even after the presence of these animals and birds vulture plays the most critical part of the ecosystem so this is also and important factor to protect the declining population.

Conclusions

There are problems and they will never stop and so to that we must keep finding ways to tackle these so that we can help protecting this environment. The diclofenac ban was implemented by the government but as we see there is still find the use of diclofenac in many parts of state as well as country, but is it really helping, no because the ban may be on the papers but its still not on the ground

and till the time its not properly implemented on the ground we will keep on finding vultures dying with the adverse effects of diclofenac in their body. In the course of my entire study and after referring to the articles and research papers diclofenac is one of the major threats/reasons but it's not the only threat/reason responsible for the deaths of these many vultures in these years, as climate change, increase in anthropogenic activities, increase in the competition these all reasons/threats altogether compared are the reason for the depletion of vulture population in the state and the country.

So, to prevent this we try to make strong and ground level strategies with the help of forest, local NGOs and others stakeholder who devoted to conservation of biodiversity. if successful conservation strategies make and strictly followed can actually bring a change and the declining population of vultures can be prevented otherwise results will be catastrophic.

Acknowledgments
The authors are thankful to the President for their support. We would like to thank all the researchers and staff of the Organization for providing scientific and technical assistance while undertaking the work.

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Advances in Data Mining

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Abstract
With an enormous amount of data stored in databases and data warehouses. It is increasingly important to develop powerful tools for analysis of such data and mining interesting knowledge from it. Data mining is a process of extracting useful data to gain knowledge from such huge data. The main problem related to retrieval of the information from the World Wide Web is the enormous number of unstructured documents and resources. In this article, a survey of the research in the area of web mining and suggest web mining categories and techniques. Furthermore, a presentation of a web mining environment generator that allows naive users to generate a web mining environment specific to a given domain by providing a set of specification.

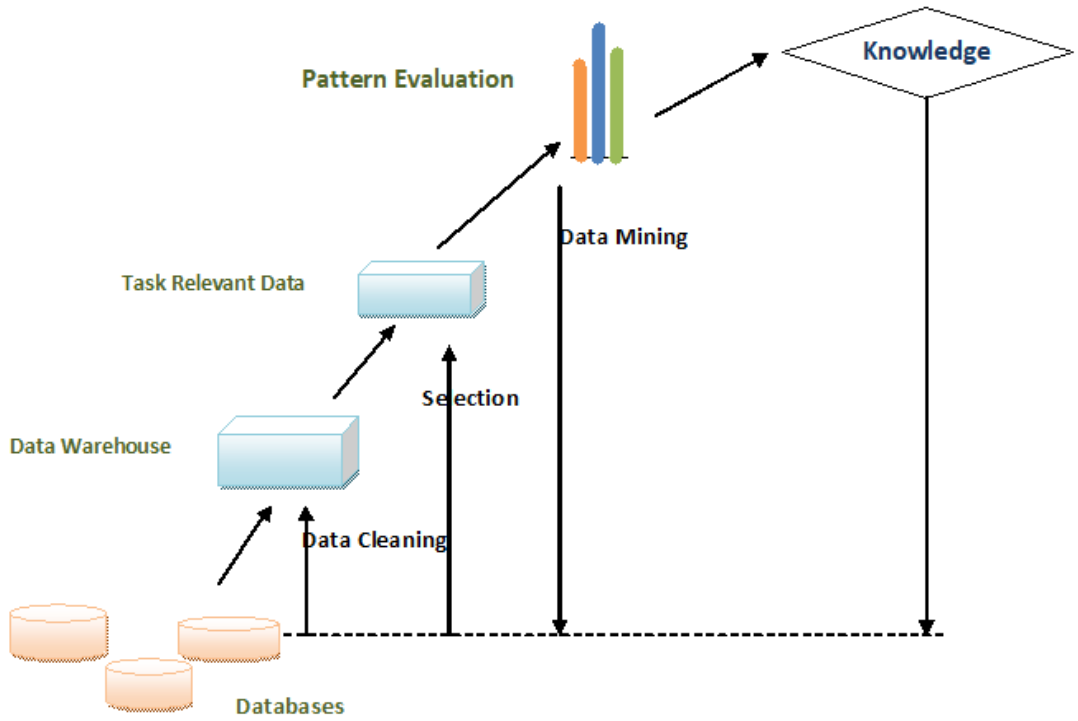
Keywords: Data mining, KDD, Data Warehouse, Pattern Evaluation, Knowledgebase.

Introduction

Data mining is a powerful new technology with great potential to help companies to focus on the most important information in the data they have collected about the behaviour of their customers and potential customers. It discovers information within the data that queries and reports can't effectively reveal. With the rapid growth in size and number of available databases in commercial, industrial, administrative and other applications, it is necessary and interesting to examine how to extract knowledge automatically from huge amount of data.

Methodology

Knowledge discovery in databases (KDD) or data mining is the non-trivial extraction of implicit, previously unknown, and potentially useful information from data. Through the extraction of knowledge in databases, large databases, serve as rich ,reliable sources for knowledge retrieval and verification, and the discovered knowledge can be applied to information management, decision making process control and many other applications. Therefore, data mining has been considered as one of the most important and challenging research areas. Researchers in many different fields including database systems, knowledgebase systems, artificial intelligence, machine learning, knowledge acquisition, statistics, spatial databases and data visualization have shown great interest in data mining. Many industrial companies are approaching this important area and realize that data mining will provide an opportunity of major revenue.



KDD Process

Important Terminologies:

Data Cleaning:

- To remove noise and inconsistent data
- Cleaning is performed for detection of syntax error.
- Parser decides whether the given string of data is acceptable within data specification.

Data Warehouse:
A data Warehouse is constructed by integrating data from multiple heterogeneous sources that support analytical reporting, structured queries, and decision making. Data Warehousing is a process of constructing and using a datawarehouse. Data warehousing involves data cleaning, data integration and data consolidation.

Data Integration:
Where multiple data sources are combined.

- Data Selection- Where data relevant to analysis task are retrieved from the database.

Data Transformation:
Where data are transformed or consolidated into forms appropriate for mining by performing summary aggregation operation for instance.

Data Mining:
An essential process where intelligent methods are applied in order to extract data patterns.

Pattern Evaluation:
To identify the truly interesting patterns representing knowledgebase on some interesting new measures.

Knowledge Representation:
Here visualization and knowledge representation techniques are used to present the mined knowledge to the user.

Data mining can be performed on the following type of data-

- Relational databases
- Data warehouses
- Advanced DB and information repositories
- Object-oriented and object-relational databases
- Transactional and Spatial databases
- Data warehouses
- Heterogeneous and legacy databases
- Multimedia and streaming database
- Text mining and Web mining

There are six stages of data mining process- Business understanding, data understanding, data preparation, modelling, evolution and deployment.

1) Business Understanding: In this step, the goals of the businesses are set and the important factors that will help in achieving the goal are discovered.

2) Data Understanding: This step will collect the whole data and populate the data in the tool (if using any tool). The data is listed with its data source, location, how it is acquired and if any issue encountered. Data is visualized and queried to check its completeness.

3) Data Preparation: This step involves selecting the appropriate data, cleaning, constructing attributes from data, integrating data from multiple databases.

4) Modelling: Selection of the data mining technique such as decision-tree, generate test design for evaluating the selected model, building models from the dataset and assessing the built model with experts to discuss the result is done in this step.

5) Evaluation: This step will determine the degree to which the resulting model meets the business requirements. Evaluation can be done by testing the model on real applications. The model is reviewed for any mistakes or steps that should be repeated.

6) Deployment: In this step a deployment plan is made, strategy to monitor and maintain the data mining model results to check for its usefulness is formed, final reports are made and review of the whole process is done to check any mistake and see if any step is repeated.

DATA MINING TECHNIQUES

CLASSIFICATION ANALYSIS

This analysis is used to retrieve important and relevant information about data, and metadata. It is used to classify different data in different classes. Classification is similar to clustering in a way that it also segments data records into different segments called classes. But unlike clustering, here the data analysts would have the knowledge of different classes or cluster. So, in classification analysis you would apply algorithms to decide how new data should be classified. A classic example of classification analysis would be our Outlook email. In Outlook, they use certain algorithms to characterize an email as legitimate or spam.

ASSOCIATION RULE LEARNING

It refers to the method that can help you identify some interesting relations (dependency modelling) between different variables in large databases. This technique can help you unpack some hidden patterns in the data that can be used to identify variables within the data and the concurrence of different variables that appear very frequently in the dataset. Association rules are useful for examining and forecasting customer behaviour. It is highly recommended in the retail industry analysis. This technique is used to determine shopping basket data analysis, product clustering,

catalogue design and store layout. In IT, programmers use association rules to build programs capable of machine learning.

ANOMALY OR OUTLIER DETECTION

This refers to the observation for data items in a dataset that do not match an expected pattern or an expected behaviour. Anomalies are also known as outliers, novelties, noise, deviations and exceptions. Often they provide critical and actionable information. An anomaly is an item that deviates considerably from the common average within a dataset or a combination of data. These types of items are statistically aloof as compared to the rest of the data and hence, it indicates that something out of the ordinary has happened and requires additional attention. This technique can be used in a variety of domains, such as intrusion detection, system health monitoring, fraud detection, fault detection, event detection in sensor networks, and detecting eco-system disturbances. Analysts often remove the anomalous data from the dataset top discover results with an increased accuracy.

CLUSTERING ANALYSIS

The cluster is actually a collection of data objects; those objects are similar within the same cluster. That means the objects are similar to one another within the same group and they are rather different or they are dissimilar or unrelated to the objects in other groups or in other clusters. Clustering analysis is the process of discovering groups and clusters in the data in such a way that the degree of association between two objects is highest if they belong to the same group and lowest otherwise. A result of this analysis can be used to create customer profiling.

REGRESSION ANALYSIS

In statistical terms, a regression analysis is the process of identifying and analyzing the relationship among variables. It can help you understand the characteristic value of the dependent variable changes, if any one of the independent variables is varied. This means one variable is dependent on another, but it is not vice versa. It is generally used for prediction and forecasting.

This article explains how to build a mining model by using Clustering technique and to solve a few concern problems to best teach online class using the web and get to know the students to serve them better by *Samia Jones & Omprakash K. Gupta.*

The Study

This article is organized in two parts. The first part of the paper provides a brief presentation of the clustering algorithm, and explains a few basic data mining terms.
The second part of the paper focuses on the performance study of two classes that are using online course over the web and the web generating a mining algorithm using a variety of parameters. A number of experiments were conducted, and their results are presented in this part. The experiments were based on different parameter of interest. The parameters varied form the number of input attributes, the sample size of the class, and so on. The results of these experiments prove that the data mining algorithm are very efficient and scalable.

The Clustering Algorithm used

The Clustering algorithm is based on the Expectation and Maximization algorithm (Microsoft, 2003). This algorithm iterates between two steps. In the first step, called the "expectation" step, the cluster membership of each case is calculated. In the second step, called the "Maximization" step, the parameters of the models are re-estimated using these cluster memberships, which has the following major steps:

1. Assign initial means
2. Assign cases to each mean using some distance measure
3. Compute new means based on members of each cluster
4. Cycle until convergence.
5.

A case is assigned to each cluster with a certain probability and the means of each cluster is shifted based on that iteration. The following table shows a set of data that could be used to predict best achievement. In this study, information was generated on users that included the following list of measurements:

1. Most requested pages
2. Least requested pages
3. Top exit pages
4. Most accessed directories
5. Most downloaded files
6. New versus returning visitors
7. Summary of activity for exam period
8. Summary of activity by time increment
9. Number of views per each page
10. Page not found

The relevant measurements are viewed which implied the following:

Table 1: Statistics on Web site visits

Statistics Report		
Hits	Entire Site (Successful)	2390
	Average per day	72
	Home page	256
Page Views	Page views	213
	Average per day	97
	Document views	368
Visitor Sessions	Visitor sessions	823
	Average per day	65
	Average visitor session length	00:31:24
Visitors	Visitors who visited once	32
	Visitors who visited more than once	75

RESULT

This case study regarding data mining focuses on statistics which are commonly measured on websites. The ultimate consequence of these statistics may be implemented to alter the website. Table 1 has discussed some basic statistics- frequency, Length and kind of visitors, beside this additional insight may be gained by observing breakdown of visiting each day. This feature can be seen separately in activity related to exam time or other issues. The primary stage of evaluating and improving of the website is the monitoring and understanding of visitor's behaviour. Another chief measurement is how many pages are viewed, if it is measured that only one page is visited by majority then it can be thought that they are getting difficulties to precede the next step.

CONCLUSIONS

The data mining concept is widely accepted due to its smooth functioning. The website offers developing and user relationship management opportunities which are only limited in imagination. It is a method to turn rapidly expanding data collections into accessible and actionable knowledge that can be used for decision supports. Data mining uses mathematical and statistical calculations to uncover hidden co-relation among large quantities data stored in databases. It is a combination of artificial intelligence, Statistics and machine learning. Today it is very popular and one of the fastest developing technology in Information System. Its future is wide open and we have to look forward its developing prospect in future.

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Advances in Power Electronics

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Abstract
Power Electronics is a branch of Electrical Engineering which deals with power conversion from one from to another form using Inductors, Capacitors, Semiconductor devices (Diode, Thyristor, MOSFET, and IGBT etc.).Power Electronics provides a basic knowledge circuitry for the control and conversion of electrical power with high efficiency. High-voltage direct current (HVDC) electric power transmission systems use DC for the bulk transmission of electrical power. Whereas, in some cases we need AC supply and we are supplied with DC quantity there, example transformers, 3Ø motor, etc. In such cases we need to convert AC to DC or DC to AC. This can be done using electronic devices such as SCR, Power BJT, Chopper, etc.

Keywords: Mosfet, Igbt, Thyristor, Scr, Power Bjt, Chopper, Seniconductor, Capacitor.

1. Introduction
Power electronics is referred to the application of solid state electronics to control and conversion of electric power.

The first known electronic device is the Mercury-arc valve (a type of electrical rectifier used to convert high AC current to DC current).this evolved into modern day.

Devices like diodes, MOSFET, thyristors, etc. The most common Power Electronic device is the AC / DC converting device-RECTIFIER. These devices are used in almost every kind of devices like Television, computer, battery etc. In industries they are mostly applied as VSD (VARIABLE SPEED DRIVE-device used to control speed of different machinery). The power of these devices ranges from tenths of watts to hundreds of watts.

2. History
Power electronics started with the development of the mercury arc rectifier. It was invented in 1902 BY Perer Coopwe Hewitt; it was used to convert alternating current (AC) into direct current (DC). From the 1920s on, research continued on applying thyratrons and grid-controlled mercury arc valves to power transmission. Uno Lamm developed a mercury valve with grading electrodes making them suitable for high voltage direct current power transmission. In 1933 selenium rectifiers were invented [1]

Julius Edgar Lilienfeld proposed the concept of a field-effect transistor in 1926, but it was not possible to actually construct a working device at that time. In 1947, the bipolar point-contact transistor was invented by Walter H. Brattain and John Bardeen under the direction of William Shockley at Bell Labs. In 1948 Shockley's invention of the bipolar junction transistor (BJT) improved the stability and performance of transistors, and reduced costs. By the 1950s, higher power semiconductor diodes became available and started replacing vacuum tubes. In 1956 the silicon controlled rectifier (SCR) was introduced by General Electric, greatly increasing the range of power electronics applications. By the 1960s, the improved switching speed of bipolar junction transistors had allowed for high frequency DC/DC converters.

R. D. Middlebrook made important contributions to power electronics. In 1970, he founded the Power Electronics Group at Caltech. He developed the state-space averaging method of analysis and other tools crucial to modern power electronics design.

Figure 1 : MERCURY ARC VALVE

3. Need for power electronics

The system and machineries in our world is totally dependent upon power electronics for its usage and sustainability. It applies to both the systems and products involved in converting and controlling the flow of electrical energy, allowing the electricity needed for everyday products to be delivered with maximum efficiency in the smallest and lightest package. According to an article by ABB, about 40% of the world's power needs are met by electrical energy. That number is quickly rising as the trend towards renewable energy sources increases. Without power electronics, this energy cannot be harnessed and delivered efficiently and energy from renewable sources, such as solar and wind, could not be fed into the electricity grid.

Power electronics allow solar energy to be used by converting the Direct Current energy produced by solar panels into AC used in the commercial electrical grid. Wind energy also needs to be converted and must be fed into a grid at a constant frequency despite changing wind conditions. Other forms of alternative power such as thermal, hydro and nuclear also take advantage of the benefits of power electronics to effectively deliver power.

4. Then vs. Now

Power electronics is taking the Center stage in most of the daily life fields. The role of power electronics is no longer that of a supporting cast member. From renewable energy and data centers to electric vehicles and smart appliances it plays a very important role.

In the early 90's Power was seen as a delivering service that allowed other systems to operate. Earlier the power market did not seem to be disruptive and had a steady growth. But in recent times, electronics power conserving is at its peak and has a huge positive impact globally.

We'r living in an interesting time where traditional methods of doing things are getting upheaval by new technologies and solutions and even business models. Thus reducing the manpower load and thereby increasing the efficiency of the system.

Siting the power adapter (charger) market as an example we can deduce that there is a makeover in significant way; the battle to set a new benchmark of efficiency. The adapter size is being decreased to make it more convenient to carry around but it does not decrease its efficiency on the other hand it is becoming more efficient. The interesting technological contributions on this front are GaN transistors. Compared to Silicon, GaN is extremely efficient at very high switching speeds. And at the same time, a higher switching frequency allows for miniaturization. The more interesting change in the market, however, is a move from wired to wireless charging. Wireless Power Transfer (WPT) is disruptive because it is a new tool in the power electronics toolkit. While the most widely known example is smart phone chargers, the WPT technology is also being used in higher power applications like charging power tools, autonomous robots, drones, and electric vehicles. The list goes on. And tied to the success of WPT are GaN transistors. For wireless power charging greater than 20 Watts, Silicon transistors simply cannot switch fast enough, heat up and become inefficient. Our GaN transistors can switch at a very high speed, and that moves wireless power transfer to a scalable, commercially viable product.

Figure 2 : WIRELESS CHARGER

In the 1960's and 70's fundamental junction transistors were used mostly. Advancement in silicon development led to the use of MOSFET (Metal Oxidized Semiconductor Field Effect Transistor), which uses the same principal but are less expensive and more efficient. As technology advanced, engineers learned that they could manufacture many transistors simultaneously, on the same piece of semiconductor material, along with other components like capacitors and resistors. The result is IC (Integrated Circuit).These circuits contains billions of infinitesimal transistors. Modern silicon commercial transistors are way smaller than these.

Scientists from Yale and South Korea recently created the world's first molecular transistor, which is made from a single benzene molecule.

Figure 3 : INTEGRATED CIRCUIT

These are just some small aspect that is going through this type of upheaval. Similar disruptions are happening in the energy market as we move from fossil fuels to renewables, in the data center market as we seek to reduce their impact on CO2 emissions, and in the automotive market as we move from internal combustion engines to electric vehicles.

Although the move to renewable energy sources has been relatively slow in the past, the pace of alternative energy generation continues to grow. For example, according to the Solar Energy Industries Association and GTM Research, new solar energy generation in the United States grew 76 percent in 2012. For the utility segment of solar energy, “construction of renewable power plants” accounted for 54 percent, or about 1.8 GW, of the installed solar panels in 2012. In addition, over 4 GW of utility-scale construction is taking place in the U.S. for additional renewable power generators. But, how does the direct current (DC) energy of renewables get converted into alternating current (AC) in order to be moved into a utility’s grid? Intelligent inverters are the key.

It is very much exciting to see how persuasively changes are being adapted in different fields of our daily life.

5. Conclusions

In this paper, we discuss the evolution of Power Electronics and related devices. Transistors are the key active components in practically all modern electronics. Thus becoming one of the most greatest and significant invention of the 20th century. The Power MOSFET is one of the most important electronic power device its application ranging from computers to modern communication technologies like smartphones. Power Electronic devices may be used as amplifiers or switches. Their usage is dependent upon several attributes. Devices such as diodes conduct when a forward voltage is applied and have no external control of the start of conduction. Power devices such as Silicon

controlled Rectifiers and thyristors (as well as the mercury valve and thyratron) allow control of the start of conduction, but rely on periodic reversal of current flow to turn them off.

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Phytoplanktons in Eutrophic Water: A Review

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Abstract
Anthropogenic activities pose a serious threat to water bodies, adding up nutrients and other pollutants that make it unfit for drinking as well as other purposes. Natural water bodies, whether ponds, lakes, wetlands, rivers are found to be eutrophicated with abundance of algal blooms and other noxious plant species that could release harmful toxins. Though eutrophication is a natural process, it gets accelerated with increase in nutrient load, disturbing the biota of the water bodies. Different water bodies vary in community composition of the microflora. Similar to zooplankton, phytoplanktons are also sensitive to change in their environment, thus making them a good indicator of water quality. pH, hardness, temperature, turbidity, sun radiance, dissolved oxygen, electrical conductivity, nitrogen, phosphorus, silica, has served to be the drivers of phytoplankton diversity. They are the most tolerant groups surviving in polluted water which makes it suitable as a bio-indicator for the assessment of water bodies. This paper highlights the ecology of phytoplankton community and its diversity in eutrophicated pond water. It also deals with best examples provided by previous research for Indian conditions.

Keywords: Phytoplanktons, eutrophication, nutrient, limiting factor, water bodies

Introduction/background

Water is essential for existence life and it is well known that approximately 71% of earth surface is covered with water and only 3% is available as fresh water. Anthropogenic activities pose a serious threat to water bodies, adding up nutrients and other pollutants that make it unfit for drinking as well as other purposes. The selective pressure of added nutrients (especially nitrogen and phosphorus) and other pollutants to water bodies has resulted into eutrophication. Eutrophic comes from Greek word "eutrophos" meaning well nourished. It is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis (Pilmis et al., 2018). It is that green layer scum that floats on water surface. It poses a serious environmental threat and responsible for degradation of water quality causing death of other fauna present there. It is subcategorized on the basis of source as *i)* natural *ii)* cultural eutrophication (human induced). Over time the water body gets accumulated with nutrients that will facilitate faster growth and reproduction of producers than normal. High nutrient loading and nuisance algal bloom leads to eutrophic zones in water bodies (Ayotunde et al., 2013, Wetzel, 2001) where the nutrients acts as a limiting factor for the growth of algae, planktons, and other simpler plant life. During the 1960s and 1970s, scientists linked algal blooms to nutrient enrichment resulting from anthropogenic activities such as agriculture, industry, and sewage disposal (Drenner, 1997). Study conducted by UNEP (United Nation Environmental Protection) has revealed that nearly 30%~40% of the lakes and reservoirs have been affected by water eutrophication all over the world and has a negative impact on aquatic ecosystem and humans. In eutrophic water rapid growth of algae (microscopic plant like organism) is seen which will ultim ately becomes dead and settle down at bottom where its microbial degradation will occur. Algal blooms are visible in the form of algal mat over surface of the water. According to biological productivity, aquatic body can be categorized in three trophic states: oligotrophic, mesotrophic and eutrophic.

Ponds are small standing water bodies usually with a muddy or silty bottom that provide habitat for many species (Moustafa et al., 2018). They are considered as wetlands and on the verge of getting diminished due to use of land in urbanized areas, agriculture, dumping of wastes, runoff or sewage input through domestic and industrial discharges. Ponds play a significant role as they *i)* serve as a

habitat for wide variety of flora and fauna *ii)* source of water for agriculture and livestock iii) serve as habitat for migratory birds and other refugees animals iv) helps to restore ground water for future v) provide source of income in rural area vi) and for aesthetic and recreational value. Ponds go through different trophic stages from ultra-oligotrophic to oligotrophic, mesotrophic, eutrophic and finally reaching hyper-eutrophic stage in course of time (Frumin & Krashanovskaya, 2014) Analysis of the trophic state of ponds is important in the assessment and management of ponds and in developing conservation strategies (Sharma et al., 2014). According to (Yusuf, 2020) the maintenance of a healthy aquatic ecosystem depends on the physico-chemical characteristic and the biological diversity of the ecosystem. Physico-chemical parameters affect plankton distribution, occurrence and species diversity and can be used as indicator of physiochemical status of any water body In India, diversity of phytoplankton in different freshwater water bodies along with their physico-chemical characteristics were studied (Shekhar, 2020). Factors supporting the phytoplankton growth are very complex and interact with physical and chemical factors, such as dissolved oxygen, temperature, visibility and the availability of nutrients, nitrogen and phosphorous (Goldman and Horne, 1983). Other nutrients such as silicon and iron also can significantly influence the outcome of species dominance and the structure and abundance of phytoplankton communities under cultural eutrophication (Hecky & Kilham, 1988). High biomass phytoplankton blooms have also been reported from the south China Sea (Huang & Qi, 1997), the Black Sea (Velikova et al., 1999), and many other locations, typically in parallel with the nutrient enrichment of coastal waters (Anderson et al., 2002). Therefore, the objective of the present study is to provide a brief introduction to plankton ecology and the types of species dominant in eutrophicated pond considering the impact of anthropogenic activities.

Mechanism of eutrophication

The excessive growth of phytoplanktons and algal biomass increases due to the availability of growth factors which are essential for photosynthesis like nutrients (phosphorus and nitrogen), sunlight, and carbon dioxide. At end of their life cycle, large amount of organic matter gets accumulated in deep water and sediments that further get degraded by microbial processes. The microbes utilize oxygen and creates oxygen deficit environment at the bottom sediments. At this stage, the rate of microbial degradation will exceed oxygen production. Other aquatic organisms will also die due to lack of oxygen for examples fishes. The anaerobic microbes are responsible for further degrading the organic matter in absence of oxygen as a result of which free toxic compounds will be produced like ammonia and hydrogen sulphide. This causes foul odour in sediment beds and water that leads to suffocation or death of aquatic species. Figure 1 and 2 represents the sources and impact of eutrophication in water bodies.

What are phytoplanktons?

Phytoplanktons are free floating single celled algal communities that drift along with water current, for example green algae, diatoms and dinoflagellates etc. Their origin is of more than 2.8× 10^9 years ago. Phytoplanktons are by definition, photosynthetic, and include cyanobacteria as well as algae (Raven et al., 2009). They are extremely diverse, varying from photosynthesizing bacteria (cyanobacteria) to plant like diatoms (protist) and commonly called as microalgae.They are primary producers that are ubiquitous and form the base of any food web in aquatic environment. Productivity in any aquatic system is directly dependent on diversity of phytoplanktons. They can utilize carbon dioxide and water and convert them to energy using sunlight. Zooplanktons serve as a connecting link between food web that is responsible for transferring energy from producers to consumer. Growth of these phytoplanktons is limited by resources available like light, phosphate, inorganic carbon etc. The water quality parameter of an aquatic environment greatly influence its productivity (Ahmed et al., 2018) and play a significant role in distribution pattern and species composition of different phytoplankton (Das & Dash, 2014). They release oxygen along with macrophytes during the process of photosynthesis that facilitates survival of other fauna in water. Many studies has been conducted to indicate key indicator groups of phytoplankton in eutrophic water bodies like blue green algae that was the dominant species found throughout the year in a pond water body (Kavitha et al., 2005). Therefore, phytoplanktons are regarded as the base for assessment and monitoring strategies for fresh water pond management. Major groups of phytoplankton includes diatoms (bacillariophyceae),

chlorophyta (green algae), chrysophyta (golden brown algae), cyanophyta (blue green algae), euglenoids (euglenophyceae), flagellates (dinophyceae). Toxigenic cyanobacteria, including *Anabena, Cylindro spermopdis, Microcystis* and *Oscillatoria* (planktothrix) tend to dominate nutrient-rich, freshwater systems due to their superior competitive abilities under high nutrient concentrations, low nitrogen-to-phosphorus ratios, low light levels, reduced mixing, and high temperatures (Paerl & Huisman, 2009). Cyanobacteria has shown to be poor quality food for most zooplankton grazers in laboratory studies (Beyer & Hambright, 2016; Wilson et al., 2006), thus reducing the efficiency of energy transfer in aquatic food webs and potentially preventing zooplankton from controlling algal blooms. According to (Okogwu & Ugwumba, 2009), cyanobacterial abundance was favored due to increased pH, width and depth and its abundance correlated with reduction in dissolved oxygen and increase in BOD values. (Bureau & Arbor, 1963) has suggested that increase in total dissolved solids was observed in eutrophic water as compared to oligotrophic water.

Phytoplanktons in water environment

Many researchers have participated in the study of phytoplankton ecology of freshwater lakes in India along with its diversity and abundance using appropriate diversity index. Most of the practical works have indicated that phytoplankton communities get affected in its diversity and abundance by the cultural eutrophication. Some of the early works that have reported phytoplankton distribution and density in fresh water lakes in India are (Frumin & Krashanovskaya, 2014; Mukherjee et al., 2010; Maske et al., 2010; Tiwari & Chauhan, 2006). A report spanning a period of 50 years (1947-1998) emphasized the factors that influence the physical, chemical and biological conditions of the Indian freshwater lake ecology system (Sugunan, 2000; Gopal, 1998) Other studies have reported the distribution pattern of phytoplankton with respect to the degree of water pollution, impact of aquaculture and climatic change (Chattopadhyay & Banerjee, 2007) and harmful and toxic effects of cyanobacteria in Indian freshwater lakes (Chaudhary & Pillai, 2009). The distribution of phytoplankton in an oligotrophic and eutrophic pond have highlighted the difference of occurrence of planktonic species in both the trophic ponds (Saha & Wujek, 1989). (Sayeswara et al., 2011), investigated the phytoplankton diversity and the relationship between water quality of a pond situated in Karnataka, India. They identified domestic sewage and agricultural runoff as the main source of nutrients that entered the pond. According to their study, pond water was unfit for human consumption but was used for domestic purpose. Although total 60 phytoplanktons were identified, the dominant species were bacillariophyceae (31.6%) followed by chlorophyceae (28.33%), cyanophyceae (25%) and euglenophyceae (15%) were abundant. The phytoplankton and zooplankton act as bioindicators of pollution. They studied the water quality parameters and found that the pH ranged between 6.5 to 7.6, dissolved oxygen between 2.7 to 5.2mg/l, and biochemical oxygen demand in the range of 6.7 to 8.9mg/l. Phosphate was found to be a critical element responsible for biological productivity and varied in the range of 1.1mg/l to 1.9mg/l. Similarly, the values of silicon ranged between 35 to 43.1mg/l indicating the presence of diatoms (bacillariophyceae). Other water quality parameters like solids, hardness, chloride, magnesium, sulphate do not show any significant effect on the growth of algal blooms. Excess of phosphate and silicate as well as acidic pH favoured the growth of indicator species that indicated organic pollution i.e. nutrient rich environment. Similar studies on Rewalsar Lake in Mandi district in Himachal Pradesh showed the relationship between phytoplankton dynamics and physiochemical parameters. Sewage influx has been the main source of addition of nutrients in the lake. Therefore, the water of the lake was found to be turbid with very high mean annual turbidity in range of (45.50-350.40 NTU) in year 2008-09 and (116.0-232.70 NTU) in 2009-10. High pH was recorded during winter (8.24-8.34) and minimum in monsoon (7.05-7.23). Biochemical oxygen demand was high (2.04-8.21mg/l) in 2008-09 and (0.0-6.50) in 2009-10, thus indicating pollution. Here, biochemical oxygen was negatively correlated with dissolved oxygen (-0.61) and pH (-0.79) at 5% significance level. High concentration of phosphates (0.023-0.11mg/l) contributed to the nutrient addition with a minimum of 0.03mg/l sufficient for growth of algal bloom. Since the lake was eutrophic, indicator species like *Microcysstis aeruginosa* (cyanophyceae) were abundant and present throughout the year. Others were *Oscillatoria limosa,* followed by *Spirulina gomonti*, *Oscillatoria princeps* and *Arthrospira khannae* all belonging to cyanobacteria. Some of the dominant species identified during the post monsoon season were *Anabena sp., Merisimopedia sp.,* and *Oscillatoria*

princeps. Author clearly mentioned that cyanophyceae presence significantly positively correlated with calcium (0.45) at 1% level and with magnesium (0.58) and total hardness (0.59) at 5% level. Cyanophyceae showed dominancy with 52% and 47% followed by bacillariophyceae (diatoms) with 24% with total eight species. If the level of calcium would have been more, then bacillariophyceae might stand as the more dominant species, indicating bacillariophyceae as strong indicator of oligotrophic water rather eutrophic. Indicator diatoms such as *Nitzschiapalea, Navicula cryptocephala* and S*ynedra ulna* are considered as pollution tolerant species (Jindal et al., 2014).

Recent study by (Ansari et al., 2015) identified the presence of phytoplanktons in a cemented pond receiving treated wastewater before discharging into Tapi River. Most dominant group was chlorophyceae (52%) followed by bacillariophyceae (30%) cyanophyceae with (14%) euglenophyceae stands at lowest with 4%. Presence of the phytoplankton indicated that the water is nutrient enriched and supported the growth of these groups. Author concluded that higher level of oxygen, nitrate, phosphate, silicate was directly related with phytoplankton diversity. Among all the parameters author showed a positive correlation between phosphate, nitrate, silicate, oxygen and diverse group of phytoplankton. The values of oxygen, phosphate, nitrate and silicate ranged between 5.678 ± 0.218mg/l, 0.257±56.786mg/l, 4.089± 0.926mg/l and 0.218± 0.029mg/l. Other water quality parameters were under permissible limit. So, the authors inferred that phosphate and nitrate are the major limiting factor that favours eutrophication of freshwater and has a direct correlation with the planktonic community. Some authors confirmed that phytoplankton density and diversity are higher in eutrophic lakes than those in oligitrophic lakes (Feng et al., 2019). Result of physicochemical analysis showed that water temperature, pH value, total nitrogen, and total phosphorus were significantly lower in oligotrophic lake as compared to eutrophic lake. Dissolved oxygen was slightly lower in oligotrophic lake. Chlorophyll a value was significantly higher in eutrophic lake. Author indicated the dominance of total phytoplankton density in eutrophic lake to be 10,000 times higher in compare to oligotrophic lake. Most dominant group of oligotrophic lake was bacillariophyta with 94% density whereas for eutrophic lake south it was chlorophyta with 68.26% followed by 24.48% density of cyanophyta. Dominating species of oligotrophic lake were *Cyclotella meneghiniana, Nitzschia linearis* and *Iconella biseriata* and for eutrophic lake those were *Dolichospermum circinale, D. viguieri, Microcystis wesenbergii* and *Merismopedia minima*. It was concluded that excessive nutrient and temperature significantly tends to increases the growth and reproduction of phytoplankton. Studies have reported that the summer is the most suitable season for the growth of phytoplankton in freshwater lakes because of long duration of sunshine period, increased salinity, pH and tropic activities. Conversely, in late summer and monsoon season, the production of phytoplankton reduced because of heavy rainfall, high turbidity, reduced salinity, temperature, pH, overcast skies and low nutrient concentration along with consumption of phytoplankton by zooplankton and fishes etc (Saravanakumar et al., 2008). During monsoon, wave action of currents and influx of rain water acts as limiting factors for phytoplankton population. The water column of the lake was remarkably stratified to large extent in heavy rainfall with high turbidity in lake water, induced due to agricultural and surface runoff and soil erosion. Subsequently, the rate of phytoplankton gradually increased in post-monsoon to the late spring.

A study was conducted to identify the influence of various physiochemical factors on the growth of bacillariophyceae considering two freshwater lakes in Hyderabad, for a period of two years. Although, both the lakes have high range of physiochemical parameters, slight variation in values resulted in more species diversity. Authors concluded that high value of dissolved oxygen (8.8mg/l), temperature (27.2°c), and silicate (2.6mg/l) to be the contributor of diverse species of phytoplanktons, whereas low temperature (26.2°c), low dissolved oxygen (6.7mg/l) and low silicate (1.0mg/l) resulted into dense diatom population in the second lake. Dissolved oxygen, temperature and silicate are the main drivers of bacillariophycean population. But according to author apart from these factors other factors like low nitrate, organic matter and phosphate also affect growth of these groups. Value of phosphate concentration varied between 0.9-1.1mg/l, nitrate 1.3-2.74mg/l and organic matter 1.28-1.6mg/l that helped in flourishing more diverse form. Some major indicators of pollution identified were: *Synedra, Navicula, Melosira* and *Cyclotella* due to high nitrate, presence of calcium supported *Achnanthes,*

Gomphonema, Cymbella, and *Navicula* species in both ponds. *Melosira* was dominant during summer indicating temperature influence on this species. Also, according to author presence of nitrate favored the growth of *Nitzschia* (Reddy, 2016). In the western region of India, studies on four lakes reported presence of seventy one algal species distributed among five groups. The authors concluded that phytoplankton population is affected by change in physico-chemical parameters like temperature, pH, wind, period of sunshine, depth of lake, DO, nutrient enrichment, turbidity. Large growth phytoplankton and algal bloom was observed in premonsoon and post monsoon due to nutrient enrichment in all pond except khandola pond. Main indicators that showed eutrophic condition were *Scenedesmus, Chroococcus, Melosira* and *Navicula.* Some authors had already reported that presence of *Scendesmus* indicates eutrophic condition. Even *Euglena acus, Anabena species, Nitzschia, Oscillatoria,* indicated organic pollution in all water bodies. They belonged to five classes: chlorophyceae (33), cyanophyceae (15), bacillariophyceae (17), euglenophyceae (5) and dinophyceae (1species). They concluded that the seasonal fluctuation plays an important role in determining the phytoplankton community structure of freshwater. Some parameters favours overgrowth over other normal growing phytoplanktons leading to formation of algal bloom (Sawaiker & Rodrigues, 2016). Studies have also reported the presence of phytoplanktons in eutrophicated lakes that receives hospital wastewater along with sewage dischrages. The result indicated that bacillariophyceae as most dominant group of lake but it varied at different study site and was abundant in themacrophytic region. Major species which showed dominance throughout the year were *Cymbella cistula, Navicula subtillisma, Fragilaria capucina, Pinnula rianobilis, Eunotia minor* and *Synedra ulna*. After bacillariophyceae, second represented group was chlorophyceae with maximum density and according to the study its regulating drivers was high transparency of water and temperature. Its major representative was *Chlorella sp, Chlorococcum sp, Comarium sp, Cladorasp, Closterium sp, Cladophora sp, spirogyra sp, Volvox sp* and *Ulothrix sp.* Accordingly it was inferred that nitrate, phosphate and organic matter regulated the growth of cynophycean group. Euglenophyceae was represented by dominant species like were *Euglena* and *Phacus* (Ahmed et al., 2018).

Concluding summary

The review paper presents a brief introduction to plankton ecology in eutrophicated pond and lakes that are influenced by physico-chemical parameters of eutrophic water. The discharge of sewage, industrial effluents or untreated wastewater to freshwater bodies leads to degradation of its quality. Major driver of phytoplankton abundance and diversity depends on temperature, light radiance, turbidity, pH, dissolved oxygen, nutrients mainly phosphorous and nitrate, total hardness and total suspended solid. Most of the nutrients enriched aquatic ecosystem favours abundance of cyanophyceae group with temperature above 20° celcius and turbid water environment. Most of the freshwater resources in India have been neglected and at the verge of extinction due to urbanization, use of land areas, dumping of waste etc. It is important to ensure and manage them for the betterment of society in a sustainable manner. Some preventive measure which can be taken to decrease the organic and nutrient load on pond like; check drainage from livestock facilities if it is directly draining into water, domestic sewage must be treated before drainage into surface water,medical waste should be treated in any constructed pond, faulty sewer line may add waste into surface water. Siltation cause problem for fish and other organism in pond and disturb food chain. Agricultural products must be used in accordance with requirement of soil and this could be achieved under certain lab that undertook proper testing of soil. And also, bio-fertilizers should be used more, since chemical are creating huge problems worldwide.

a b

Figure 1: *a)* Natural eutrophication in Renuka Wetland (in Himachal Pradesh) b) Cultural eutrophication

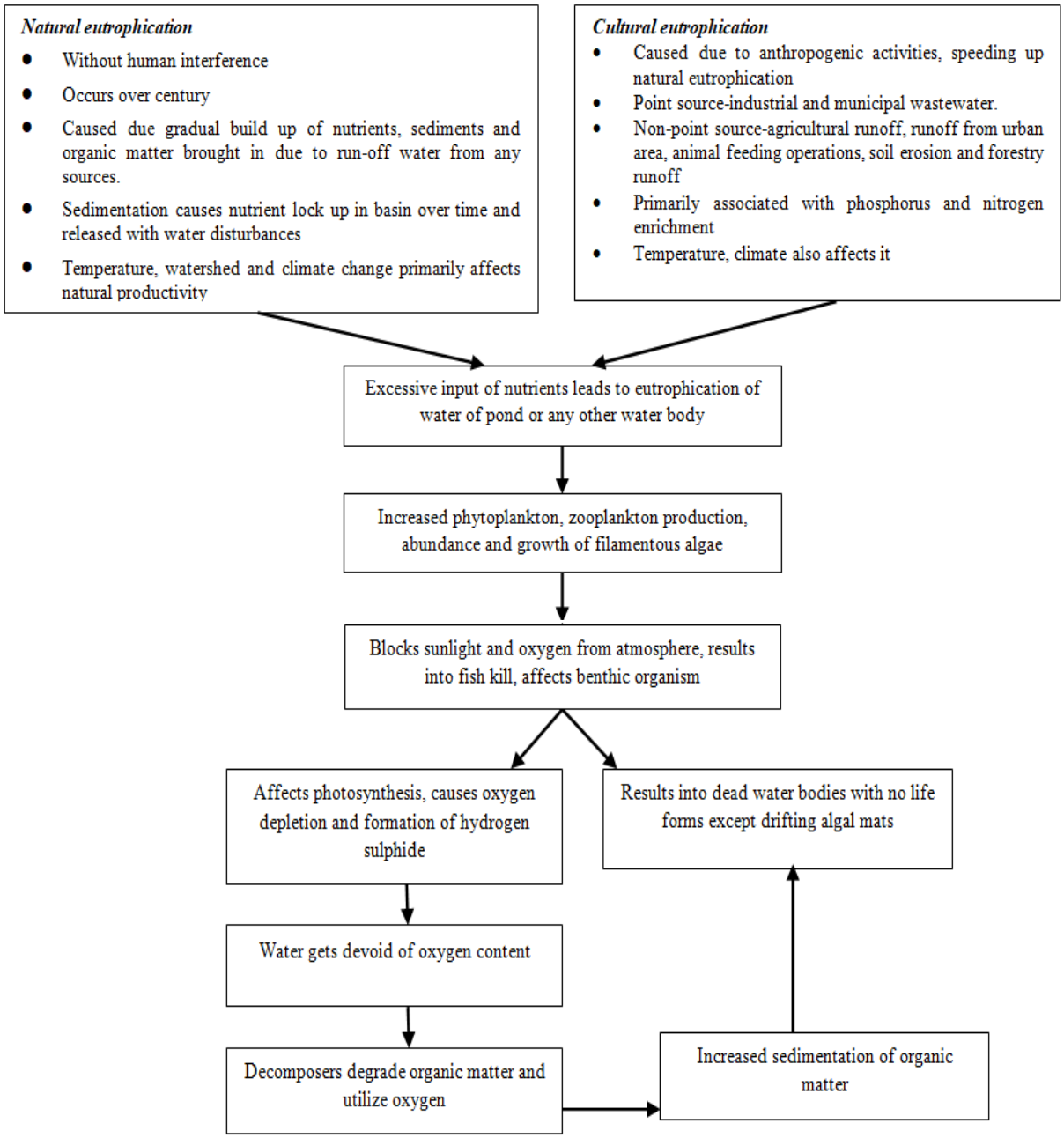

Figure 2: Sources and impact of eutrophication in water bodies

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Wetlands for Wastewater Treatment and Management: A Review

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Abstract
Wetlands are very distinct type of ecosystems that are very productive, dynamic, and fragile, not only this they provide countless services for human welfare and contribute to the integral formation of the global water cycle. They are natural that are abundantly found in India or man-made known as constructed wetlands. Constructed wetlands mimic natural wetlands in the fact that they function to remove pollutants from wastewater, either from domestic or industrial sectors, in a controlled environment. The paper gives some introductory information about the wetlands their types, significance in the natural environment, and threats faced due to human-induced anthropogenic activities. According to Ramsar convention wetlands have been categorized according to different criteria that have been highlighted. The role of wetlands in wastewater treatment has also been discussed considering the factors affecting the performance and efficiency of wetlands. These systems play a pivotal role in the polishing of treated effluent from the wastewater treatment plant and therefore find a place to be incorporated in conventional treatment for reducing bacterial and pollutant loads.

Keywords: Constructed wetland, natural wetland, threats, wastewater treatment.

Introduction/Background

The wetlands are said to be a very distinct type of ecosystem that are very productive, dynamic, and fragile, not only this they provide countless services for human welfare and contribute to the integral formation of the global water cycle. Wetlands occupy nearly 64%of the earth's surface (Shine & Klemm, 1999). India is blessed with a large number of wetlands distributed in different geographical regions. They provide drinking water, fish, fodder, wildlife habitat, control rate of runoff in urban areas, buffer shorelines against erosion, and recreation to society. They play a significant role in freshwater supply, groundwater recharge, controlling flood, nutrient removal, carbon sequestration, toxics retention as well as climate change mitigation (Meena & Sharma, 2019). Wetlands can also be defined as land transitional between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water. We use the word wetland to refer to all areas with water covered periodically, seasonally, or permanently, such as tidal flats, and flooded areas near rivers, rice paddies, swamps, or lakes, respectively. They share characteristics of both environments yet cannot be classified unambiguously as either aquatic or terrestrial. The key is the presence of water for some significant period of time, which changes the soil properties, and also the microorganisms, plant and animal communities, such that the land functions in a different way from either aquatic or dry habitats (Wu et al., 2015). Ramsar convention is an intergovernmental treaty which was adopted on 27th Feb 1971 in Ramsar a city in Iran. This treaty is based on the convention and sustainable use of natural resources. One of the key instruments of the convention is the list of wetlands of international importance. All the parties to this convention have an obligation to include at least one site which meets the criteria which are established by the conference of the parties. According to Ramsar convention wetland is defined as, "Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Article 1.1). In addition, Ramsar Sites "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within

the wetlands" (Article 2.1). According to Ramsar convention the wetlands have been classified as i) natural wetlands – that include swamps, marshes, ox-bow lakes, waterlogged areas, ii) artificial or man-made – that includes reservoirs, tanks, lagoons, ash ponds, estuary, aquaculture ponds, etc.

India is one of the developing countries facing a rapid increase in population. According to (CPCB, 2015), only 30% of wastewater is treated and the rest (70%) goes off as runoff (to water bodies) or infiltrates the soil affecting the aquifers. Recent researches have shown that the constructed wetlands have been widely used on a global scale for remediation of domestic wastewater, mine water, urban stormwater, and industrial wastewater (Auvinen et al., 2017). It is encouraging to see a surge in the research from the Indian perspective. A number of researchers have reported especially with an objective of technology transfer for serving the requirement of local people (Dutta et al., 2017 , Kaushal et al., 2016, Kallimani et al., 2015, Joshi, 2015, Vipat et al., 2008). Reports on the pilot-scale study have shown good removal efficiency in constructed wetlands for inorganic nitrogen (67%), sulfate (60%), chemical oxygen demand (65%) and even pathogen (*Esherichia coli)* by 87% (Patil et al., 2016). In many cases, rural areas have received a lot of attention, with ICRISAT working for domestic wastewater treatment (Tilak et al., 2016). Therefore, constructed wetlands have even been used as polishing units and have shown the good capability of coliform removal (Kumar, 2018).

The objective of the present review is to provide a snapshot of the significance of natural wetlands and the potential functioning of constructed wetlands for wastewater treatment. It also highlights the factors that are responsible for increasing the efficacy of constructed wetlands for pollutant removal. Further, it also provides future consideration and recommendations to be incorporated into wastewater treatment plants for the polishing of effluents.

Constructed wetlands and wastewater treatment

Since the 1950s wetlands have been used for water purification in different parts of the world. From a practical standpoint, constructed wetlands offer better opportunities for wastewater treatment than natural wetlands. They are subdivided into the surface flow, subsurface flow, vertical flow, horizontal flow, or hybrid based on the flow path of wastewater and can be used in combination for increasing the efficiency of a system (Kadlec & Wallace, 2008). They are designed for optimal performance of the Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), and nutrient removal processes and for maximum control over the hydraulic and vegetation management of the wetland. In general, they have been found to be efficient to remove more than 90% of BOD, COD, suspended solids, and bacteriological pollution from the through-flowing wastewater. However, the removal of N and P remains close to 50% (Verhoeven & Meuleman, 1999). Studies have also reported a maximum of 90% of removal of coliform and pathogenic organisms (Kaushal et al., 2016). Different configurations and designs assist in treating domestic/industrial wastewater, agriculture, or stormwater. The treated effluent can be used for aquaculture, in irrigational fields, reused in industries, used for toilet flushing, or assist in groundwater recharge.

The basic mechanism involved during the treatment of wastewater in constructed wetlands includes physical, chemical, and biological processes. Physical processes include filtration, sedimentation, biological uptakes, and nutrient transformation by aerobic and anaerobic bacteria. The chemical process includes precipitation absorption and decomposition which purifies and treats the wastewater. Plant species like *Phragmites* and *Typha* are used in the treatment of tannery wastewater. (Freedman et al., 2014) suggested the use of halophytes in horizontal subsurface flow constructed wetlands to polish treated wastewater with excess salt to decrease its salinity. It has been reported that a combination of a mixture of plants in wetlands for treatment of municipal wastewater, perform more effective than a single plant species (Farid et al., 2014). In another study by (You et al., 2014), pilot-scale constructed wetlands planted with *Leerisa hexandra* were used to remove heavy metals like chromium, copper, and nickel from electroplating wastewater. This system achieved 84.4%, 97.1%, and 94.3% removal of chromium, copper, and nickel from wastewater respectively. Macrophytes-vegetated constructed wetlands have been found to efficiently remove total suspended solids, total nitrogen, biochemical oxygen demand, heavy metals, xenobiotics, pesticides, and polyaromatic hydrocarbons from various wastewaters (Parthasarathy & Narayanan, 2014).

The Constructed wetlands are proving to be a valid treatment option for the different industrial wastewater such as petroleum refinery wastewater, agricultural wastewater, and paper pulp wastewater, acid mine drainage, etc. Constructed wetlands have a low maintenance and capital costs than conventional treatment systems (ITRC, 2003). Compared to Conventional systems, natural systems can be operated using less electricity and less labor (USEPA, 1987).

Factors affecting the performance of wetlands

1. **Wetland Macrophytes (Plant) -** Macrophytes or the type of plant species in the wetland are the utmost important factor which affects the performance of a wetland. These are the plant which grows in water or in wet areas and are large enough to be viewed with the naked eye. Some of them are rooted in the sediment while some floats on the surface of the water without attaching itself to any substrate. The species of macrophytes should be selected well for better performance of the artificial or constructed wetlands.

2. **Substrate or infiltration media-**Substrates, also known as media, support matrix/material or filling material are another major component in CW-MFCs. Substrates play an integrated role in physical, chemical and more significant biological functions to eliminate (including filtering, trapping, adsorbing, biodegrading) the pollutants (Yang et al., 2018). They also serve as a support matrix for the living organisms and provide storage for many contaminants. In a CW-MFC, the preference of substrate or filtration media to be used is of major significance for the functioning of the entire system. On a practical level, cost and local availability are the two rudimentary factors determining the selection (Dordio & Carvalho, 2013). The physical component like the size of the particle, porosity, electrical conductivities, hydraulics, specific surface area, chemical components like toxicity, chemical stability, surface charge and biological component like electron (donor/acceptor) characteristic of the substrate has to be considered for enhancing the performance. Natural substrate materials include sand and gravel, anthracite, zeolite, forsterite, manganese sand, granite, volcanic rocks, quartz, soil, etc. Man-made substrate materials include hollow bricks, ceramic, artificial ecological substrates, steel slag, activated carbon, sponge iron, etc.

3. **Microorganisms-**The type of microorganisms that play an essential role in the performance of constructed wetland – microbial fuel cell (CW-MFC) is generally known as electroactive bacteria or electrogens. These are bacteria with the ability to generate electrical energy through the oxidation of organic matter and transfer the generated electrons to an acceptor outside of their cells (Guang et al., 2020, Yadav et al., 2012). Electrogenic microorganisms are widely found in natural and polluted environments. Anaerobic sludge from industrial or domestic wastewater treatment plants, anaerobic sediment, primary industrial or municipal effluent and even farm soils are identified as germ sources for EABs (Shi et al., 2018).

4. **Biofilms-**A biofilm is an assemblage of microbial cells that is irreversibly associated (not removed by gentle rinsing) with a surface and enclosed in a matrix of primarily polysaccharide material. Noncellular materials such as mineral crystals, corrosion particles, clay or silt particles, depending on the environment in which the biofilm has developed, may also be found in the biofilm matrix. Biofilm-associated organisms also differ from their planktonic (freely suspended) counterparts with respect to the genes that are transcribed (Donlan, 2002).

5. **Electrodes-** Electrodes are the main host for the redox reaction in the system and as a result, have a significant influence on the overall performance of the system. The choice of electrode material plays a pivotal role in CW-MFC (Shi et al., 2018). For a typical CW-MFC, there are two kinds of electrodes: the anode electrode and the cathode electrode, both buried respectively in the anaerobic and aerobic regions of the reactor. By burying the anode and placing the cathode at the surface, CW-MFC can take advantage of the natural redox conditions approaching anaerobic at the anode, while the cathode is supplied with dissolved oxygen from the atmosphere and oxygen leakage from the rhizosphere of wetland plants (Rani et al., 2018).

6. **Hydraulic Retention time-**It is a measure of the average length of time that are soluble compound remains in a constructed bioreactor and is considered the most influential factor that affects contact between substrates and microorganisms, that effect favors higher treatment efficiency (Velvizhi, 2018). When the hydraulic retention time is extended, the removal rate of the pollutants and the output power of the system can be improved, that is, the power generation performance of the system is enhanced.

Threats to natural and constructed wetland

Due to human-induced activities, natural wetlands have faced lots of pressure due to which it is diminishing and rarely found in any urbanized area. Agricultural and industrial practices along the catchment area also make it vulnerable to human activities. One of the major threats to the inland wetland is the aquatic weeds which get multiplied very quickly and cover the water bodies such as *Hydrilla, Eichornia,* etc. Cleaning of weeds is a major problem faced by nearby peoples. Other floating plant species like *Salivia* and *Pistia* which create a big menace, therefore mechanical removal becomes important to control the growth of aquatic weeds which is a major challenge.

Summary and future recommendation

In the light of sustainable energy and carbon management, constructed wetland offers many advantages and future possibilities. It's simple construction, low operating cost, low energy requirement make it a quite promising technology for the treatment of wastewater in the rural areas. Wetlands could be the better alternative for wastewater purification in the remote location of small residential areas which excludes the connection to conventional sewer systems. A good conceptual design is a foremost thing for a successful operation of any wetland wastewater treatment plant. The main design criteria to be considered are wastewater type to be treated, loading rate, sediments, the type of the plants to be used, and the management needed for the operation. Studies have shown that if properly managed and efficiently utilized wetland systems can achieve high treatment efficiencies with regards to both organic and inorganic nutrients as well as pathogen removal. Constructed wetlands have given a chance for use as an alternative technology in wastewater treatment by local municipalities and industries.

Figure (a-c) Plant species found in wetland a) *Canna indica* b) *Typha augustifolia* c) *Iris pseudacorus*

Figure (d-f) d) Natural wetland e) and f) simple construction of constructed wetland with gravel as substrate, can be used for recycling of household wastewater

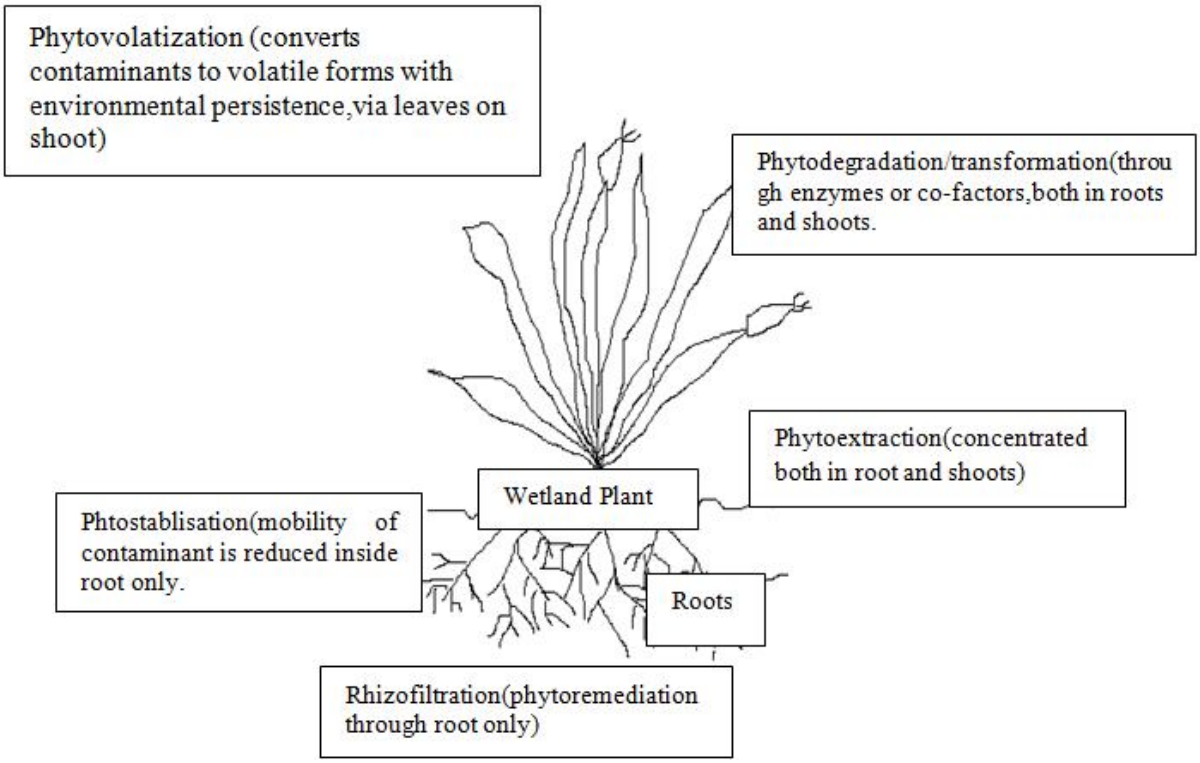

Figure g) Representation of mechanism of phytoremediation in wetland plant species

Table 1: CRITERIA FOR A RAMSAR WETLAND

GROUP A	Sites containing representative or unique wetland types	Criterion 1	A Wetland should be internationally important if it contains a representative, rare or unique sample of a natural or near natural wetland type found with appropriate biogeographic region.
GROUP B	Sites of international importance for conserving biodiversity, criteria based on ecological communities.	Criterion 2	A wetland should be considered internationally important if it supports vulnerable or endangered species or threatened ecological communities.
		Criterion 3	A Wetland should be considered internationally important if it supports population of plant or animal species important for maintaining the biological diversity of a particular bio geographical region.
		Criterion 4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles or provides refuge during adverse condition.
Group C	Specific criteria based on water birds.	Criterion 5	Wetland should be internationally important if it regularly supports 20,000 or more water birds.
		Criterion 6	A wetland should be considered internationally important if it supports 1%

			of the individual in a population of one species or subspecies of water bodies.
Group D	Specific criteria based on fishes.	Criterion 7	A wetland should be considered internationally important if it supports a significant proportion of indigenous fish sub species, species of families, life history stages, species interactions and/or populations that are representative of wetland benefits and values and thereby contributes to global biological diversity.
		Criterion 8	A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground nursery and/or migration path on which fish starts either within the wetland or elsewhere depends.
GROUP E	Specific criteria based on other than	Criterion 9	A wetland should be internationally important if it supports 1%of the individual of one species or sub species of wetland

Source:https://www.ramsar.org/sites/default/files/documents/library/ramsarsites_criteria_eng.pdf

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Design and Implementation of Steganographic Method for Digital Images and Visual Cryptography

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ABSTRACT
Today's data is transferred in public network is not secure because of interception by eavesdropper. Steganography, is a better technique for writing the hidden messages in another file format like text, image, videos. In this paper, we proposed a technique of data hiding using interpolation, least significant bit, digital watermarking and cryptography. Performance is tested through the measures mean squared error (MSE) & peak signal to noise ratio and data embedding capacity. Result shows with these parameter are shows better results from the previous results. Results are also shows in bar charts form. The experimental results showed that the average PSNR was 45.05 dB and 429888 bit data embedding capacity was respectively which is better results from the previous algorithm.

Keywords: LSB, Interpolation, watermarking, PSNR, MSE, capacity, cryptography.

INTRODUCTION
Steganography is the art of hiding a file, image, or secret message within another message, image, or file [2]. The word steganographic combination of the Ancient Greek words steganos, meaning "covered, concealed", and graphein meaning "writing"[2]. For example, the hidden message may be in invisible ink between the visible lines of a private letter. Steganography technique is that which is basically used for information security. Steganography transmits data by actually hiding the existence of the message so that a viewer cannot detect the transmission of message and hence cannot try to decrypt it [2]. Steganography is not to alter the structure of the secret message, but hides it inside a cover object. After hiding process cover object & stego object are similar. So, steganography (hiding information) and cryptography (protecting information) are totally different from one another. Detecting procedure of steganography known as Stegoanalysis [3]. Some of the applications of Steganography include ownership protection, proof for authentication, air traffic monitoring, medical applications etc.

Steganography is the practice of hiding secret messages within cover image to produce a stego image. The recipient of a stego image can use his knowledge of the particular method of steganography employed to recover the hidden text from the stego image [11]. Information hiding is a recently rapidly developed technique in the field of information security and has received significant attention from both industry and academic. It contains two main branches: digital watermarking and steganography with cryptography. The carrier for steganography can be image, text, audio and video. Multimedia data is easy to destroy by the unauthorized persons through Internet. So, it becomes important to be able to transmit the data secretly.

In steganography does not alter the structure of the secret message, but hides it inside a cover image so that it cannot be seen. A message in a cipher text, for instance, might arouse suspicion on the part of the recipient while an "invisible" message created with steganography methods will not. In other word, steganography prevents an unintended recipient from suspecting that the data exists. Steganography software is becoming effective in hiding information in image, video, audio or text files. Most used steganography technique in least significant bit.

The main objective of Steganography is to communicate securely in such a way that the true message is not visible to the observer. That is unwanted parties should not be able to distinguish any sense between cover-image (image not containing any secret message) and stego image (modified cover-image that containing secret message). Thus the stego image should not deviate much from original cover image [10]. Steganography transmits data by actually hiding the existence of the message so that a viewer cannot detect the transmission of message and hence cannot try to decrypt it [9].

Steganography is a technique used to transmit a secret message from a sender to a receiver in a way such that a potential intruder does not suspect the existence of the message. Generally this is done by embedding the secret message within another digital medium such as text, image, audio or video [14].

LSB

The most important image Steganographic technique is Least Significant Bit embedding technique. In this data can be hidden in least significant bits of the cover image and human eye would be unable to see the hidden image in the cover file. This technique can be used to hiding images in 24-bit, 8-bit or gray scale format. In this technique, least significant bit of each pixel is replaced with the secret message bit until message end. When using a 24 bit image one can be store 3 bit in each pixel by changing a bit of each if the green, red and blue color components. An 800 x 600 pixel image can be store 1,4400,00 bits or 180,000 bytes of the embedded data. For example, a 24 bit can be as follows:

(10110101 01101100 10101101)

(10110110 11001101 00111110)

(10110101 01100011 10001110)

The number 150 that binary representation is 10010110 is embedded into least significant bits of this part of image, the resulting grid as follows:

(10110101 01101100 10101100)

(10110111 11001100 00111111)

(10110101 01100010 10001110)

Although the number is embedded into first 8 bytes of grid, only 3 underlined bits need to be changed according to embedded message. On an average, only the half of bits in an image will need to be modified to hide secret message using maximum cover size. There are 256 possible intensities of the each primary color. Therefore, changing LSB of a pixel results in small changes in intensity of colors. These changes cannot be perceived by the human eye, thus message is successfully hidden. If the message is hidden even in second to least significant as well as in least significant bit then too no difference is seen in image.

In LSB, consecutive bytes of the image data from first byte to the end of message are used to embed the information. More secure system can be in which sender and receiver share a secret key which specifies only certain pixels to be changed. Even if the intruder suspects that LSB steganography has been used, there is no way of knowing that pixels to target without the secret key. Thus it is very important techniques [8].

Discrete Wavelet Transform

Discrete Wavelet Transform is a technique frequently used in compression, watermarking, digital image processing. The transforms in discrete wavelet transform is based on small waves, called wavelet, of varying frequency and also limited duration. A wavelet series is a representation of a square integrable function by a certain orthonormal series generated which is by a wavelet. Further, the properties of wavelet could decompose original signal into wavelet transform coefficients that contains the position information. The original signal can be completely reconstructed by performing Inverse Wavelet Transformation on these coefficients. Watermarking in the wavelet transform domain is generally a problem of embedding watermark in the sub bands of the cover image. There are four subbands created at the end of each level of image wavelet transformation: they are High-Low

(horizontal) subband (HL), Low-Low pass subband (LL), High-High (diagonal) pass subband (HH) and Low-High (vertical) subband (LH). So, subsequent level of wavelet transformation is applied to LL subband of previous one.

Image Interpolation methods

Interpolations techniques are used for improve the capacity, maintain a good image quality and recover cover image. Image interpolation methods, such as nearest neighbor, B- spline, bilinear, cubic, Langrange, Gaussian and bicubic have been used for the re-sampling. The nearest neighbor method can find the closest corresponding pixels of cover image for each block and set them for a new pixel value for destination image using neighboring pixels. The bilinear interpolation method determines new value from the weighted average of four closest pixels. So, these methods are used to change the size of the images to estimate unknown values of the pixels [7].

Nearest Neighbor technique for Interpolation

INP is that pixels at near the neighboring locations tend to have the similar intensity values. It means that we can be improve image quality with the less distortion.

Suppose that a cover image has four pixels. We can calculate new pixels for up-scaling image 2 times as follows [7].

x'10 = (140+(140+120)/2)/2=135

x'01 = (140+(140+195)/2)/2=153

x'11= (135+153)/2=144

x'21= (120+(120+188)/2)/2=137

x'12= (195+(195+188)/2)/2=193

For the cover image of the four pixels (140, 120, 195, 188), new pixels (x'00, x'20, x'02, x'23) are retained. But new intermediate pixels (x'10, x'01, x'11, x'21,x'12) are calculated[7].

Cryptography

RSA Algorithm was given by three MIT's Rivest, Shamir & Adleman and has been published in year 1977. RSA algorithm is a message encryption cryptosystem in which two prime numbers are taken initially and after that the product of these numbers is used to create a private and a public key, that is further used in encryption and decryption. By using the RSA algorithm we are increasing the security. In case of steganalysis only cipher text could be extracted which is in the encrypted form and is not readable, therefore will be secure. RSA algorithm procedure can be illustrated in brief as follows [1]:

- Select two large strong prime numbers, p and q. Let n = p q.
- Compute Euler's totient value for n: f (n) = (p - 1) (q - 1).
- Find a random number e satisfying 1 < e < f (n) and relatively prime to f (n) i.e., gcd (e, f (n)) = 1.
- Calculate a number d such that d = e-1 mod f (n).
- Encryption: Given a plain text m satisfying m < n, then the Cipher text c = m e mod n.
- Decryption: The cipher text is decrypted by m = c d mod n[5].

RELATED WORK

Ki-Hyun Jung et al. [7] in 2014, they have proposed semi- reversible data hiding method based on interpolation and LSB substitution. The interpolation method has been preprocessed before hiding the secret data for the purpose of good quality and higher capacity. Then, the LSB substitution method was applied for the embedding secret data. The cover image with the scaled down size and secret data could be extracted from the stego-image without the need of any extra information.

G. Raj Kumar et al. [14] in 2014, have been improved least significant bit steganalyzers by analyzing and manipulating features of the some existing least significant bit matching steganalysis techniques.

This paper explains the LSB Embedding technique with lifting based DWT schemes by using Micro blaze Processor implemented in a FPGA using System C coding. Future work can be extended to RGB or color image processing and can be extended for video processing level also.

Shilpa Thakar et al.[15] in 2013, this paper describe the review of Steganography. Image Steganography alongwith the LSB insertion method used in Image Steganography. The paper suggested a few for future research like integrity and data capacity of cover image. Some steganographic methods need to improve security by using cryptography against attacks.[35]

Gurpreet Kaur et al. [16] in 2013, they compare digital watermarking with other techniques of data hiding.

Steganography, Fingerprinting, cryptography and Digital signature techniques are compared with watermarking. It provides ownership assertion, authentication and integrity verification, usage control and content labeling. All techniques of data hiding secure data with their methods, but watermarking is more capable because of its efficiency. In Watermarking they mark the information which is to be hiding. Security of data is essential today because of cybercrime, which is highly increased day by day. Watermarking provide us easy and efficient security solutions of digital data. Watermarking provide security of not only images, but also audio video and text.

Shamim Ahmed Laskar et al. [11] in 2012, proposed method has been employed for applications that require high-volume embedding with robustness against certain statistical attacks. The present method is an attempt to identify the requirements of a good data hiding algorithm. Steganography is not a good solution to secrecy, but neither is encryption. But if these methods are combined, we will have two layers of protection. If a message is encrypted and hidden with a LSB steganographic method the embedding capacity increases and thus we can hide large volume of data. And the method satisfies the requirements such as capacity, security and robustness which are intended for data hiding. The proposed algorithm is analyzed in the light of the statistical framework in order to prove its efficiency and also to show its level of security. The main focus of the paper is to develop a system with extra security features where a meaningful piece of text message can be hidden by combining two basic data hiding techniques.

Shilpa Gupta et al.[12] in 2012, In this paper existing Least Significant Bit Algorithm has been analyzed and found to have a more amount of distortion, so a new method has been proposed "Enhanced Least Significant Bit (ELSB). It improves the performance of the LSB method because information is hidden in only one of the three colors that is BLUE color of the carrier image. This minimizes the distortion level which is negligent to human eye.

Chunlin Song et al. [17] in 2009, have presented description and analysis of the recent advances in the watermarking in digital images. These techniques are classified into the several categories depending upon domain in which hidden data is inserted, size of hidden data and the requirement of which hidden data is to be extracted. The experiment shows the different effective algorithms of watermark. The result indicates frequency domain is more robustness than spatial domain. Several challenges that are often unaddressed in the literature have also been identified. Meeting these challenges is essential in advancing the current state of the art of watermarking in digital images.

PROPOSED METHODOLOGY

In this section we explain the methodology for the proposed technique and also draw the flow chart of proposed technique. we divide the methodology in three phase and further explain the all steps.

Phase 1:

Code is developed for opening GUI for his implementation. After that we develop a code for loading the image file and message file in the MATLAB database.

Phase 2:

Code is developed for LSB & watermarking using discrete wavelet transform. Apply both LSB and interpolation with watermarking and visual cryptography on watermarked.

Phase 3:
After this code is developed for the extraction process. Within the extraction process we develop code for the message extraction from the watermarked image after cryptography.

Phase 4:
After that code is developed for the analysis of results obtained using various parameters like MSE, PSNR and Capacity.

Flow Chart: Sender Side

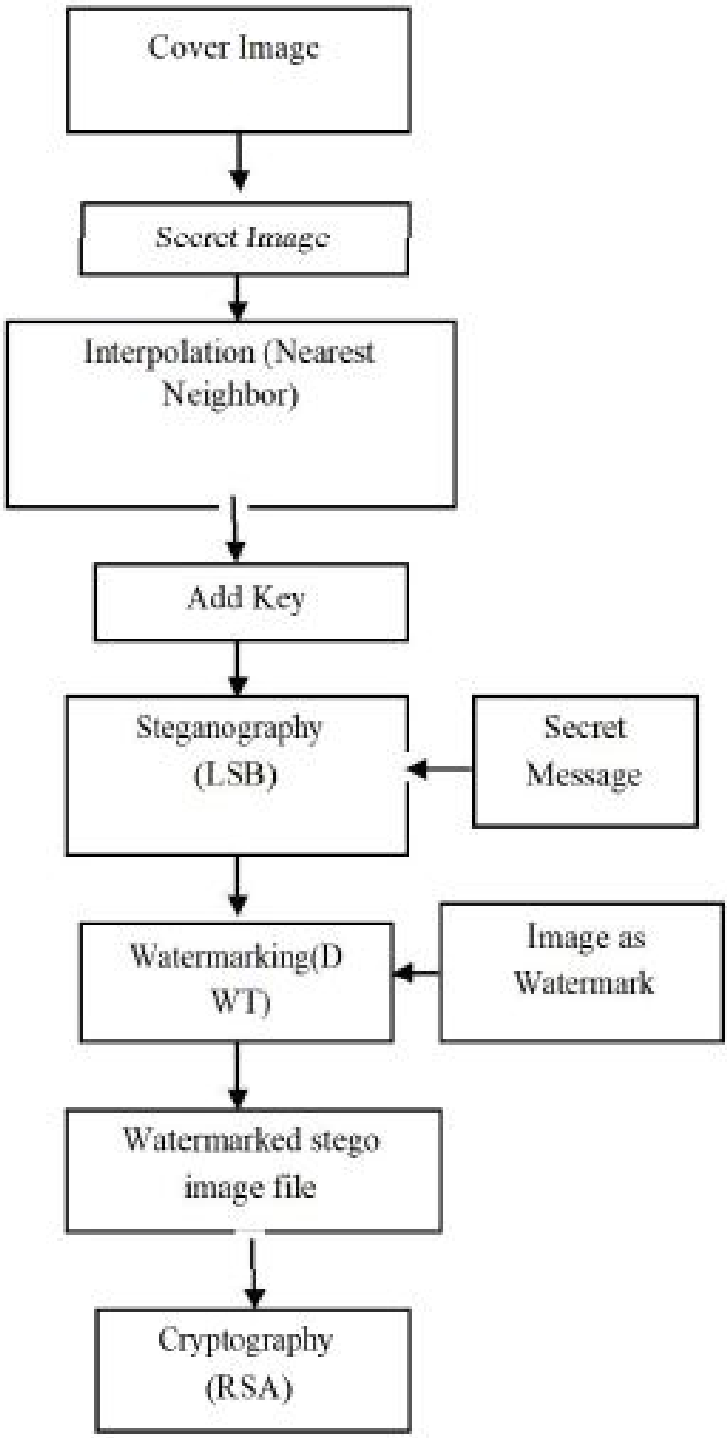


Figure: 1.1 Sender Side flow chart

Flow Chart: Receiver Side

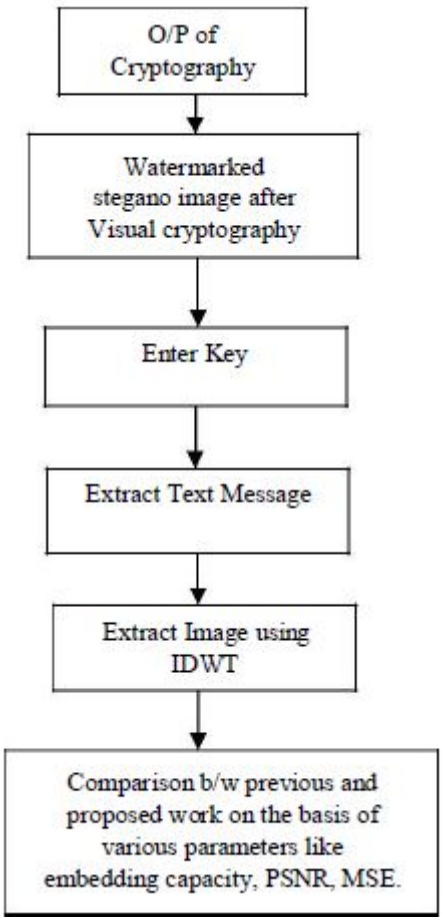


Figure: 1.2 Receiver Side Flow Chart

EXPERIMENTAL RESULTS & DISCUSSION

In this section we present and discuss the implementation of the proposed technique, data parameter used, experimental results of the proposed method and also shows the results in the bar charts form and table form also. Implementation process of proposed technique implementation of proposed algorithm in matlab with inbuilt toolbox image processing using GUI functions.

Embedded Process

1.) Load the cover image 2.) Load Secret image

3.) Apply Interpolation using (Nearest Neighbor) 4.) Add Key

5.) Hide secret data using LSB

6.) Apply watermarking using DWT on secret image 7.) Apply RSA algorithm on watermarked image

Extraction Process

1.) Load watermarked and crypto image

2.) Load watermarked image after cryptography 3.) Enter Key

4.) Extract text message using ILSB

5.) Extract secret image using IDWT

6.) Find MSE, PSNR, Embedding Capacity

Parameters

Following are the parameters which are used implementation:

PSNR

The Peak Signal to Noise Ratio (PSNR) is the ratio between maximum possible power and corrupting noise that affect representation of image. PSNR is usually expressed as decibel scale. The PSNR is commonly used as measure of quality reconstruction of image. The signal in this case is original data and the noise is the error introduced. High value of PSNR indicates the high quality of image[13].

PSNR1 =10*log10((255)^2/MSE)

Here MSE is a mean square error

MSE

Mean Square Error can be estimated in one of many ways to quantify the difference between values implied by an estimate and the true quality being certificated. MSE is a risk function corresponding to the expected value of squared error. The MSE is the second moment of error and thus incorporates both the variance of the estimate and its bias. The MSE of an estimate and is defined as[13]

MSE =

Capacity

The maximum amount of information that can be carried in the media, steganography algorithm can be implanted without being carried in the media to apply tangible change. High capacity steganography algorithms is to evaluate the main parameters However, high capacity, reduced image quality due to use of the algorithm can establish a compromise between quality and capacity of the application or the preference of one over the other.

Experimental results, bar charts and tables

Experimental results, bar charts and tables of results shows as following:

For the testing of results we used four images 512*512 which shows different results for different image. Airplane, man, boat and pepper images are used for testing as following.

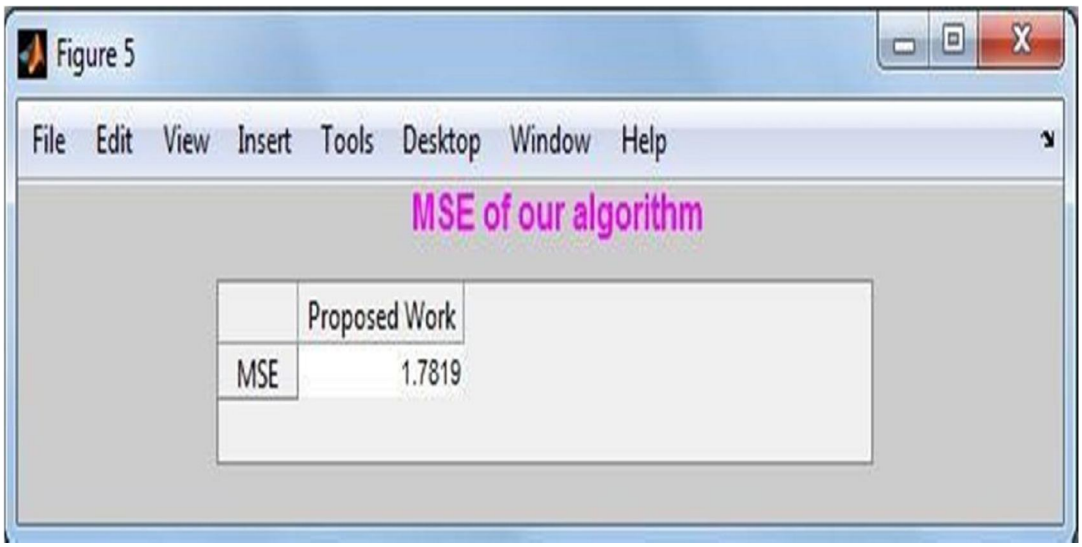
Airplane

Man

Boat

Pepper

Figure 1.3 Four original cover image



Results are shown in the bar charts form as following:

Figure: 1.4 MSE of Our algorithm of Airplane

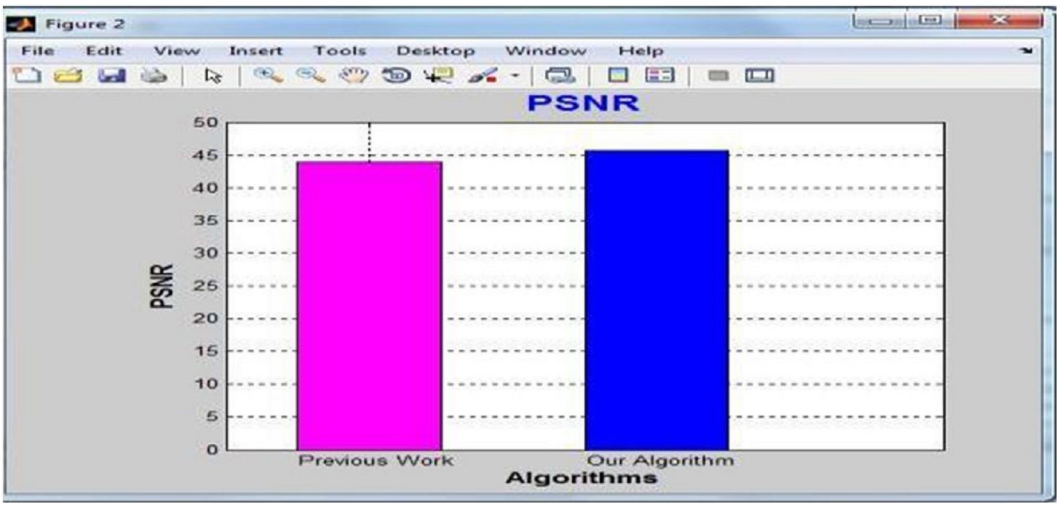


Figure 1.5 Comparison of PSNR b/w previous & our algorithm of Airplane

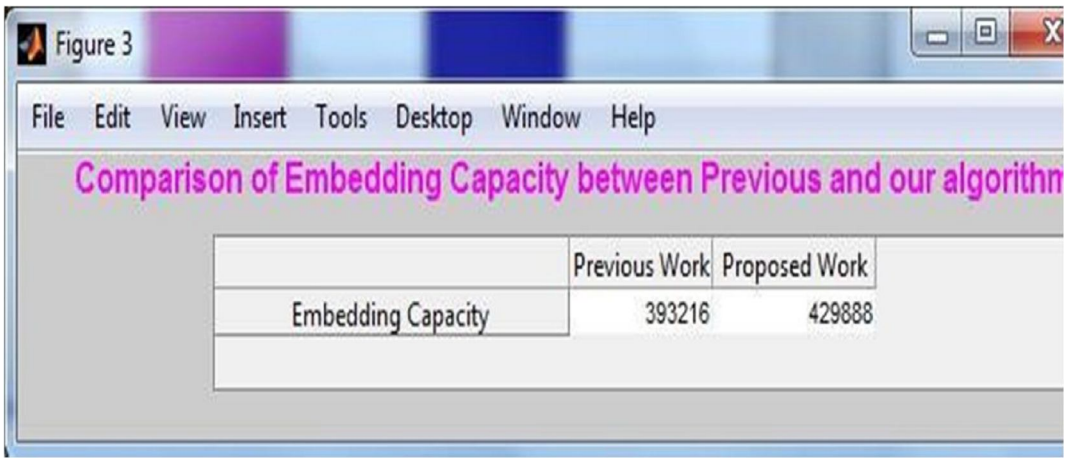


Figure 1.6 Comparison of PSNR b/w previous and algorithms in bar charts

Figure: 3.6 Comparison of embedding capacity between previous and our algorithm of Airplane

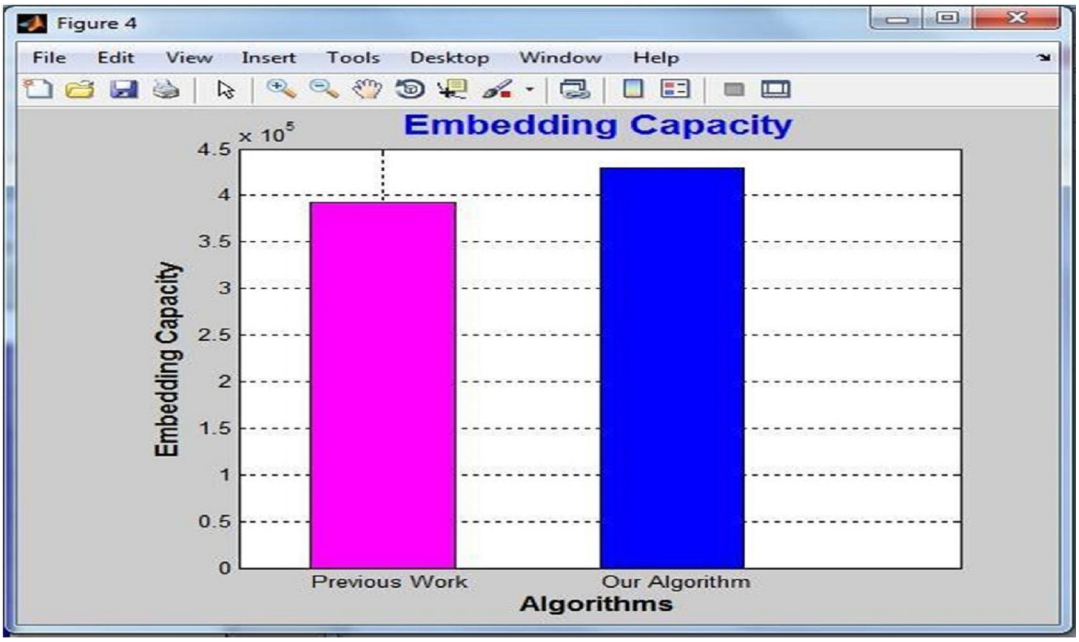


Figure: 1.7 Comparison of embedding capacity between previous and our algorithm in bar charts of Airplane

PSNR= 45.6220

PSNR= 44.9835

PSNR= 44.4977

PSNR= 45.1199

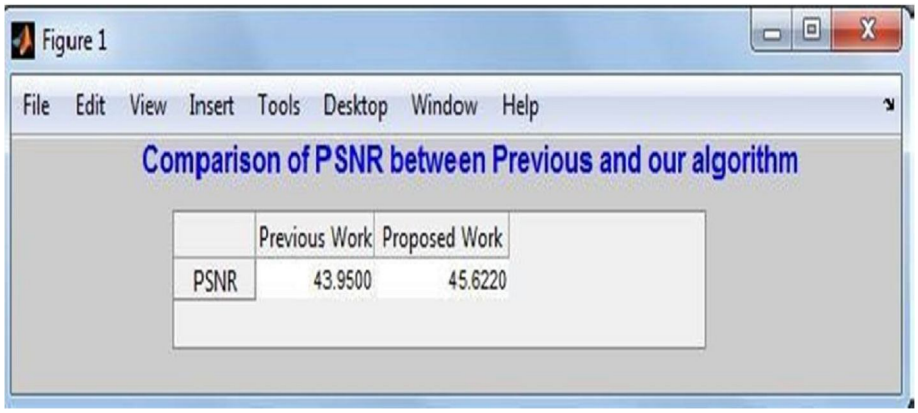


Figure: 1.8 Four watermarked image after visual cryptography with PSNR result

Experimental results shows in the form of tables as following:

Table: 1. MSE, Capacity and PSNR values of our algorithms with different images

Cover Image	MSE	Capacity(bit)	PSNR(dB)
Airplane	1.7819	429888	45.6220
Man	2.0641	429888	44.9835
Boat	2.3084	429888	44.4977
Peppers	2.0003	429888	45.1199

Table: 2. Comparison of data embedding capacity of our algorithms with previous work

Cover Image	Capacity of Previous Work	Capacity Our Algorithm
Airplane	393216	429888
Man	393216	429888
Boat	393216	429888
Pepper	393216	429888

Table: 3. Comparison of PSNR of our algorithms with previous work

Cover Image	PSNR of Previous Work	PSNR Our Algorithm
Airplane	43.95	45.6220
Man	43.93	44.9835
Boat	43.92	44.4977
Pepper	43.93	45.1199

CONCLUSIONS & FUTURE SCOPE

We have proposed Steganographic method based on Interpolation and LSB substitution of digital images with Watermarking and Cryptography. The interpolation method has been applied before hiding secret data for the purpose of higher capacity and good quality. Then, the LSB substitution method was applied for embedding secret data. Then applied DWT on the image. After this cryptography RSA algorithm used security purpose. The experimental results showed that the average PSNR was 45.05 dB and 429888 bit data embedding capacity was respectively which is better results from the previous algorithm. In future work the work possible with histogram and also improve the PSNR using different techniques and also work done based on other file format.

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Demosaicking for Artificial Vision -Implementation and Evaluation

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Abstract
The invention of Charge Coupled Devices made digital color imaging and artificial vision cost effective and easy. But the cost-effective single chip color filter array captures fifty percent of Green, twenty five percent of Blue and twenty five percent of Red color intensity of the original scene. Later those discarded and missing color samples are to be estimated for restoring the full color image. The process is called Demosaicking. Different companies employ different demosaicking methods in reconstructing the full color image by estimating the missing color samples. In this research paper Non-adaptive and Adaptive Interpolation Methods are mathematically analyzed and implemented using MATLAB. The resultant images are presented for subjective evaluation. Minimum Mean Square Errors and Signal to Noise Ratios obtained are presented for Objective Performance Evaluation of the algorithms. All the artificial and embedded vision devices, robotic vision devices and machine vision devices employ these color image reconstruction methods for digital color image restoration. In the artificial vision domain, visual attention is used to demonstrate current visual interest of robots on the one hand. This functionality is usually referred to as vision guided robotics. In this chapter, the authors illustrated the perspectives in the designing of robotic system which is guided by the vision provided to it through camera. Using MATLAB for color recognition process and embedded coding for functionality of robot, the authors have designed and implemented a vision guided robot that identifies and follows the traffic signals which can be used for autonomous intelligent vehicles for the blind.

Keywords: Charge Coupled Device, Color Image Reconstruction, Interpolation Methods, Mean Square Error, Signal to Noise Ratio, Vision Guided Robots, Visual Attention Control, Embedded Vision

I. Introduction

Consumer-level digital cameras were introduced in mid-1990s; in about a decade, the digital camera market has grown rapidly to exceed film camera sales. It's all because of 2009 Noble Prize winning invention of charge coupled device (CCD) in 1969 by W.S.Boyle and G.E.Smith (1974) [1]. Today, there are point-and-shoot cameras with over 8 million pixels; professional digital single lens reflex (SLR) cameras with more than 12 million pixels are also available. Resolution, light sensitivity, and dynamic range of the sensors have been significantly improved such that image quality of digital cameras has become comparable to that of film cameras. During an image capture process, a digital camera performs various processing mechanisms of the imaging pipeline, an important component of it is colour filter array (CFA) interpolation i.e., to recover a full-resolution image from its CFA data.

To produce a colour image, there should be at least three colour samples at each pixel location. One approach is to use beam-splitters along the optical path to project the image onto three separate sensors. Using a colour filter in front of each sensor, three full-channel colour images are obtained. This is a costly approach as it requires three CCDs sensors and moreover these sensors have to be aligned precisely (a nontrivial challenge to mechanical design). A more cost-effective and relatively less complex solution is to put a CFA in front of the sensor to capture one colour component at a pixel and then interpolate the missing two colour components. Among many CFA patterns, the most commonly used is the Bayer pattern (1974) [2]. The Bayer CFA array is shown in Fig.1.

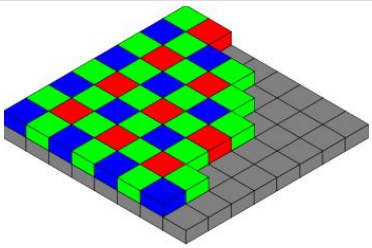

Fig. 1. Bayer Pattern of Color Filter Array

Here the Green filters are in quincunx (interlaced) grid with Red, Blue filters fill up the empty locations. As shown in Fig. 2, the rest of the sensor array is determined by the repeating this pattern both horizontally and vertically in both the spatial dimensions, R.Kimmel (1999) [3]. Here 50% of Green 25% of Red and 25% of Blue pixels of the original image will be available after sub sampling the datasets. The green channel is measured at a higher sampling rate than the other two because the peak sensitivity of the human visual system (HVS) lies in the medium wavelengths, corresponding to the green portion of the spectrum, D.Alleysson, S.Susstrunk and J.Herault (2005) [4]. Although we limit our discussion to the demosaicking problem with reference to the Bayer pattern here, the demosaicking algorithms developed for Bayer pattern can in general be extended to other patterns. Because of the mosaic pattern of the CFA, this interpolation process has been widely known as "demosaicing". Systematic analysis and comparison of different CFA patterns are referred to recent works.

II. Literature review

The presence of CFA between lens and sensor produces 'mosaic' of color samples. The mosaic of colors needs to be undone to recover three color planes in order to obtain a full color representation of the scene information. This process interpolating the missing color sample is referred to as demosaicking, Ngai Li, Jim S. Jimmy Li, and Sharmil Randhawa (2017) [5]. There are a variety of methods available for this interpolation process [6]-[7].

R_{11}	G_{12}	R_{13}	G_{14}	R_{15}	G_{16}	R_{17}
G_{21}	B_{22}	G_{23}	B_{24}	G_{25}	B_{26}	G_{27}
R_{31}	G_{32}	R_{33}	G_{34}	R_{35}	G_{36}	R_{37}
G_{41}	B_{42}	G_{43}	B_{44}	G_{45}	B_{46}	G_{47}
R_{51}	G_{52}	R_{53}	G_{54}	R_{55}	G_{56}	R_{57}
G_{61}	B_{62}	G_{63}	B_{64}	G_{65}	B_{66}	G_{67}
R_{71}	G_{72}	R_{73}	G_{74}	R_{75}	G_{76}	R_{77}

Fig. 2. Bayer CFA Pattern for Interpolation Procedure

Interpolation Methods for Digital Color Image Reconstruction are classified as Non -adaptive algorithms and Adaptive algorithms. 1.Nearest Neighbor Replication (NNR) also called as Closest Neighborhood Interpolation Algorithm (CNA), 2.Bilinear Interpolation (BILIN), 3.Median Interpolation(MIA), and 4.Smooth Hue Transition Interpolation(SHTIA) belong to first category and 5.Edge Sensing Interpolation-1 (ES-1) and 6.Edge Sensing Interpolation-2 (ES-2) fall under Adaptive algorithms category. These are the interpolation methods studied, analyzed and implemented, and then their performance is evaluated at subjective and objective levels in this research article.

A. **Non -adaptive Interpolation Methods for Digital Color Image Reconstruction**

1) Nearest Neighbor Replication (NNR) Method: *It's also called as Closest Neighborhood Interpolation Algorithm (CNA). It is the simplest Demosaicking algorithm. It assigns a color value with the nearest known red, green or blue pixel value in the same color plane. There is usually some ordering as to which (left, right, top, or below) nearest neighbor to use for the particular implementation, Ozawa.N (1987) [8]. However, it does not do a good job of interpolation, and it creates zigzag zipper color artifacts that distort the image.*

2) Bilinear Interpolation (BILIN) Method: *This is another Simplest and little faster method of interpolation algorithms. The bilinear interpolation allocates the missing color component with the linear average of the adjacent pixels with same color component, Hamilton and Adams (1997) [9]. For example, the pixel location (2,2) in Fig. 2 contains* blue *component only. Hence the missing GREEN component can be estimated as average of the left, right, top and bottom* green *pixel values. The missing* red *component can be estimated as average of the four diagonally adjacent corner neighbors containing* red *pixels. Arabic Numbers are used to represent rows and columns of green, red and blue colors.Bilinear Interpolation Process is given in steps below from (1.1) to (1.3).*

a) Interpolation of Green Pixel G_{22} in position Blue Pixel B_{22} is given by

$$G_{22} = \frac{G_{12} + G_{32} + G_{21} + G_{23}}{4} \qquad (1.1)$$

b) Interpolation of Blue Pixel B_{22} in position Blue Pixel B_{22} is given by

$$B_{22} = B_{22} \qquad (1.2)$$

c) Interpolation of Red pixel R_{22} in the position of Blue Pixel B_{22} is given by

$$R_{22} = \frac{R_{11} + R_{33} + R_{31} + R_{13}}{4} \qquad (1.3)$$

Similar Procedure can be followed for interpolating other missing pixels.

3) **Median Interpolation(MIA) Method:** ***If median interpolation is used at B_{22} for interpolating missing color samples G_{22} and R_{22}, it allocates the missing color component with the "median" value of the adjacent pixels of same color component, as opposed to the linear average used in bilinear interpolation. This provides a slightly better result in terms of visual quality as compared with the bilinear interpolation. However, the resultant images are still blurry for images with high frequency contents, and for high resolution still imaging system, this is still not acceptable. Median Interpolation Process is given in steps below from (1.4) to (1.6). T. W. Freeman (1988) [10].***

a) The Chrominance B_{22} at B_{22} is available

$$B_{22} = B_{22} \qquad (1.4)$$

b) To find the Chrominance R_{22} of the Bayer pattern at B_{22}, we have to calculate the median of the neighbour pixels R_{22}

$$R_{22} = Median\left(R_{11}, R_{13}, R_{31}, R_{33}\right) \qquad (1.5).$$

c) To find the missing Luminance pixel lines G_{22} at B_{22}, the median of the neighboring pixels of G_{22} is to be calculated

$$G_{22} = Median\left(G_{21}, G_{23}, G_{12}, G_{32}\right) \qquad (1.6)$$

4) **Smooth Hue Transition Interpolation (SHTIA) Method:** ***The key problem of the color artifacts in both bilinear and median interpolation is that the hue values of adjacent pixels change suddenly (non-smoothly). On the other hand, the Bayer CFA pattern can be considered as combination of a luminance channel (green pixels) and two chrominance channels (red and blue pixels). The smooth hue transition interpolation method interpolates these channels differently, David.R.Cok (1987) [11]. The missing Green component in every Red and Blue pixel locations in the Bayer pattern can first be interpolated using bilinear interpolation as discussed before. The idea of chrominance channel interpolation is to impose a smooth transition in hue value from pixel to pixel. In order to do so, it defines blue "hue value" as B/G, and red "hue value" as R/G. For interpolation of the missing blue pixel values m n B, in pixel location (m, n) in the Bayer pattern, the following three different cases may arise, as given in steps below from (1.7) to (1.9).***

a) As shown in pixel location in (2,3) Fig.2, If the pixel location (m, n) contains Green color component only and the adjacent left and right pixel locations contain Blue color component only,then the Blue information in location (m, n) can be estimated as follows:

$$B(m,n) = G(m,n) \times \frac{1}{2} \times \begin{Bmatrix} \left(B(m,n-1)/G(m,n-1)\right) \\ +\left(B(m,n+1)/G(m,n+1)\right) \end{Bmatrix} \qquad (1.7)$$

b) As shown in pixel location (3,2) in Fig.2, If the pixel location (m,n) contains Green color component only and the adjacent top and bottom pixel locatins contain Blue color component only, then the Blue information in the location (m,n) can be estimated as follows:

$$B(m,n) = G(m,n) \times \frac{1}{2} \times \begin{Bmatrix} \left(B(m-1,n)/G(m-1,n)\right) \\ +\left(B(m+1,n)/G(m+1,n)\right) \end{Bmatrix} \qquad \textbf{(1.8)}$$

c) As shown in pixel location (3,3) in Fig.2.; If the pixel location (m, n) contains Red color component only. Obviously, four diagonally neighboring corner pixels contain Blue color only, Then BLUE information in location (m, n) can be estimated as follows:

$$B(m,n) = G(m,n) \times \frac{1}{4} \times \begin{Bmatrix} \left(B(m-1,n-1)/G(m-1,n-1)\right) \\ +\left(B(m-1,n+1)/G(m-1,n+1)\right) \\ +\left(B(m+1,n-1)/G(m+1,n-1)\right) \\ +\left(B(m+1,n+1)/G(m+1,n+1)\right) \end{Bmatrix} \qquad (1.9)$$

The interpolation of missing *Red* pixel values can be carried out similarly. Depending on the location, interpolation step happens, and the definition of "hue value" changes. For example, if the pixel value is transformed into logarithmic exposure space from linear space before interpolation, instead of *B/G* or *R/G*, one can now define the "hue value" as *(B-G)* or *(R-G)*. This is coming from the fact that *log(X/Y) = log(X) – log(Y) = X' – Y'*. Here *X'* and *Y'* are the logarithmic values of *X* and *Y* respectively. Since the linear/nonlinear transformation can be done using a simple table look-up and all the division for calculating hue value is replaced by subtraction, this helps reduce computational complexity for implementation.

B. Adaptive Interpolation Methods for Digital Color Image Reconstruction

These algorithms are relatively complex and do perform better compared with Non-Adaptive Interpolation Algorithms. In this research paper two Adaptive algorithms viz., Edge Sensing Interpolation Algorithms 1 and 2 are studied, implemented and their performance is evaluated at subjective and objective levels.

1) **Edge Sensing Interpolation-1 (ES-1) Method:** ***The edge sensing adaptive demosaicking algorithm uses a set of threshold values to determine whether to average adjacent pixels on the right and left side or adjacent pixels on the top and bottom side of the pixel being interpolated. As the name alludes to, this algorithm is especially important in Demosaicking edges within a picture. Essentially the algorithm determines where a particular direction of adjacent pixels (top-bottom or left-right) is exclusively greater than a given threshold value, as shown in equations below from (1.10) to (1.13). If this is the case, then most likely a line or edge exists and therefore when averaging adjacent pixels for Demosaicking, it is best not to smooth in the direction where the gradient values are higher than a given threshold value. Where this method fails is along diagonal lines, since the gradients are only taken along the horizontal and vertical directions.Edge Sensing Interpolation-1 process is given in steps below. Hibbard, R.H., (1995) [12].***

a) Finding the gradient in horizontal direction of green pixel G_{33}.

$$G(H) = Mod\left(G_{32} - G_{34}\right) \qquad (1.10)$$

b) Finding the gradient in the vertical direction of green pixel G_{33}

$$G(V) = Mod\left(G_{23} - G_{24}\right) \qquad (1.11)$$

c) Finding the threshold of the vertical and horizontal gradient.

$$T = \frac{G(H) + G(V)}{2} \qquad (1.12)$$

d) Finding G_{33} at R_{33}

$$\begin{aligned}
&\textit{If}\\
&G(V) \prec T\\
&\textit{Then}\\
&G_{33} = \frac{G_{23} + G_{43}}{2}\\
&\textit{Elseif}\\
&G(H) \prec T\\
&\textit{Then}\\
&G_{33} = \frac{G_{32} + G_{34}}{2}\\
&\textit{Elseif}\\
&G_{33} = \frac{G_{23} + G_{34} + G_{32} + G_{34}}{4}
\end{aligned} \qquad (1.13)$$

2) **Edge Sensing Interpolation-2 (ES-2) Method:** ***Depending on luminance gradients, different predictors are used for estimating the missing*** **green** ***values in the edge sensing interpolation method. First, two gradients are defined one in horizontal direction and the other in vertical direction for each pixel location*** **red** ***or*** **blue.** ***Laroch, G.A, and Prescott.M.A., (1994) [13].***

III. Performance evaluation

The evaluation of performance of Interpolation methods is done at two levels i.e., Subjective and Objective levels. Wenmain Lu and Yap-peng Tan (2003) [14].

A. Subjective Performance Evaluation

Fig. 3 shows from top to bottom the original image, 2D and 3D Bayer arrays of the test image 1 i.e., image of Macaws, a standard test image taken from the Kodak test image data base. Fig. 4 shows from top to bottom the original image, 2D and 3D Bayer patterns of test image 2 i.e., image of St. Mary's Engineering College, Hyderabad. Fig. 5 shows the resultant images from top to bottom and from left to right of Interpolation methods 1 to 6 implemented for test image 1. Fig. 6 shows the resultant images of test image 2 from top to bottom, from left to right implemented for Interpolation methods 1 to 6. MATLAB is used for implementation. Fig. 5 and Fig. 6 are presented here for the evaluation of the interpolation methods at subjective level. The viewer can observe and interpret the results for the performance of the algorithms but this method is not a perfect one. Hence Objective Performance evaluation is necessary.

B. Objective Performance Evaluation

The Objective Performance metrics used here to evaluate the performance of the interpolation methods are Minimum Mean Square Error (MMSE) and Signal to Noise Ratio (SNR) obtained through the implementation of the algorithms for test images 1and 2 using MATLAB.

- Minimum Mean Square Error (MMSE)

MMSE corresponds to the expected value of the squared error loss or quadratic loss. It measures the average of the squared error. Minimum is its value, better is the performance of the interpolation method.

$$MMSE = \frac{\sum_{x=1}^{m}\sum_{y=1}^{n}\left[\boldsymbol{I}_o(x,y) - \boldsymbol{I}_r(x,y)\right]^2}{(m \times n)} \qquad (1.14)$$

Where (m×n): size of the image, $I_o(x, y)$: Original Image, $I_r(x, y)$: Reconstructed Image.

- Signal to Noise Ratio(SNR)

SNR is a measure used to quantify how much a signal has been corrupted by the unwanted signal. It is defined as the ratio of signal power to the noise power corrupting the signal.

$$SNR = [-10\log]\frac{\frac{1}{KL}\sum_{k=1}^{k-1}\sum_{l=1}^{l-1}\left(\boldsymbol{I}_o(k,l) - \boldsymbol{I}_r(k,l)\right)^2}{255^2}[dB] \qquad (1.15)$$

Where the product KL: Spatial Resolution of the image; the numerator represents the squared average pixel value of the image; and the denominator represents the squared color resolution.

The objective performance metrics MMSE and SNR values obtained using Interpolation Methods 1 to 6 (CNA/NNA, MIA, BILIN, SHITA, ES-1 and ES-2) for test image 1 and 2 respectively are Tabulated in TABLE I. The graph charts of the same are shown in Fig. 7 and 8.

Fig. 3. Original image, 2D and 3D Bayer Array of Test Image 1

Fig. 4. Original image, 2D and 3D Bayer Array of Test Image 2

Fig. 5. Resultant Images of test image 1 for interpolation methods 1 to 6

Fig. 6. Resultant Images of test image 2 for interpolation methods 1 to 6

TABLE I. OBJECTIVE PERFORMANCE METRICS-MMSE AND SNR

SERIAL NO.	INTERPOLATION METHOD	TEST IMAGE 1						TEST IMAGE 2					
		MMSE			SNR			MMSE			SNR		
		RED	GREEN	BLUE	RED	GREEN	BLUE	RED	GREEN	BLUE	RED	GREEN	BLUE
1	CNA/ NNA	6.9342	4.3953	7.1951	43.6874	45.6535	43.5272	34.1288	26.7500	35.8306	36.0550	37.7186	41.2688
2	MIA	3.6307	2.3016	3.7778	46.1088	49.2817	45.9656	31.8643	21.0043	33.0435	36.5409	38.7566	36.4215
3	BILIN	3.4694	2.3193	3.5620	46.4683	49.2485	46.3652	32.9541	24.4220	33.5819	36.4251	38.1801	36.3667
4	SHTIA	3.8672	2.3463	2.5114	45.9152	49.1982	47.5434	33.0005	24.5569	34.7842	36.2688	38.1603	36.0885
5	ES-1	3.7620	1.9892	2.2534	45.9725	49.9153	47.8817	30.6912	19.7867	32.8111	36.7096	39.0134	36.2601
6	ES-2	**1.4749**	1.5748	**1.3283**	49.4165	50.9299	49.7887	27.0655	19.9569	25.6218	37.3107	38.9842	37.7424

IV. Interpretation of the results

The resultant images presented in Fig. 3 to 6 will help the viewer in evaluating subjectively the performance of the interpolation methods. But all images look alike to a naked eye. Hence the Objective performance metrics MMSE and SNR will help anyone to evaluate objectively which interpolation method is better. Minimum is the value of MMSE; and greater is the value of SNR, better is the performance of the algorithm. From the graphic charts of MMSE and SNR shown in Fig. 7 and 8, it is clear that Edge Sensing-2 Interpolation method do better compared with other algorithms. But its MMSE is least and SNR is greater relatively. Graph chart of resultant MMSE (first half) and

SNR(second half) values of interpolation methods 1 to 6 for test image 1. As shown in Fig 9, from the earlier discussed demosaicking algorithms, it is seen that different perspectives in the designing of the vision for guided robots. Based on that knowledge, it is designed and implemented a vision guided robot, which recognizes the red, blue and green colors and takes the direction as forward, right and back respectively

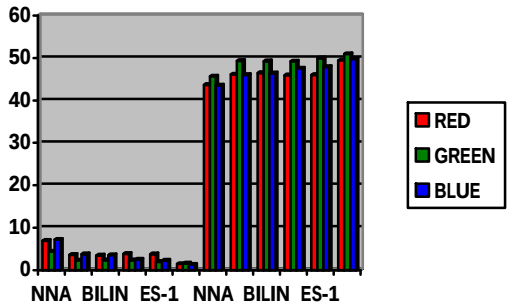

Fig. 7. Graph chart of resultant MMSE(first half) and SNR(second half) values of interpolation methods 1 to 6 for test image1(Standard test image Macaws).

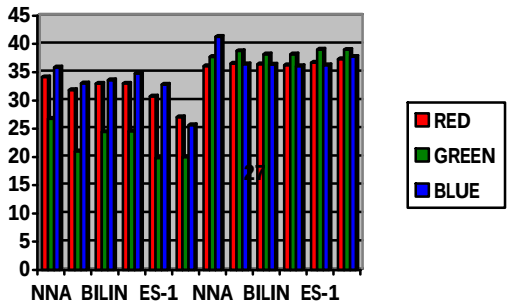

Fig. 8. Graph chart of resultant MMSE(first half) and SNR(second half) values of interpolation methods 1 to 6 for test image 2(Non standard real time test image).

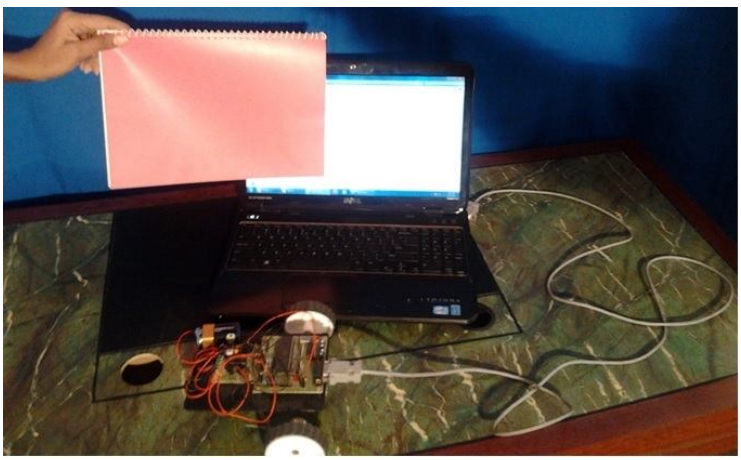

Fig. 9. Color recognising Vision guided robot implementation for designing the autonomous vehicle for the blind.

v. CONCLUSIONS

In this paper, four non adaptive and two adaptive, altogether six color image reconstruction algorithms are implemented using MATLAB, after due theoretical study and mathematical analysis. The

comparative performance analysis-subjective and objective quality (MSE& SNR) of reconstructed images is done. For the digital design of machine, robotic or artificial vision devices, if we were to choose one only from the algorithms we have considered here, and then edge sensing algorithm-2 can be preferred. To verify the design and implementation of artificial vision for robots, autonomous vision guided vehicles for the blind, the color recognition robot and designed and implemented. The developed vision based robot recognizes the traffic signals red, green and blue and makes changes in its functioning accordingly. MATLAB is used for developing color recognition process and embedded coding is used for functionality of the robot. The developed model can be used for designing autonomous intelligent vehicles for the blind.

VI. FUTURE ENHANCEMENTS

The interpolation methods can be evaluated based on their computational complexities. And other objective performance evaluation metrics can also be explored and implemented.

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ISBN: 978-81-946375-0-9

Haematological Study of Pigeon (Columba livia) on the basis of special reference to Morpho Anatomy, Behavioural, Reproduction, Growth & Development

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Abstract
Humans have observed birds from the earliest times and Stone Age drawings are among the oldest indications of an interest in birds. Many aspects of bird biology are difficult to study in the field. These include the study of behavioural and physiological changes that require a long duration of access to the bird. Studies in bird behaviour include the use of tamed and trained birds in captivity. Studies on bird intelligence and song learning have been largely laboratory based. Studies of bird migration including aspects of navigation, orientation and physiology are often studied using captive birds in special cages that record their activities. The present study was designed with the following objectives to study and analyze corpuscular haematological parameters related to reproduction, growth, development and behaviour of the domestic or feral pigeon.

Introduction

The Rock Dove (Columba livia) or Rock Pigeon is a member of the bird family Columbidae (doves and pigeons). In common usage, this bird is often simply referred to as the "pigeon". The domestic pigeon (Columba livia) (also called the rock dove or city pigeon) was originally found in Europe, Northern Africa, and India. Early settlers introduced it into the eastern United States as a domestic bird in the 1600s. Since then, it has expanded throughout the United States to Alaska, across southern Canada, and south into South America. Feral pigeons (Columba livia), also called city doves, city pigeons, or street pigeons, are derived from domestic pigeons that have returned to the wild. The domestic pigeon was originally bred from the wild Rock Dove, which naturally inhabits sea-cliffs and mountains. Rock (i.e., 'wild'), domestic, and feral pigeons are all the same species and will readily interbreed. Feral pigeons find the ledges of buildings to be a substitute for sea cliffs, have become adapted to urban life, and are abundant in towns and cities throughout much of the world. Wild Rock Doves are pale grey with two black bars on each wing, although domestic and feral pigeons are very variable in color and pattern. There are few visible differences between males and females. The species is generally monogamous, with two squeakers (young) per brood. Both parents care for the young for a time.

Rock Dove

Scientific classification

Kingdom: Animalia

Phylum:	Chordata
Class:	Aves
Order:	Columbiformes
Family:	Columbidae
Genus:	Columba
Species:	C. livia

Habitats include various open and semi-open environments. Cliffs and rock ledges are used for roosting and breeding in the wild. Originally found wild in Europe, North Africa, and western Asia, feral pigeons have become established in cities around the world. The species is abundant, with an estimated population of 17 to 28 million feral and wild birds in Europe. Pigeons nest and roost on and in houses because it gives them a good view of nearby feeding areas or because they have gained access to the interior of the building and made your attic their home. They usually access buildings through broken windows, missing or loose vents or soffit or any other small gap or opening. Pigeons also like high places because they are able to keep a close watch on things and spot predators. Pigeons are social birds and each flock works as a team. Someone always has an eye out for danger. Pigeons live in every part of the world but the North and South Poles. They started out as pets, but through accidental or intentional release have developed into perhaps the most common feral bird. Originally they liked places with lots of grain, like farms, especially when they are near areas with good nesting sites in high and inaccessible places, like cliffs or buildings. Once known as "rock doves," pigeons live anywhere there is adequate food and shelter and are common in most urban and suburban areas. Stadiums and fast-food restaurants, parks and bridges, airports and schools-all are common pigeon environments. While feeding the pigeons in the park seems harmless, it definitely contributes to the overall problem of urban pests. There are very few predators of pigeons (cats, hawks and falcons) and the birds flourish, overwhelming some areas. Pigeons are non-migratory, medium size birds. They have a variety of colourings, but are frequently white or grey, usually with salmon colored legs and feet. They have a smooth appearance with a round body, narrow neck and relatively small head. They feed on the ground, usually in groups or flocks, but occasionally as individuals. They roost anywhere that is comfortable-ledges of buildings, attics, statues. Pigeons have been known be called "flying rats." These birds can be pests if they have chosen to hang out near your home or office. Here you will find tips for humane ways to deter pigeons. This is a guide about getting rid of pigeons. The first pigeons, or Rock Doves, were brought to North America by European settlers and are now found throughout the United States, southern Canada and Mexico. Pigeons have long been used to deliver messages, particularly during World War I and II. Scientists are baffled by their uncanny ability to find their way home over hundreds of miles.

The species is also known as the Rock Pigeon or Blue Rock Dove, the former being the official name from 2004 to 2011,

Behavioral Study: The behavioral study in male and female squabs and adult pigeons were carried out.

Statistical Analysis: Results are presented as mean ± SD and total variation present in a set of data was analyzed through one way analysis of variance (ANOVA). Difference among mean values has been analyzed by applying Dunnet's t-test. Calculations were performed with the Graph Pad Prism Program (Graph Pad software, Inc., San Diego, U.S.A.). The criterion for statistical significance was set at $P< 0.05$.

Hematological findings -Data of hematological parameters are shown from Fig. 1-9 shows significant changes in the in the erythrocyte counts (RBCs), hemoglobin percentage, PCV levels, ESR, MCV, MCH, WBC Counts, Neutrophil counts, Lymphocyte counts in male and female squabs ($P < 0.0001$).

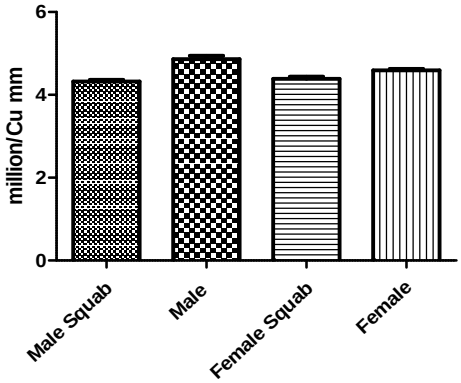

Fig.1. Total RBC Counts. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

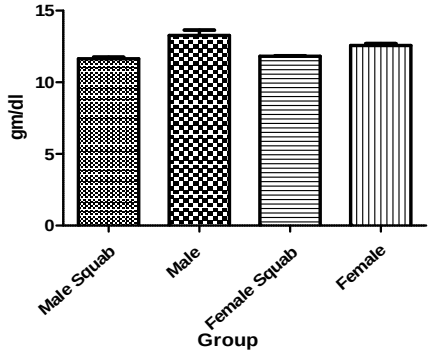

Fig.2. Haemoglobin Percentage. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

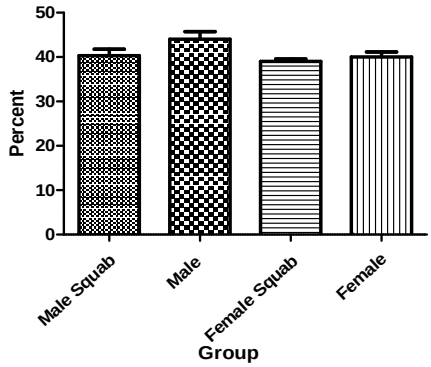

Fig.3. PCV Level. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

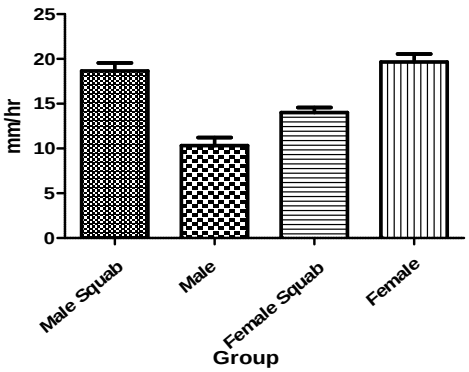

Fig.4. ESR Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

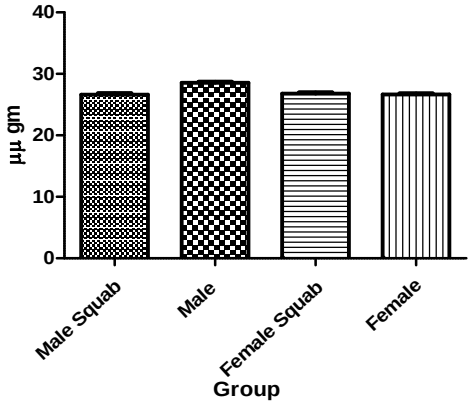

Fig.5. MCH Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

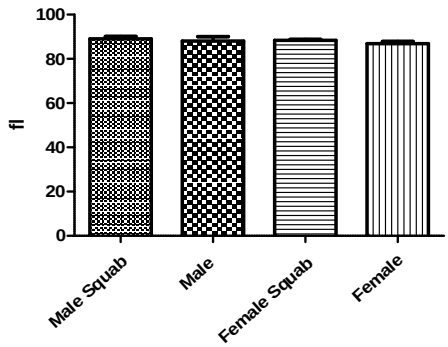

Fig.6. MCV Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

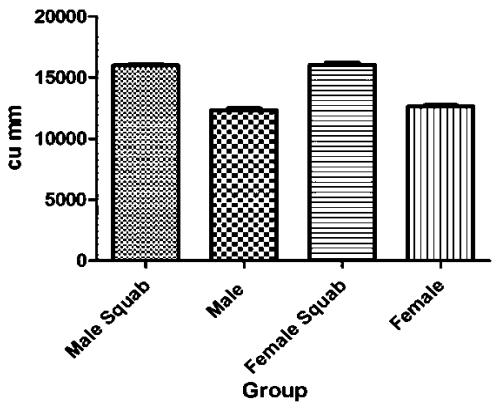

Fig.7. WBC Counts Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

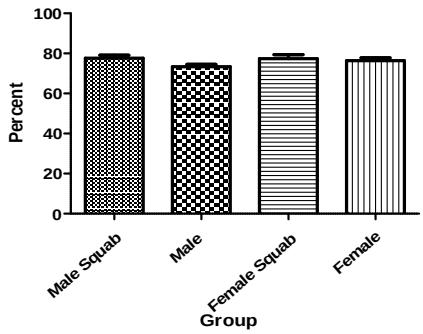

Fig.8 Neutrophil Counts Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

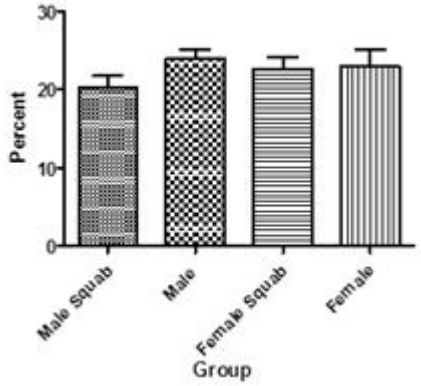

Fig.9 Lymphocyte Counts Levels. The data are presented as mean ± S.D, n = 6, significance at P< 0.001.

The Hypothesis-

Pigeons are usually gray, but can have several colour phases, including reddish-brown, tan, mottled and white. They generally have two black bars on the wing, a broad black band on the tail, a whitish rump and red feet. Their average weight is 370 grams and average length is 28cm. When pigeons take off their wing tips touch, making a characteristic clicking sound. They feed not only on grains but also on the treats that humans provide such as bread, popcorn, peanuts, cake, etc. Pigeons are non-migratory, flourishing in large cities throughout the world and other human-inhabited areas. Pigeons are very social birds and although they tend to breed and roost in groups, they are usually monogamous and pair for life unless one partner dies. Under ideal conditions, pigeons may live 15 to 20 years, although in the urban setting, they seldom live longer than three to four years. A major advantage of city life is the presence of building ledges, rafters, beams, bridges and balconies that provide shelter and nesting sites. Most breeding occurs in the spring and summer months, but pigeons can and will breed in any season of the year. Both male and female birds guard the nest, which is a flimsy collection of loose sticks and twigs. One or two white eggs are laid per nesting and both parents incubate the eggs. Pigeons will raise several clutches per year, using the same nest site. Incubation lasts about three weeks and the nestlings are helpless, blind and down-covered when they hatch. They are brooded for at least a week by attentive parents and then leave the nest approximately four weeks after hatching. The species is also known as the Rock Pigeon or Blue Rock Dove, the former being the official name from 2004 to 2011, at which point the IOC changed their official listing to its original British name of Rock Dove. In common usage, this bird is still often simply referred to as the "pigeon". Baby pigeons are called squabs. There are 12 subspecies recognized by Gibbs (2000); some of these may be derived from feral stock.

Objectives of research

The present study significantly shows the haematological correlation with the behavioural changes in Pigeon The adult female is almost identical to the male, but the iridescence The adult of the nominate subspecies of the Rock Dove is 29 to 37 cm (11 to 15 in) long with a 62 to 72 cm (24 to 28 in) wingspan. Weight for wild or feral Rock Doves ranges from 238–380 g (8.4–13 oz), though overfed domestic and semi-domestic individuals can exceed normal weights. It has a dark bluish-gray head, neck, and chest with glossy yellowish, greenish, and reddish-purple iridescence along its neck and wing feathers. The iris is orange, red or golden with a paler inner ring, and the bare skin round the eye is bluish-grey. The bill is grey-black with a conspicuous off-white cere, and the feet are purplish-red. Among standard measurements, the wing chord is typically around 22.3 cm (8.8 in), the tail is 9.5 to 11 cm (3.7 to 4.3 in), the bill is around 1.8 cm (0.71 in) and the tarsus is 2.6 to 3.5 cm (1.0 to 1.4 in). Young birds show little luster and are duller. Eye colour of the pigeon is generally orange but a few pigeons may have white-grey eyes. The eyelids are orange in colour and are encapsulated in a grey-white eye ring. The feet are red to pink. Pigeons feed on the ground in flocks or individually. They roost together in buildings or on walls or statues. When drinking, most birds take small sips and tilt

their heads backwards to swallow the water. Pigeons are able to dip their bills into the water and drink continuously without having to tilt their heads back.

Distribution and habitat

Feral Rock Doves in semi-natural habitat perched on sea cliffs. The Rock Dove has a restricted natural resident range in western and southern Europe, North Africa, and into South Asia. The Rock Dove is often found in pairs in the breeding season but is usually gregarious. The species (including ferals) has a large range, with an estimated global extent of occurrence of 10,000,000 km2 (3,900,000 sq mi). It has a large global population, including an estimated 17–28 million individuals in Europe. Fossil evidence suggests the Rock Dove originated in southern Asia and skeletal remains unearthed in Israel confirm their existence there for at least three hundred thousand years. However, this species has such a long history with humans that it is impossible to tell exactly where the species' original range was. Its habitat is natural cliffs, usually on coasts. Its domesticated form, the feral pigeon, has been widely introduced elsewhere, and is common, especially in cities, over much of the world. A Rock Pigeon's lifespan is anywhere from 3–5 years in the wild to 15 years in captivity, though longer-lived specimens have been reported. The main causes of mortality in the wild are predators and persecution by humans.[citation needed] The species was first introduced to North America in 1606 at Port Royal, Nova Scotia.

Male and female Difference Based on Following Four Types.

Size-Male pigeons are slightly bigger and more robust than females. However, it is often difficult to observe size difference between sexes in domestic and wild species, such as the turkey-sized Victoria crowned pigeon (Goura victoria), which is endemic to New Guinea. The head shape can help to differ males from females. In some species, female pigeons have narrower heads.

Colour-In some species, adult males have brighter orange rings around the edge of their irises. Females often have light orange or greenish gray eyes. Domestic and feral pigeons with predominant black patterns and iridescent neck feathers are more likely to be males. Wood pigeon (Columba palumbus) males often have lighter breasts in comparison to females. Endemic to the Fiji islands, Ptilinopus victor is a species featuring distinct colours between sexes: males are bright orange and females are green.

Sexual Organs-Although the only external sexual organ in both male and female pigeons is the cloaca, which is also used for excretion, internal sexual organs are very distinct between the sexes. Male pigeons produce sperm in two testicles, which become larger during mating season. Females have only one functional ovary, which is linked to a long tube called the oviduct.

Behaviour-The best way to identify the sex of a pigeon is to observe its behaviour. During mating season, males make a distinct and long sound, bow to the floor and open their tails making a semi-circle, while females stand upright swelling their plumage. Males also peck the heads of females.

Result And Discussion

Behavioural Studies:- Feeding Behaviour in Pigeons

These birds feed on the ground and can be attracted to platform feeders. Offering crumbs, cracked corn and other grain seeds will attract these birds Feral pigeons are not only seen as pariahs, they are a joy for many people as well. © H Van Grouw. Feral pigeons live independently of but usually close to humans, their buildings, and agriculture products. Their long history could well have produced birds that are more independent of humans than feral seem to be. And it is worth noting that even wholly wild Rock pigeons today take advantage of humans as resources for food, as in agriculture fields. In some towns all or part of the pigeon population may fly out into the surrounding country to feed, returning to roost and nest on the buildings. The same individuals may feed both inside the town and in the surrounding fields. Feral pigeons living in large towns often feed inside the town itself. Some natural food is obtained from exposed earth or grass plots in parks and gardens but the greater part consist of bread or other artificial food which is found by them in the streets.

Flocking behaviour

The flock behaviour of feral pigeons Columba livia var. living in the Salford Docks, Manchester, was studied. Feeding flocks varied in size and were distributed according to the availability of regular sources of spilled grain and other commercial feeding stuffs. Compared with feeding flocks, roosting flocks were smaller but more numerous, probably because roosting sites were not limiting. The value of the flock habit in locating food sources by local enhancement is described. Food mostly occurred sporadically, depending on commercial activity and was only available to the birds when workmen moved off. Birds tended to arrive at the feeding grounds when human activity was reduced. In summer the flocks spent about 6 h in the vicinity of food sources (7 h in winter), but were able to approach and `scramble' for food during about 10 min/h; individual birds had less time to feed because to some extent different segments of the flock were first to get to a food pile when one became available. A stable social hierarchy in both the roosting and feeding flocks was demonstrated by marking birds with colored and serially numbered patagial tags. Some birds consistently occupied the centre of the feeding flocks, and these individuals obtained more food per minute, and per area searched, than average flock members; birds on the flock edge obtained very little food.

Breeding Behaviour

Pairs are monogamous, often breeding in consecutive seasons for as long as both birds of a pair live. Most will attempt to raise several broods each year. Sometimes as many as four or five broods will be raised in a single year. The breeding season of these birds can be all year provided climate conditions allow. There seems to be some slowing down during the winter months.

1 Courtship 2 Nesting 3 Cooing 4 Food

Courtship-Courtship rituals among can be observed in urban parks at any time of the year. The male on the ground or rooftops puffs up the feathers on the neck to appear larger and thereby impress or attract attention. He approaches the hen at a rapid walking pace while emitting repetitive quiet notes, often bowing and turning as he comes closer. At first the female invariably walks or flies a short distance away and the male follows her until she stops. At this point he will continue the bowing motion and very often make full- or half-pirouettes in front of the female. The male will then proceed to feed the female by regurgitating food, as they do when feeding the young. The male then mounts

the female, rearing backwards to be able to join their cloacas. The mating is very brief with the male flapping his wings to maintain balance on top of the female.

Nesting-Nests are rudimentary, similar to other ground or cliff nesting birds such as turkey, quail, and ducks. Abandoned buildings are favourite nesting areas. Mass nesting is common as pigeons are a community flocking bird; often dozens of birds will share a building. Loose tiles and broken windows provide access, and pigeons are adept at spotting new access points, for example following property damage caused by strong winds. Nests and droppings tend to stay clustered and remain dry when out of the weather. Pigeons are particularly fond of roof spaces. These often contain water tanks. Any water tank or cistern on a roof must therefore be secured and sealed off to keep the pigeons out of them. The popularity of a nesting area does not seem to be affected by the pigeons' population density.

Cooing-In Wendell Levi's The Pigeon, he describes the crowing/cooing of pigeons as mostly being associated with strutting and fighting in male birds. Hens will also coo, but this is noticeably less guttural than the cooing of the cock. Cooing is also more frequent between couples during mating and nesting. Both parents participate in the incubation of the eggs.

Food-Pigeons breed when the food supply is abundant enough to support embryonic egg development, which in cities can be any time of the year. Lying of eggs can take place up to six times per year. Pigeons mate for life, and are often found in pairs during the breeding season, but usually the pigeons are gregarious preferring to exist in flocks of from 50 to 500 birds (dependent on the food supply). Feral pigeons can be seen eating grass seeds and berries in parks and gardens in the spring, but there are plentiful sources throughout the year from scavenging (e.g., remnants left inside of dropped fast-food cartons) and they will also take insects and spiders.

Parental Care: Baby pigeons, normally called squabs, require about 24 hours to peck and wiggle their way out of their egg. Those who raise baby pigeons need to allow the little squab to work their own way out of the egg, as the fight for freedom is a healthy part of their body's development and any interference can cost them their life. Once their damp downy little bodies emerge, the baby pigeon is considered to be one of the least attractive of baby birds, with large awkward eyes and almost thin floppy neck. Of course, as they grow up they will adapt a more visually appealing body. Feral pigeons can be seen eating grass seeds and berries in parks and gardens in the spring, but there are plentiful sources throughout the year from scavenging (e.g., remnants left inside of dropped fast-food cartons) and they will also take insects and spiders. Additional food is also usually available from the disposing of stale bread in parks by restaurants and supermarkets and from tourists buying and distributing birdseed, etc. Pigeons tend to congregate in large, often thick flocks when feeding on discarded food, and have been observed flying skilfully around trees, buildings, telephone poles and cables, and even through moving traffic just to reach a food source

Nesting Behaviour

Build a shed or loft with an attached fly pen for the homing pigeons. A workable loft size is 4 feet by 8 feet with a 7-foot height. Provide a sturdy roof and a door for easy access. Construct the breeding loft so it is dry and draft-free. Make it rodent- and cat-proof. Design the loft so both shade and sunlight are provided to the birds throughout the day.Attach the nest boxes to an interior wall of the loft. Provide two nest boxes for each breeding pair of pigeons. The nest boxes are 12-18 inches wide, 12 inches high and 12 inches deep with a closed back. Place a 1-inch-by-4-inch board across the front bottom of each nest box to retain the nest material and keep the eggs and squab from falling out. Extra nest boxes will prevent quarrelling among the breeding pairs. Construct a separate perch in the loft for each bird. Perches can be made from 1-inch-by-4-inch boards. Attach the 3-inch-long perches to the board across the front of each nesting box.Design an easy-to-clean loft to avoid a build-up of feces. Cover the floor with an inch of sand and place bedding material on the bottom of each nest box

Anatomy

External anatomy (topography) of a typical bird: 1 Beak, 2 Head, 3 Iris, 4 Pupil, 5 Mantle, 6 Lesser coverts, 7 Scapulars, 8 Coverts, 9 Tertials, 10 Rump, 11 Primaries, 12 Vent, 13 Thigh, 14 Tibio-tarsal articulation, 15 Tarsus, 16 Feet, 17 Tibia, 18 Belly, 19 Flanks, 20 Breast, 21 Throat, 22 Wattle, 23

Eyestripe Bird anatomy, or the physiological structure of birds' bodies, shows many unique adaptations, mostly aiding flight. Birds have a light skeletal system and light but powerful musculature which, along with circulatory and respiratory systems capable of very high metabolic rates and oxygen supply, permit the bird to fly. The development of a beak has led to evolution of a specially adapted digestive system. These anatomical specializations have earned birds their own class in the vertebrate phylum.

Skeletal system in Pigeon

The Pigeon skeleton is highly adapted for flight. It is extremely lightweight but strong enough to withstand the stresses of taking off, flying, and landing. One key adaptation is the fusing of bones into single ossifications, such as the pygostyle. Because of this, birds usually have a smaller number of bones than other terrestrial vertebrates. Pigeon also lack teeth or even a true jaw, instead having evolved a beak, which is far more lightweight. The beaks of many baby birds have a projection called an egg tooth, which facilitates their exit from the amniotic egg, and that falls off once it has done its job.

Pigeon have many bones that are hollow (pneumatised) with criss-crossing struts or trusses for structural strength. The number of hollow bones varies among species, though large gliding and soaring birds tend to have the most. Respiratory air sacs often form air pockets within the semi-hollow bones of the bird's skeleton. Some flightless birds like penguins and ostriches have only solid bones, further evidencing the link between flight and the adaptation of hollow bonesPigeon also have more cervical (neck) vertebrae than many other animals; most have a highly flexible neck consisting of 13-25 vertebrae. Birds are the only vertebrate animals to have a fused collarbone (the furcula or wishbone) or a keeled sternum or breastbone. The keel of the sternum serves as an attachment site for the muscles used for flight, or similarly for swimming in penguins. Again, flightless birds, such as ostriches, which do not have highly developed pectoral muscles, lack a pronounced keel on the sternum. It is noted that swimming birds have a wide sternum, while walking birds had a long or high sternum while flying birds have the width and height nearly equal.

Muscular system

The supracoracoideus works using a pulley like system to lift the wing while the pectorals provide the powerful downstroke.Most birds have approximately 175 different muscles, mainly controlling the wings, skin, and legs. The largest muscles in the bird are the pectorals, or the breast muscles, which control the wings and make up about 15 - 25% of a flighted bird’s body weight. They provide the powerful wing stroke essential for flight. The muscle medial (underneath) to the pectorals is the supracoracoideus. It raises the wing between wingbeats. The supracoracoideus and the pectorals together make up about 25 – 35% of the bird's full body weight]The skin muscles help a bird in its flight by adjusting the feathers, which are attached to the skin muscle and help the bird in its flight maneuvers.There are only a few muscles in the trunk and the tail, but they are very strong and are essential for the bird. The pygostyle controls all the movement in the tail and controls the feathers in the tail. This gives the tail a larger surface area which helps keep the bird in the air.

Reproductive system

Pigeons are monogamous birds which mean they live in pairs. They reach the sexual maturity at the age of 6 months (some a little earlier, some later) and the reproduction is started at the age of 8 months. The breeder matches the pairs and close them in special created boxes for partners to get used with each other. Usually, a week is quite enough for the couple to be enclosed in the box and get used with each other. A good habit is to separate female and male in different lofts before copulation. Personally, I separate them in the winter for about 2 months before copulation and I make different pairs every year. Female lays in the nest 2 small white eggs. The first egg is usually laid in the afternoon and the second one in the morning two days later (about 44 hours difference). Pigeon eggs weight approximately 25g, depending on the pigeon breed. Brooding is done by both partners. The male pigeon broods during the day (between 9 am and 6 pm) and the female pigeon during the night (6 pm to 9 am). The chicks hatch after 17 days and weight around 20 g (depending on the pigeon breed).Usually, pigeons cover their chicks in the first 6 days of life, then the chicks start to cover in

leathers and parents can leave the nest more often to prepare the next eggs series. In many cases, the pigeons lay new eggs before the chicks are fully grown and out of the nest. (Every 30 days … to 45 days, pigeons lay new pair of eggs)

The Rock Dove breeds at any time of the year, but peak times are spring and summer. Nesting sites are along coastal cliff faces, as well as the artificial cliff faces created by apartment buildings with accessible ledges or roof spaces. The nest is a flimsy platform of straw and sticks, laid on a ledge, under cover, often on the window ledges of buildings. Two white eggs are laid; incubation is shared by both parents lasting from seventeen to nineteen days. The newly hatched squab (nestling) has pale yellow down and a flesh-colored bill with a dark band. For the first few days, the baby squab is tended and fed (through regurgitation) exclusively on "crop milk" (also called "pigeon milk" or "pigeon's milk"). The pigeon milk is produced in the crops of both parents in all species of pigeons and doves. The fledging period is about 30 days.

Integumentary system

Scales-The scales of Pigeons are composed of the same keratin as beaks, claws, and spurs. They are found mainly on the toes and metatarsus, but may be found further up on the ankle in some birds. Most bird scales do not overlap significantly, except in the cases of kingfishers and woodpeckers. The scales and scutes of birds were originally thought to be homologous to those of reptiles and mammals. However more recent research suggests that scales in birds re-evolved after the evolution of feathers. Bird embryos begin development with smooth skin. On the feet, the corneum, or outermost layer, of this skin may keratinize, thicken and form scales. These scales can be organized into;

Cancella – minute scales which are really just a thickening and hardening of the skin, crisscrossed with shallow grooves.

Scutella – scales that are not quite as large as scutes, such as those found on the caudal, or hind part, of the chicken metatarsus.

Scutes – the largest scales, usually on the anterior surface of the metatarsus and dorsal surface of the toes.

Beak-The beak, bill, or rostrum is an external anatomical structure of birds which is used for eating and for grooming, manipulating objects, killing prey, fighting, probing for food, courtship and feeding young. Although beaks vary significantly in size, shape and color, they share a similar underlying structure. Two bony projections—the upper and lower mandibles—are covered with a thin keratinized layer of epidermis known as the rhamphotheca. In most species, two holes known as nares lead to the respiratory system.

Respiratory system

Due to their high metabolic rate required for flight, birds have a high oxygen demand. Development of a unique and highly efficient respiratory system enabled the evolution of flight in birds. Although birds have lungs they rely mostly on air sacs for respiration. While the lungs in birds are comparably smaller in birds than in mammals, the air sacs account for 15% of the total body volume, compared to 7% lung volume in mammals. These sacs do not play a direct role in gas exchange, but act like a series of bellows to move air unidirectionally through the respiratory system. Birds lack a diaphragm, so rather than the regular expansion and contraction of the respiratory organs like is seen in mammals, the air sacs allow the tract to maintain a fixed volume with oxygenated air constantly flowing in a single direction through them. The active phase of respiration in bird is exhalation, requiring muscular contraction.

Circulatory system

Birds have a four-chambered heart, in common with humans, most mammals, and some reptiles (mainly the crocodilia). This adaptation allows for an efficient nutrient and oxygen transport throughout the body, providing birds with energy to fly and maintain high levels of activity. A Ruby-throated Hummingbird's heart beats up to 1200 times per minute (about 20 beats per second).

Digestive system

Many birds possess a muscular pouch along the esophagus called a crop. The crop functions to both soften food and regulate its flow through the system by storing it temporarily. The size and shape of the crop is quite variable among the birds. Members of the order Columbiformes, such as pigeons, produce a nutritious crop milk which is fed to their young by regurgitation. Birds possess a ventriculus, or gizzard, composed of four muscular bands that rotate and crush food by shifting the food from one area to the next within the gizzard. The gizzard of some species contains small pieces of grit or stone swallowed by the bird to aid in the grinding process of digestion, serving the function of mammalian or reptilian teeth. The use of gizzard stones is a similarity between birds and dinosaurs, which left gizzard stones called gastroliths as trace fossils.

Urogenital and endocrine systems

Male birds have two testes which become hundreds of times larger during the breeding season to produce sperm. The testes in male birds are generally asymmetric with most birds having a larger left testis. Female birds in most families have only one functional ovary (the left one), connected to an oviduct — although two ovaries are present in the embryonic stage of each female bird. Some species of birds have two functional ovaries, and the order Aptery giformes always retain both ovaries. Most male birds have no phallus. In the males of species without a phallus, sperm is stored in the seminal glomera within the cloacal protuberance prior to copulation. During copulation, the female moves her tail to the side and the male either mounts the female from behind or in front (as in the stitchbird), or moves very close to her. The cloacae then touch, so that the sperm can enter the female's reproductive tract. This can happen very fast, sometimes in less than half a second.

.**Kidney-**Avian kidneys functions in almost the same way as the more extensively studied mammalian kidney, but with a few important adaptations; while much of the anatomy remains unchanged in design, some important modifications have occurred during their evolution. A bird has paired kidneys which are connected to the lower gastrointestinal tract through the ureters. Depending on the bird species, the cortex makes up around 71-80% of the kidney's mass, while the medulla is much smaller at about 5-15% of the mass. Blood vessels and other tubes make up the remaining mass. Unique to birds is the presence of two different types of nephrons (the functional unit of the kidney) both reptilian-like nephrons located in the cortex and mammalian-like nephrons located in the medulla. Reptilian nephrons are more abundant but lack the distinctive loops of henle seen in mammals. The urine collected by the kidney is emptied into the cloaca through the ureters and then to the colon by reverse peristalsis.

Nervous system

Acute eyesight—raptors have vision eight times sharper than humans—thanks to higher densities of photoreceptors in the retina (up to 1,000,000 per square mm in Buteos, compared to 200,000 for humans), a high number of neurons in the optic nerves, a second set of eye muscles not found in other animals, and, in some cases, an indented fovea which magnifies the central part of the visual field. Many species, including hummingbirds and albatrosses, have two foveas in each eye. Many birds can detect polarised light.Birds have a large brain to body mass ratio. This is reflected in the advanced and complex bird intelligence.

Osmoregulation-

Water is taken in by the Columba livia directly by drinking water or indirectly from the food they ingest. They drink water through a process called double-suction mechanism. Daily diet of the Pigeon places many physiologically challenges it must overcome through osmoregulation. Protein intake for example causes an excess toxins of amine groups when it is broken down for energy. To regulate this excess and secrete these unwanted toxins the Columba livia must remove the amine groups as uric acid. Nitrogen excretion through uric acid can be considered an advantage because it doesn't require a lot of water and isn't very soluble, but producing it takes more energy because of its complex molecular composition**.**

Temperature Changes-The Columbia Livia is habituated within many vast environments with varying degrees of temperatures. Like all vertebrates, Columbia Livia perspires heat through

evaporation of water when temperatures are high in the environment. It's preferred niche temperature ranges between +39 - +42 degrees Celsius.

Conclusion

The present study significantly shows the haematological correlation with the behavioural changes in Pigeon

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ISBN 978-81-946375-0-9
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