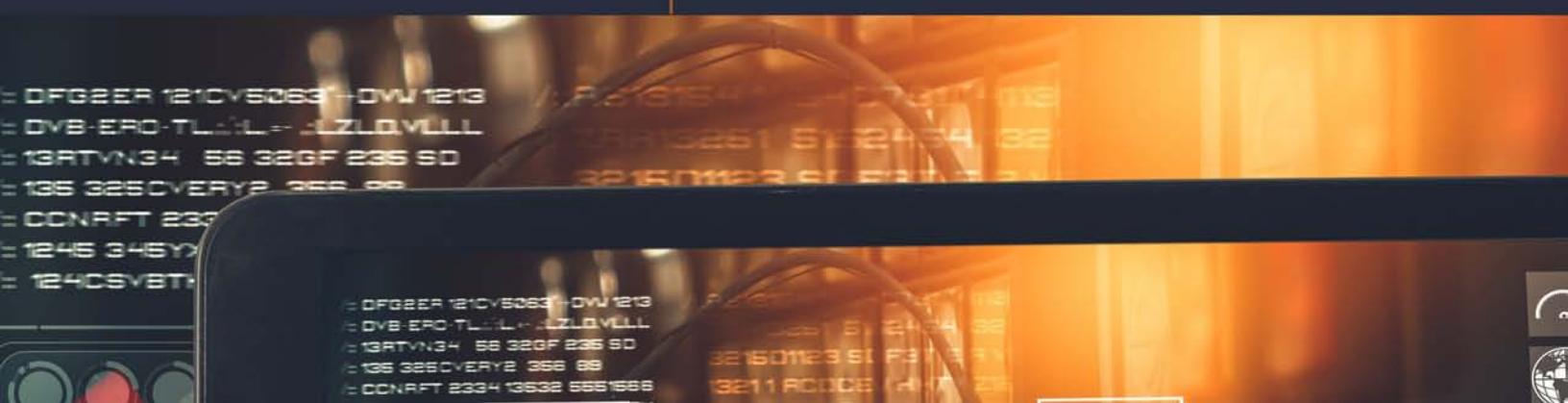


# RESEARCH ON ENGINEERING APPLICATIONS IN MULTIDISCIPLINARY SECTORS

PART 2



Editors:  
**Nitin Tyagi**  
**Satya Prakash Yadav**

**Bentham Books**

# **Research on Engineering Applications in Multidisciplinary Sectors (*Part 2*)**

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## PREFACE

Predicting the future with certainty may remain a distant dream, yet understanding and preparing for forthcoming developments is essential. Part 2 of this book captures the current and forthcoming trends in a globally competitive context, offering guidance to young researchers and scientists poised to make impactful contributions. It also fosters the sharing of experiences and exchange of ideas to promote national collaboration. The insights presented here will greatly benefit management professionals, academicians, industrial experts, and technical participants engaged across multidisciplinary sectors. This part promotes high-quality research and serves as a platform for presenting advances in engineering, technology, science, and artificial intelligence, highlighting their significance for societal progress.

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## CHAPTER 1

# Limnological Characterization of River Ramganga in Western Uttar Pradesh, India

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**Abstract:** Water is considered a life-sustaining resource on this planet Earth. Similarly, rivers are considered the lifeline of society. Rivers keep themselves in good condition due to their self-cleansing power. Indiscriminate dumping of solid and liquid waste due to enhanced urbanisation and industrialisation has reduced the self-cleansing capacity of the rivers, and as a result, the rivers get polluted. Therefore in the current investigation, water quality status of river Ramganga was assessed at the selected sites of three different districts (Moradabad, Rampur, and Bareilly) of western Uttar Pradesh, India based on their Limnological characteristics {Turbidity, Total Dissolved Solids (TDS), pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Phosphate ( $PO_4^{3-}$ ), Nitrate ( $NO_3^-$ ), Sulphate ( $SO_4^{2-}$ ), Iron (Fe), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Zinc (Zn)}. The obtained data were processed to calculate the water quality index (WQI), heavy metal pollution index (HPI), and heavy metal evaluation index (HEI). It was observed that the studied physicochemical parameters were within the limits of the Bureau of Indian Standards (BIS), except TDS. The values of studied heavy metals were found beyond the ideal limit of BIS, except for zinc. The obtained WQI values elucidate that the river water is unsuitable for consumption (WQI is  $> 100$ ) except at SS-4 and 5, where water quality falls in the very poor category (WQI=75-100). Based on HPI, the water quality of raw water falls in the unsuitable for drinking category (HPI is  $> 10$ ), showing a higher concentration of heavy metals in the river. HEI values were also found in the higher zone (HEI is  $> 20$ ). Heavy metals are major contributory factors in the quality degradation of the river Ramganga water. Therefore, there is an urgent need for a wastewater treatment facility along the river coast to protect the water quality and flora and fauna of rivers.

**Keywords:** Heavy metals, HEI, HPI, Lifeline, Pollution, Self-cleansing power, WQI.

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## INTRODUCTION

Water is of supreme importance as it directly impacts the health of living beings [1, 2]. Surface water is available in streams, rivers, ponds, lakes, etc. [3]. Rivers are considered the lifeline of society. In old times, most of the civilizations grew along the rivers due to fertile soil and easy availability of various goods required for living [4, 5]. Rivers possess self-cleansing power and can assimilate a fixed quantity of waste. As the industrialization and urbanization grow in India, the pressure on rivers also grows. Most of the rivers lost their self-cleansing power due to the uncontrolled dumping of solid and liquid waste. Therefore, the concern about rivers has increased in India. Globally, various authors studied the different aspects of riverine ecosystems *viz.* morphological characters [6], effects of land use pattern [7], and hydrological alteration due to soil losses [8].

The key elements which impact the quality of water bodies are domestic and industrial effluents, solid waste dumping, and agricultural fields' runoff [9 - 12]. Lack of sewage treatment plant (STP), effluent treatment plant (ETP), and awareness among the society are some of the indirect causes of water pollution [13]. Due to the increased levels of nutrients in the rivers, the phenomenon of eutrophication and acidification happens, which disturbs the ionic balance of the water and results in the loss of biodiversity along with other aesthetic values [14]. The Ramganga river flows through residential areas, as well as agricultural and industrial areas, and therefore it plays a vital role in the survival of living beings living in the catchment zone. Therefore, it becomes very crucial to regularly perform the assessment of the water of the river Ramganga to avoid any major health issues in the area. Therefore, in the current investigation, physical, chemical and heavy metal characteristics of the river Ramganga were assessed at the selected locations in three different districts (Moradabad, Rampur, and Bareilly). The obtained data on physical and chemical characteristics was processed to calculate the WQI. The data on heavy metal characteristics was also processed to calculate the HPI and heavy HEI to classify the water quality at the selected locations.

## MATERIALS AND METHODS

### Study Area

The river Ramganga originates from Chamoli district of Uttarakhand and then travels a distance of approximately 650 Km before joining the river Ganga near Kannauj, Uttar Pradesh [3, 15]. The present study was conducted on the river Ramganga in three different districts (Moradabad, Rampur, and Bareilly) of western Uttar Pradesh, India. Different types of industries, such as distilleries, sugar mills, bronze, pulp and paper, and others, are located along the river coast.

All these industries discharge their waste in either treated or partially treated and untreated form, directly or indirectly, in the river Ramganga. Therefore, three sites were selected of Moradabad, three of Rampur and four of Bareilly (Table 1).

**Table 1. Showing the sites and their coordinates.**

SN	District	Site name and Code	Co-ordinates
1	Moradabad	Moradabad-Kashipur Roadways Bridge (SS-1)	28.807507N, 78.80589E
2		Ramganga Pull Moradabad (SS-2)	28.809345N, 78.805857E
3		Devapur Ahatmali (SS-3)	28.797481N, 78.823532E
4	Rampur	Raipur (SS-4)	28.632778N, 78.956114E
5		Telipura (SS-5)	28.630180N, 78.972501E
6		Chamraul (SS-6)	28.628023N, 78.979380E
7	Bareilly	Ramganga Roadways Bridge (SS-7)	28.294454N, 79.368412E
8		Ramganga Railway Bridge (SS-8)	28.292584N, 79.371223E
9		Bareilly Nath Nagri Ramganga (SS-9)	28.289950N, 79.370629E
10		Ramganga Dam (SS-10)	29.295951N, 79.368492E

### Sampling and Analysis

The samples of water from the selected locations were collected each month starting from January 2023 to June 2023 in a plastic can of capacity 2 litres. Samples for DO and BOD were collected in BOD bottles, and for heavy metals in separate bottles and preserved. pH was measured at the site. The analysis of the rest of the parameters of water samples was performed in the laboratory following the standard methodologies (Table 2) of APHA (2012) and CPCB (2010).

**Table 2. Standard methodologies and instruments used for the analysis of parameters.**

SN	Parameters	Methodology used / Instruments used
1	<b>pH</b>	With the help of a pH meter (Company name: EI, Model no: EI 112).
2	<b>TDS</b>	With the help of a microprocessor-based TDS (Company name: ESICO, Model no: ESICO 1601)
3	<b>Turbidity</b>	Turbidity meter (Company name: Labcare, Model no: LB-963)
4	<b>Dissolved Oxygen (mg/l)/ BOD (mg/l)</b>	Winkler's Iodometric method
5	<b>COD (mg/l)</b>	Reflux method
6	<b>Phosphate (mg/l)</b>	Spectrophotometric method
7	<b>Nitrate (mg/l)</b>	Spectrophotometric method

## **CHAPTER 2**

# **Application of Geo-textile in Geo-technical Engineering- A Review**

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**Abstract:** Geo-textiles, a recently developing field in civil engineering and other sectors, have a wide range of possible uses across the world. For infrastructure projects like building roads, ports, and other structures, geo-textiles are the ideal material. For separation, reinforcement, filtration, drainage, stability, barrier, and erosion protection, geo-textiles are utilized. The majority of geo-textiles consist of polyolefin, polyester, or polyamide polymers, which can lead to environmental issues such as soil contamination and microplastic build-up. These limitations make time-consuming recollection of the content important for some applications. Therefore, the creation of more ecologically responsible and biodegradable geo-textiles is desirable for a variety of application scenarios. So the researcher's interest also shifts to the recent advancements in geo-textiles, with a focus on green geo-textiles and high-performance geo-textiles. The paper presents an overview of the different natural and synthetic textile fibers used for geotextile applications.

**Keywords:** Environment, Geo-engineering, Geo-textiles, Natural fibres, Polymer, Strength, Synthetic fibres.

### **INTRODUCTION**

Technical textile (TT) products are designed mainly for their functional and technical properties instead of aesthetically pleasing qualities. Technical textiles are functional fabrics that have uses in a variety of industries such as civil engineering and building, agriculture, health care, industrial safety, personal protection, and so on [1]. Technical products that are utilized in geotechnical applications involve soil, rock, earth, and so on. Permeable or synthetic fabric, either woven or non-woven, is commonly used for geotechnical engineering material [2]. The Indian market of technical textiles is projected to be USD 24 billion in FY 2021-22, as against the global market of about USD 24 billion in

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2019, when the Indian market was USD 19 billion. But our average growth rate is 12%, which is much higher than the global level of only 4%. Top four global exporters of technical textiles are USA- 23%, Europe- 22%, China- 13%, Japan- 7%, while India exported about USD 2.04 billion in FY 2019-20 and that can grow exponentially if the appropriate strategy and ecosystem is in place at the earliest [3]. The technical textiles market is expected to grow with overall valuation forecast to surpass US\$ 202.93 billion in 2023. In 2033, the market value will grow at an average annual compound growth rate (CGAR) of 6.7% [4] (Table 1).

**Table 1. Indian market size of technical textiles.**

(In INR. Crore)						
Sectors	CAGR (2013-16)	FY (2017-18)	FY (2018-19)	FY (2019-20)	FY (2020-21)	FY (2021-22)
Clohtech	~11%	8133	9028	10021	11123	12346
Meditech	~9%	5142	5605	6109	6659	7258
Agrotech	~12%	1614	1808	2025	2268	2540
Packtech	~11%	48318	53633	59633	66081	73350
Protech	~9%	3139	3422	3730	4066	4432
Geotech	~13%	1275	1441	1628	1840	2079

(Source- ICRA Baseline Survey- ITTA Analysis)

Geo-textiles were among the very first textile creations in human history. Mats made of grass and linen have been discovered during the excavation of ancient Egyptian sites. Following that, geo-textiles were utilized in the building of roads to stabilize highways. Geo-textiles are made of natural and synthetic fibers and fabrics that come into contact with soil or rock and other geo materials [5]. Geotechnical engineering material is made of permeable fabric or synthetic material, which can be woven or non-woven. The very first reported application of geo-textiles was in nylon bags containing sand at the Dutch Delta Works in 1956. Over the last 60 years, geo-textiles have become extensively utilized in geotechnical engineering. For over 30 years, geo-textiles have been used successfully in road construction. Their main purpose is separating the sub base from the sub grade, which leads to a stronger building of roads [6].

Geo-textiles have been shown to be one of the most adaptable as well as affordable ground modification materials available.

According to ASTM (1994), geo textile is a permeable material that interacts with soil, rock, earth, or any material as a part of the civil engineering project [7].

Nylon, polyester, and polypropylene are synthetic fibers used in geo textiles, but ramie, jute, and other natural fibers can also be used. Table 2 shows the geo-textiles properties along with their ASTM standards.

**Table 2. Geo textiles properties and associated ASTM standard test method [7].**

Property	Reporting units	Standard test designation
Grab strength	(KN)	AST M D 4632
Sewn seam strength		AST M D 4533
Tear strength		AST M D 6241 / 4833
Puncture strength		AST M D 4491
Permittivity	Sec <sup>-1</sup>	

## **Different Types of Geosynthetics**

- Geo-textiles
- Geomembrane
- Geogrids
- Geonets
- Geocomposites

## **Types of Geo-textiles and Their Properties**

Geotextiles are versatile engineering materials that are broadly classified. The applications of geotextiles depend on unique functionalities tailored to suit particular engineering aspects:

### ***Woven***

Woven products are developed by the weaving process; their mesh opening, pore size, and count of warp and weft [8]. Woven fabrics having high tensile strength and low elongation that are suitable for reinforcement and separation applications. Woven are also used in road construction to provide structural stability by separating the subgrade from aggregate layers.

### ***Nonwoven***

Nonwoven, also known as mats, is a readily produced range of formulations and spatial layouts [9]. Nonwoven has excellent filtration and drainage capabilities due to their porous structure. It is mostly used for drainage in landfill liners and coastal erosion control.

**CHAPTER 3****MediTech: Smart Technical Textiles****Meenakshi Tamta<sup>1</sup> and Arpana Kamboj<sup>1,\*</sup>**<sup>1</sup> Department of Textile Design, Swami Vivekanand Subharti University, Meerut, Uttar Pradesh, India

**Abstract:** Technical textile has a very significant subset called medical textile that encompasses a wide range of items. The word “medical textile” generally refers to all textile products used by the medical industry for a variety of functions. Medical textile, commonly referred to as healthcare textile, is one of the most rapidly developing segments of the technical textile market. The ongoing advancements and breakthroughs in both textile technology and medical processes are driving the growth rate of technical textiles in this sector. Material components employed in this field encompass yarns, woven, knitted, and non-woven textile materials, as well as composite materials reinforced with textiles. From simple surgical sutures to complicated composite structures for bone and tissue replacement, hygiene materials, and protective items used in operating rooms and postoperative wound management, the applications are numerous and diverse. The primary objective of this study is to highlight the significance of textiles with technical properties in medical, surgical, and health-care applications, as well as to identify specific textiles that are currently being utilized in this field.

**Keywords:** Healthcare, Non-woven, Surgical, Sutures, Textiles, Yarn.

**INTRODUCTION**

Technical textiles are those textiles that are primarily known for their performance or functional characteristics rather than their aesthetic and decorative properties. Technical textiles are designed in such a way that they can be used for an extensive range of applications, such as automotive, healthcare, construction, aerospace, and protective textiles. These textiles are designed according to their specific uses and have improved filtration, durability, lightness, flexibility, resistance, and strength properties [1, 2]. Technical textiles are classified into twelve different categories based on their applications, such as agriculture-specific textiles (agrotech), construction textiles (buildtech), clothing textiles (clothtech), geo textiles (geotech), home textiles (hometech), industrial textiles (indutech),

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medical textiles (meditech), automobile textiles (mobiltech), packaging textiles (packtech), protective textiles (protech), sports textiles (sportech), and eco-friendly textiles (oekotech) [3].

Medical or healthcare textiles are a specialized category of technical textiles. These textiles are designed and engineered for highly specialized and advanced medical and healthcare applications. These fabrics are well-known for their creative and high-performance properties, which make them useful in a variety of medical processes, diagnostic equipment, and patient care. Medical textiles are those finished goods that are used for surgical end-use and hygiene, and for maintaining health, and ensuring private care. Based on the area of application, the medical textile products can have woven, knitted, and non-woven type. Increasingly, synthetic fiber is being utilized in the manufacturing of these products. Development in the field of textiles, both natural and manmade textiles, focuses on how they enhance the comfort of the users. Application of medical textiles has been refined with the development of new fibers and manufacturing technologies for yarns and fabrics. The most basic and vital use of textiles in medicine has been wound care and preventing chronic wounds. The most used amongst textiles are bandages and wound dressings, which are affordable and reusable. The medical textile should have bio-compatibility, flexibility, and strength [4]. The important requirements for biomedical products, nontoxicity, no allergenic response, strength, mechanical properties, durability, elasticity, and biocompatibility are considered vital prerequisites for successful health products [5]. Based on the Medical Smart Textile Market [6], there is a CAGR growth estimate of 7.51%, with USD 2.10 billion expected by the end of 2027. The need to provide better healthcare services now and in the future is linked to the development of novel textile-based implantable items. Another key issue is that the global population's life expectancy is rising, which will increase the number of surgeries and implanted items needed. Different textiles, such as woven, knitted, and non-woven textiles, are expected to expand significantly between 2017 and 2028. Smart textiles have numerous obstacles, including cost, scalability, sustainability, component integration, and so on. Smart textiles are frequently more expensive than traditional textiles due to the specialized materials and fabrication procedures required to make them. It is difficult to scale production while retaining quality and functionality, particularly for specialized or niche applications. The use of non-biodegradable or non-recyclable components in smart textiles raises questions regarding their environmental impact. The seamless embedding of electrical components such as sensors, actuators, and power sources into fabrics without impairing their flexibility and comfort is challenging. The arena of medical textiles is a boon, which is meant for converting the painful days of patients into comfortable days. The aim of this review paper is to provide a comprehensive overview of the significance and advances in medical textiles. It

covers all the aspects of medical textiles, such as materials, properties, potential applications, and recent innovations in medical textiles.

## **BACKGROUND AND SIGNIFICANCE OF MEDICAL TEXTILES**

The discovery of wound closures and sutures thousands of years ago paved the way for the creation of medical textiles. Wound closures emerged as a result of advancements in surgery between 5000 and 3000 BC. These natural wound closures are fashioned from flax, silk, linen strips, and cotton. The natural materials utilized were first lubricated in oil and wine to provide a clean wound closure technique and to prevent tissue drag. Soldier ant mandibles (jaw/jawbones) were also utilized to close wounds. These were used to create surgical clips in intestinal surgery. Cornelius Celsus, a Roman, documented the use of sutures and clips in 30 AD, and Aelius Galen described the use of silk and catgut around 150 AD. Sushruta, an Indian plastic surgeon, has developed a suture material made of flax, hemp, and hair. Surgical and suture techniques advanced further in the 1800s with the invention of sterilization methods. With the invention of synthetic polymers and fibers, synthetic sutures were introduced.

## **MEDICAL TEXTILE FIBERS**

The fibres used in medical textiles are divided into two categories: commodity fibres and specialty fibres.

### **Commodity Fiber**

Natural fibres include cotton, silk, and viscose, which are cellulose-based fibres, whereas synthetic fibres include polyester, polypropylene, PTFE (poly-tetra fluoroethylene), polyamide, carbon, and glass fibre.

### **Specialty Fibers**

Specialty fibers are made from different materials.

- a. **Collagen:** Cow skin is used to make collagen. It is a protein that comes in either a hydrogel or fibre form. When used as a suture, collagen fibres are as strong as silk and biodegradable.
- b. **Calcium Alginate:** This synthetic fibre is derived from brown seaweed. This fibre has anti-inflammatory effects. Calcium alginate fibres have been shown to help with wound healing. These fibres are non-toxic, biodegradable, and hemostatic in wound dressings.
- c. **Chitin:** This is a polysaccharide derived from crab and prawn shells. It has very good antithrombogenic properties. It is easily absorbed by the body and aids in healing.

## CHAPTER 4

# Nanotechnology: Historical Evolution, Types, and Applications - A Comprehensive Review

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**Abstract:** This review paper investigates nanotechnology in-depth, covering its historical growth, multiple kinds, and numerous applications. It follows the advancement of nanotechnology from concept to reality, beginning with its inception and historical milestones. It analyses the distinctive qualities and fabrication processes of nanotechnology by categorizing it into several sorts, such as top-down and bottom-up approaches. Furthermore, the review demonstrates the broad range of nanotechnology applications, which include medicine, electronics, energy, and environmental solutions. This review emphasizes the multidisciplinary significance of nanotechnology and the need for responsible integration into society by revealing its revolutionary potential across different sectors.

**Keywords:** Bottom-up approach, Nanoscale, Nanotechnology, Top-down approach.

## INTRODUCTION

Advancements in the fields of health care, energy, conservation of the environment, building, the agricultural sector, food manufacturing, and other areas are made possible by nanotechnology. The study of manipulating matter at the atomic and molecular level is known as nanotechnology. Nanotechnology, sometimes known as “nanotech,” is a multidisciplinary science concerned with the manipulation, characterization, and use of materials and structures at the nanoscale. The term “nanoscale” refers to dimensions ranging from one to one hundred nanometers (nm), where one nanometer equals one billionth of a meter. It improves the material's speed, durability, and all of its other properties. Through modification, chemical and molecular methods are used to form nanoparticles (NPs), and nanostructured materials. An interesting area of research for nanotech-

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nology is the investigation of the characteristic features that arise from altering (particularly decreasing) the size of the nanoparticles [1].

## History

Nanotechnology existed and was in use in the distant past, but no one knew what the phrase meant. In 40000 BC, the world saw the discovery of cave paintings corresponding roughly to the chronological order of the Satsuma glass in 1950 AD depicted in Fig. (1). The timeline of modern nanomaterial discovery extends from the mid-1850s with Michael Faraday's investigations into light and matter. According to Albert Einstein, 1 nanometer is the diameter of a sugar molecule. In the 1940s,  $\text{SiO}_2$  NPs were developed as rubber alternatives. Ernest Ruska and Max Knoll's research on electron microscopy was essential in its advancement. The scanning tunnelling microscope, a creation of Heinrich Rohrer and Gerd Binning, came next. Carbon nanotubes were first described by Radushkevich and Lukyanovich using electron microscopy in 1952. The phrase "nanotechnology" was first used in a speech by Richard P. Feynman in 1959.

By coining the terms "nanometer" and "Nanotechnology" in the 1960s and 1974, respectively, Richard Zsigmondy and Norio Taniguchi made notable contributions. Nanotechnology expanded as a result of Sumio Iijima's research on carbon nanotube structure in 1991 and Erik Drexler's book from 1986. For discovering fullerenes in 1985, F. Curl, H. W. Kroto, and R. E. Smalley shared the 1996 Nobel Prize in chemistry. Additionally, for their work on the physical characteristics of graphene that has delaminated from graphite at normal temperature, Andre Geim and Konstantin Novoselov were awarded the 2010 Nobel Prize in Physics. The properties of bulk materials, such as strength, conductivity, toughness, and lightness, have recently been greatly improved by the development of several nanomaterials, which have also added new intriguing properties like self-healing, self-cleaning, anti-freezing, anti-bacterial, and so on. Nanoparticles are frequently used because of the unique impacts of their size and form that improve the material's external appearance. Additionally, the majority of nanoparticles employed in the industry are embedded in nanocomposite materials, which form inert (polymer or cement) or matrix materials [2]. The recently published research papers are tabulated as shown in Table 1.

## Classifications of Nanomaterials

### *Agreement with their Physical Dimensionality*

Nanomaterials, categorized as 0D, 1D, 2D, and 3D, vary in size and morphology as shown in Fig. (2) below. 0D materials have all dimensions within nanometers, suitable for optoelectronics and biomedicine. 1D materials (nanotubes, nanowires)

exceed 100 nm in one dimension, ideal for diverse properties. 2D materials (graphene, metal oxides) possess two dimensions  $>100$  nm, offering unique characteristics. 3D materials (all dimensions  $>100$  nm) display intricate structures and integration with 3D printing for versatile applications.

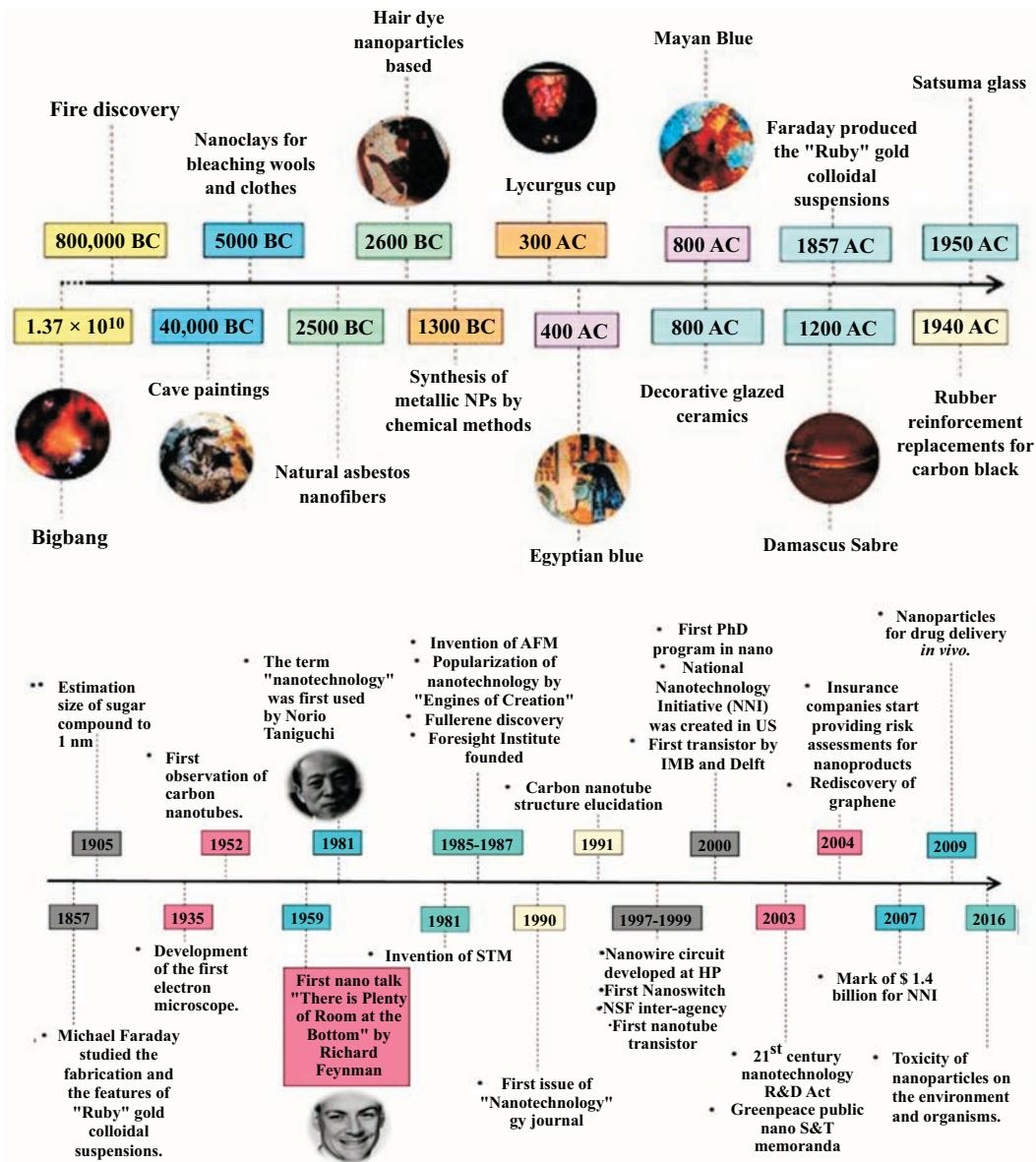


Fig. (1). Ancient and recent history of nanotechnology.

## **CHAPTER 5**

# **State-of-the-art Review and Future of Blockchain-based Internet of Things**

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**Abstract:** In the current context, the rapidly evolving, disruptive, and promising technology to expand secure distributed databases has generated tremendous anxiety in both the public and corporate sectors, as well as enthusiasm and optimism. A potential remedy for this is the creation of secure, decentralized networks of networked devices using blockchain-based Internet of Things (B-IoT), which combines the advantages of blockchain and IoT. Although this technology has the potential to alter sectors and create new opportunities completely, it also has several drawbacks. The distributed replicated database is frequently utilized for blockchain technology. A B-IoT has improved security, transparency, and productivity as its main benefits. This paper emphasizes the importance of B-IoT, its features and vulnerabilities, and the need for continual innovation and collaboration to enable its successful adoption and deployment.

**Keywords:** Blockchain, Blockchain-based internet of things, Internet of things, Scalability.

## **INTRODUCTION**

Blockchain was first suggested by Stuart Haber, a computer scientist, and W Scott Stornetta, respectively, in 1990. But since 2009, a lot of sectors have paid considerably greater attention to blockchain technology [1]. A blockchain can generate income by reducing limits on consumer procurement, chain management, and other sectors. Blockchain-based Internet of Things (B-IoT) is a fast-expanding industry that combines the advantages of blockchain technology

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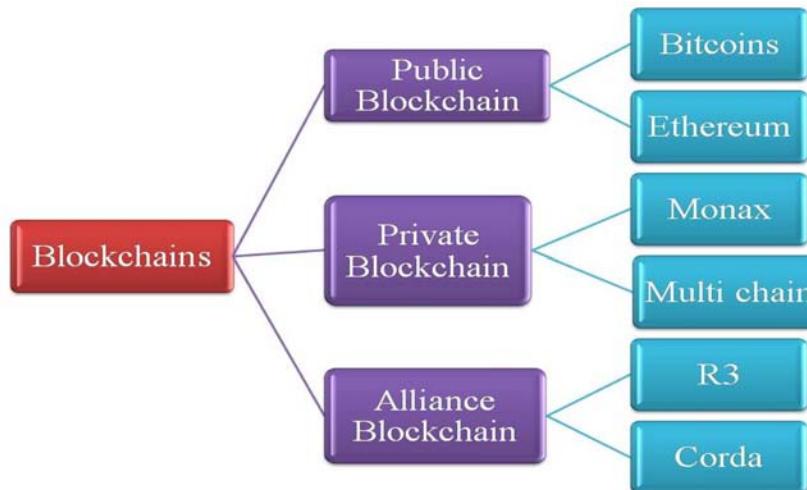
and connected gadgets to build safe, decentralized networks [2]. By facilitating safe and transparent data sharing across numerous parties, this technology has the power to completely transform a number of industries, including finance, logistics management, and healthcare. Blockchain enhances industries by securing data and ensuring transparency. In healthcare, it manages patient records; in supply chains, it tracks goods; and in smart cities, it optimizes infrastructure and services. One successful blockchain-IoT case study is IBM's Food Trust platform, which combines blockchain and IoT to track food products throughout the supply chain. This integration ensures transparency, enhances food safety, and reduces waste, enabling consumers and suppliers to verify the authenticity and freshness of products in real-time. Data security and decentralization have been revolutionized by blockchain technology. On the other hand, the IoT has changed and, it has made it smarter, more efficient, and more connected. When used together, B-IoT can build a safe, open, and decentralized network that is resilient to failures and assaults and presents several potentials for innovation. IoT networks built on blockchain have several benefits over older IoT networks. It first offers a more secure method of sharing and storing data. Because blockchain is distributed, it prevents data from being altered, and using cryptographic methods protects data from unauthorized access. Second, because blockchain is transparent, tracking the path taken by data as it moves throughout the network is feasible. This increases IoT device accountability and guarantees that data is utilized ethically. Third, smart contracts can automate various activities in B-IoT, lowering the need for human intervention and streamlining operations [3]. Significant time and money savings may be obtained as a result. Finally, users may share their data selectively with third parties and have more control over it with B-IoT. As a result, data breaches are prevented, and data privacy is enhanced.

B-IoT has recently attracted a lot of attention through the publication of numerous academic papers. Wang *et al.* [4] investigated the possibilities of B-IoT for smart city applications. According to the authors, blockchain technology can improve IoT data security, privacy, and interoperability, and open up new business models for services aimed at smart cities. For instance, Li *et al.* [5] suggested a new consensus algorithm for the blockchain-based Internet of Things (IoT) that increases scalability and uses less energy. In the meantime, a new architecture that permits interoperability between various blockchain networks was presented by Bhardwaj *et al.* [6] in response to an investigation into the interoperability issues of B-IoT. The Internet of Things (IoT) and blockchain technology are combined in a new technology called B-IoT. Due to its promise to offer safe, transparent, and effective solutions for numerous IoT applications, it has attracted a lot of interest recently. The research on B-IoT is reviewed.

The theoretical foundation for blockchain-based IoT security and research problems related to this technology was described by Zhang *et al.* [7]. They also highlight the difficulties in integrating blockchain with IoT devices, including insufficient computational power, storage, and bandwidth. Liu *et al.* [8] put up a blockchain-based solution for efficient and safe data sharing in industrial IoT environments. A thorough analysis of the current blockchain-based IoT technologies and their applications is provided by Dorri *et al.* [9]. They revealed the potential uses of B-IOT in areas including supply chain management, smart cities, and healthcare. A blockchain-based architecture for safe IoT-enabled healthcare applications was put up by Al-Turjman *et al.* [10]. To protect patient privacy and data integrity, the authors contend that blockchains can offer a secure and open environment for hosting and exchanging healthcare data. A real-world healthcare dataset was used to analyze the suggested architecture, and the findings indicated that it might increase the security and effectiveness of managing healthcare data. Li *et al.* [11] discussed evaluating current IoT systems based on blockchain for smart grid applications. The authors examine the benefits and drawbacks of various blockchain-based architectures, including consensus methods and private *vs.* public blockchains. They also review possible B-IOT uses in energy trading, demand response, and managing renewable energy sources.

### Classification of Blockchain

The blockchain may be divided into public, private, and alliance blockchain, depending on how it is used in various applications as shown in Fig. (1) [12, 13].



**Fig. (1).** Classification of blockchain.

## CHAPTER 6

# The Development of Sustainable Products through Creative Up-Cycling of Fabric Waste from Boutiques and Tailor Shops

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**Abstract:** In this period of rapid technological development, society is more concerned about the sustainability of products. The textile and clothing industry is a focus of the sustainability movement because of its effects on the environment and society. One of the major environmentally damaging sectors in the world is the textile industry. Management of leftover cloth has been one of the problems we have today. The leftover materials from tailoring shops and boutiques are often dumped in landfills and lakes, which is the most underdeveloped aspect of solid waste management services. The careless disposal of textiles results in pollution and an unhealthy environment. Consumption also contributes to the creation of garbage; therefore, production is not the only source. The creation of indigenous textiles is prioritized in sustainable development because it creates employment possibilities, particularly for rural areas, and helps to safeguard the environment. Indian textiles and crafts are well-known throughout the world. Therefore, this study explores the viability of sustainable development in the fashion industry by creating upcycled and handmade products that fuse classic designs with new technologies to boost demand while promoting sustainable development.

In this chapter, up-cycling techniques were investigated and used to make a variety of women's accessories out of clothes leftover from boutiques and tailor shops. It has also discussed critical findings about the assessment and acceptability of sustainable products made from leftover fabric using craft-design up-cycling techniques that adhere to sustainability principles.

**Keywords:** Classic designs, Craft-design, Garment Industry, Indigenous textiles, Sustainable development, Up-cycling techniques.

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## INTRODUCTION

One of the primeval and most well-established types of garbage is clothing and textile refuse. There is a massive production of textiles due to technical advancements, industrialization, and the quick evolution of fashion, and production is still linked to some level of pollution and trash. Although our current way of living makes it impossible to set production limits, we can always discover new methods to recycle and lessen our impact on the environment. These environmentally favorable practices are crucial not only to preserve nature but also to safeguard our future populations. One of the most significant sectors of the consumer products business is textile waste. We all require clothing and other textile goods like purses, jewellery, shoes, and other accessories. However, one of the major contaminants is also thought to be textile refuse. Textile manufacturing and usage also contribute to garbage. The quantity of garbage produced by Indian textile waste could reach 36% of all utilized yarn and fabric weight [1].

Recycling is different from reuse in that it involves reducing the substance to its initial state before using the resulting raw fibre to create any useful cloth. Uncomfortable apparel can be utilized for bandages, rugs, bandages, blankets, and a variety of other domestic purposes. In Western cultures, used apparel is frequently discarded or given to charities. Additionally, it is offered in online sales, street markets, resale stores, and dress shops. Used apparel is frequently gathered on an industrial scale, sorted, and transported for reuse in developing nations. There are various ways to recycle clothes in the textile and clothing industry. The most popular technique entails creating a textile or apparel item from recycled consumer refuse, like plastic bottles or waste polyester yarns or fabrics. Other methods involve reusing used apparel and textiles in a manner that doesn't involve tossing them away, like shredding them into fibres for soundproofing. They prefer redistributing the items as used apparel to thrift stores or textile dealers (also referred to as rag collectors), and reusing textiles for clothing [2, 3]. Cloth is a wonderful resource, and there are many ways to repurpose used fabric from garments, by repurposing discarded clothing to create something new. We can also utilize leftover fabric to create mittens, hats, belts, backpacks, wristbands, and hair bands [3].

Up-cycling refers to the creative process of transforming waste materials- in this case, fabric waste from boutiques and tailor shops—into new, higher-value products. This sustainable approach not only minimizes textile waste but also contributes to the development of a circular economy by reusing existing materials. Techniques commonly used in fabric upcycling include sorting, cutting, dyeing, printing, and sewing. Sorting fabric waste by type and quality ensures that only usable materials are selected for the process [4 - 18]. The waste is then cut

and reshaped into smaller, more manageable pieces that can be used for new products such as bags, cushions, or fashion accessories. Dyeing and printing techniques are used to refresh the fabric, with eco-friendly methods like natural dyeing or low-water synthetic dyes being preferred for their reduced environmental impact [19 - 22]. Finally, the fabric is sewn and assembled into final products, often incorporating artistic elements like patchwork or intricate designs [19]. This process reduces the need for new raw materials, thereby cutting down on resource consumption and pollution. Brands like Patagonia and Reformation have successfully implemented up-cycling strategies to create sustainable fashion and home products from fabric waste, promoting both environmental sustainability and creative design [20, 21].

Recycling, reclamation, and reuse are now essential for the effective handling of cloth refuse. On top of being environmentally sustainable, these offer significant revenue by lowering the cost of raw materials. Waste management in the worsted and knitwear industries offers a straightforward, step-by-step method for tackling waste reduction in a methodical manner. Pre- and post-consumer textile refuse recycling and repurposing have always been intriguing concepts. Nevertheless, the idea has been included in many textile production facilities in developed nations. It must still be directed to India.

It is advantageous for the Earth and the economy to reuse and recycle fabrics that have been underused or discarded. The environmental quality initiative is supported by the textile industry, which also works to divert more demand-recoverable textile refuse from landfills. The three major justifications for recycling waste are: recycling waste reduces the need for landfill space, recycling waste lowers the costs of trash removal, which are constantly rising, and recycling waste protects the ecosystem and human health. When textile refuse is burned in large amounts, organic pollutants like acid gases and dust particles are also released, both of which are detrimental to people and the environment [4]. Upcycling fabric waste offers significant environmental benefits, particularly in terms of waste reduction, carbon footprint, and resource consumption. One of the most immediate and quantifiable benefits of upcycling is its ability to reduce the vast amounts of textile waste that end up in landfills. The fashion industry is one of the largest producers of waste globally, with [18] estimating that over 92 million tons of textile waste are generated annually, with less than 1% of clothing being recycled into new products. By reusing fabric scraps from boutiques and tailor shops, upcycling directly addresses this issue, keeping textiles out of landfills and reducing the pressure on waste management systems. Moreover, upcycling minimizes the environmental impact of the textile industry's linear production system, shifting it towards a circular economy where products are reused, remade, and recycled rather than discarded [23, 24]. This transition has

## CHAPTER 7

# A Deteriorating Production Model with Probabilistic Demand having Reliability under Inflation

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**Abstract:** We develop a model here dealing with probabilistic demand in a production model. The reliability has been considered with the production process, and product deterioration is also considered. The proposed model is studied in inflationary conditions. In this article, the model is structured under the backlog and the non-backlog cases. A mathematical formulation has been provided for the given model, and the quantitative example has served as a demonstration of the theoretical results. To examine the impact of all of the variables on the offered model, a sensitivity assessment has also been provided. The results give some managerial outputs for the practitioners.

**Keywords:** Deterioration, Inflation, Inventory, Probabilistic demand, Production, Reliability.

## INTRODUCTION

For a long period, researchers have considered the deterministic approach toward developing the model. Almost all models are based on deterministic or constant demand patterns, which is not practical. The model of a deterministic approach has been proposed by several researchers. Conventionally, researchers created heuristic techniques to calculate the quantity of economic orders (EOQ) considering deterministic demand rates. Decisions on production in many different kinds of businesses can be greatly impacted by inflation and demand uncertainty. Greater manufacturing costs, including greater labor, energy, and raw material expenses, might result from inflation. Demand and income may be impacted if companies must raise prices to keep up with inflation. Since inventory

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can appreciate in value over time, inflation may make inventory management more challenging. Organizations may find it challenging to predict demand due to demand uncertainty, which might result in either overproduction or underproduction. Because businesses would need to have extra inventory on hand to fulfill erratic demand, it can also have an effect on inventory management. Because businesses can find it difficult to adapt to shifts in demand, it might cause supply chain disruptions. Following that, Donaldson [1] proposed a model assuming a linear time-dependent demand with no shortage inventory. Goswami and Chaudhuri [2] extended a linear trend in demand model to incorporate economic order quantities. Using an analysis of Seliaman and Ahmad's [3] optimization of inventory decisions, Sarkar and Moon [4] built a framework that takes into account unpredictable demand with inflationary circumstances.

It is hard to overlook the detrimental effects of inflation in a context with an elevated inflation rate. A model of economic replenishment incorporating inflation was introduced by Buzacott [5]. Afterwards, the model presented by Misra [6] simulated various costs for the EOQ by using different inflation rates. In an article published later, Yang *et al.* [7] discussed a variety of variable demand patterns in inventory models. As Saxena *et al.* [8] describes, deteriorating items can be inventoried in a partial backlog, using the hypothesis of age governed greenhouse gas emissions from the product itself. Motla *et al.* [9] propose that retailers should select the best course of action for producers under fuzzy environment. Saxena *et al.* [10] consider a sustainable model with the effect of machine breakdown under circular economy. Kumar *et al.* [11] created a model for merchandise that is seasonal, and they believe that their demand rate is a trapezoid function of the period. Handa *et al.* [12] created a supply chain problem where exponential demand and multivariate production/remanufacturing rates for deteriorated products are considered.

The quality of manufactured goods has also been regarded as superior in many of the previous articles. Products are not necessarily perfect because the quality of the production process used by the manufacturer directly affects their performance. Thus, a production process under stable conditions could result in some defective items. Jauhari [13] devised a model that incorporated defective items of quality. Jayaswal *et al.* [14] studied an unreliable manufacturing system using an economic quantity model. Their assumption is that low-quality items are sold in one consignment once the screening process is complete. A green inventory model for new and revamped production system was presented by Bhardwaj *et al.* [15]. Based on imperfect production and deterioration, Mishra *et al.* [16] proposed a green inventory model under stock-dependent demand. Sundarajan *et al.* [17] looked at the best trade credit rules under inflation with a stock-dependent rate based on price determination economic quantity. Kumar *et*

*al.* [18] formulated a model for easily spoilt commodities with a time-reliant decaying rate under inflationary circumstances. The impact of inflation on charges and the promotion of green investment are taken into account. Yadav *et al.* [19] proposed a manufacturer-retailer integrated inventory model with controllable lead time under the effect of learning-forgetting in the setup cost. Further, many authors have presented a probabilistic model for prediction and regression in their research work [20 - 24]

As a result, unrealistic assumptions are often made in traditional research articles, such as deterministic demand rates and 100% reliable production systems. However, these assumptions are not true in reality. Thus, we have presented this model with a non-reliable production system. In addition, the production system produces some defective products that are rejected. Inventory is presumed to deteriorate during storage. The study is conducted by using random demand rates for the products in the inflationary environment. We demonstrate the model together with the stochastic profit's sensitivity.

## PRESUMPTIONS AND NOTATIONS

The study has taken into account the presumptions and annotations listed below:

### Presumptions

1. Demand is assumed to be probabilistic, meaning that it is uncertain and can be described by a probability distribution. In this model, demand is believed to be uniformly distributed throughout the time horizon and is probabilistic in nature. Below is presented the probability density function for the demand functional  $x$  (Equ. 1):

$$f(x) = \begin{cases} \frac{1}{(b-a)}, & a \leq x \leq b \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

2. Stock out is unavoidable and considered to be fully backlogged.
3. Reliability in a production process refers to the ability of the process to produce products that meet the required specifications and quality standards, without interruptions or failures. In this approach, reliability is considered in the production process.

## CHAPTER 8

# Neonatal Jaundice Detection and Classification Using Deep Convolutional Neural Network

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**Abstract:** Neonatal jaundice refers to the manifestation of a yellowish hue in the sclerae and integument of a neonate, which arises from elevated bilirubin concentrations. The use of deep learning techniques for the early detection and assessment of newborn jaundice can potentially reduce the incidence of problems in neonates. This study focuses on detecting and classifying jaundice in neonates using a deep convolutional neural network (CNN). The proposed deep CNN model utilizes Adam and RMSProp as an optimizer. The model with Adam optimizer showed better training and testing accuracy when compared with RMSProp. The loss of 0.2031 and 0.1923 was obtained with Adam as an optimizer, and 0.2152 and 0.2015 with RMSProp as an optimizer on the training and test datasets. This technology can potentially decrease the duration required for jaundice identification and facilitate the monitoring of jaundice in neonates.

**Keywords:** Convolutional Neural Network, Deep learning, Image classification, Jaundice, Neonates.

## INTRODUCTION

Jaundice or icterus is a medical condition characterized by yellow discoloration in the integumentary system, ocular region, and mucous membranes resulting from an excessive accumulation of bilirubin in the circulatory system. Bilirubin, an endogenous yellow pigment generated from erythrocyte (red blood cells) degradation, is commonly metabolized by the hepatic system and subsequently eliminated through the biliary route [1]. Jaundice may indicate underlying medical conditions like hepatitis, blood abnormalities, or liver ailments [2, 3]. Neonatal jaundice occurs due to the immaturity of a newborn's liver, which hinders the proper metabolism of bilirubin, leading to its accumulation in the body. This

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particular medical problem is often observed, impacting around 60% of neonates delivered at full-term and up to 80% of infants born prematurely [4 - 6]. Although mild jaundice is frequently observed in newborns, the presence of severe cases can result in hyperbilirubinemia and, if not properly addressed, kernicterus [7]. Kernicterus is a severe pathological illness that has the potential to result in detrimental effects on the brain, including cognitive impairment, hearing loss, and even mortality. Furthermore, it is worth noting that newborn jaundice has a substantial role in the mortality of infants, as reported by the Centres for Disease Control and Prevention in 2020. Thus, monitoring and treating newborn jaundice with phototherapy or exchange transfusion is essential to prevent these issues and protect the baby. Jaundice becomes visible on the skin when serum total bilirubin levels reach around 1.5 mg/dL. Because the sclera has a higher elastin concentration than other skin regions, jaundice is best identified by looking at it [1, 8]. But when the total blood bilirubin level is more than 2-3 mg/dL, scleral jaundice can be seen with the unaided eye, even in the absence of specialized equipment [9 - 12].

In contemporary times, the advent of computer vision and machine learning methodologies, specifically Convolutional Neural Networks (CNNs), has facilitated the prompt, non-intrusive, and economically viable identification of jaundice. These techniques involve the analysis of patient images to identify manifestations of yellowing in the skin or eyes, as well as to estimate bilirubin levels. The authors, J.H. Park *et al.*, have proposed a methodology based on deep learning to quantify scleral jaundice using smartphone-captured photos of the sclera. The research findings demonstrated a correlation between the depicted images and the bilirubin concentration in the bloodstream, namely among those with bilirubin levels equal to or greater than 1.5 mg/dL, within two distinct groups of patients. According to Park *et al.* [13], the application demonstrates a sensitivity of 80.0% and specificity of 92.6% in detecting hyperbilirubinemia when the Phototherapy Simplification Bundle (PSB) threshold is set at 1.5. These findings suggest that the app holds promise as a practical tool for monitoring patients. They used YCbCr Cr and Cb values and HSV hue to identify skin pixels. They found that jaundiced skin had increased kurtosis, indicating extreme values and a deviation from normal. Kurtosis was suggested as a metric to distinguish normal and jaundiced skin [14]. Leung *et al.* [15] investigated color matrices to quantify the yellowness of the sclera images by examining two color metrics without requiring training: one based on blue chromaticity in the original RGB color space and another newly introduced metric called JECI, which operates in the CIE XYZ color space shows a strong correlation with TSB (-0.73 and 0.73 respectively;  $p<0.01$  in both) [15]. Abdulrazzak *et al.* [16] examined hospital records of twenty-three Nigerian infants. They covered the conception period, gender, early birth weight, age, and parental ethnicity. A multi-layer perceptron

classified jaundice severity as low, moderate, or high using these features. Out of 23 validation examples, the model classified 13 correctly.

## MATERIALS AND METHODS

### Dataset

The proposed work consists of 511 images that were collected from Google images. The images were used to identify the infants with no jaundice and those with jaundice. We ensured that our dataset is diverse and includes a variety of images with different lighting conditions, skin tones, and backgrounds. Table 1 provides a detailed summary of the images in the dataset, along with the distribution of data used for training and testing the model.

**Table 1. Dataset Description.**

Categories	Number of Images	
	Training	Testing
Jaundice	88	22
Normal	313	88

### Image Pre-Processing and Augmentation

Several preprocessing steps were applied to ensure consistency and improve the model's performance. Each image was resized to 224x224 pixels for uniformity, and pixel values were normalized to the range [0,1] to facilitate faster convergence. Pre-processing technologies were utilized in this section to improve the image quality and reduce the overall noise [17]. Due to the lack of disease images, neural networks tend to get the information about the training set too fast, leading to overfitting problems in training CNNs. This issue can be solved through data augmentation technology. Data augmentation allows the model to learn and improve its detection performance by learning patterns. In this study, we propose using various random transformations, including rotation by 20°, width and height shifts by 20%, horizontal flipping, shear and zoom by 20%, and fill mode as nearest.

## PROPOSED DEEP CONVOLUTIONAL NEURAL NETWORK

The convolutional neural network (CNN) is a sophisticated deep learning framework specifically developed to tackle complex problems that are characterised by large datasets. The architecture has four distinct layers, including convolution, max-pooling, fully-connected, and output. Many CNN models are

## **CHAPTER 9**

# **Cyber Crime and Law: Awareness among Undergraduates**

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**Abstract:** In the modern era, our heavy reliance on electronic technology has made safeguarding data from cyber threats a complex challenge. The primary objective of cyber attacks is to inflict financial harm upon businesses, contributing to the significant issue of cybercrime. This problem can be attributed, in part, to a lack of awareness or disregard among the general public. Specifically, undergraduate students, who are relatively new to the internet landscape, often lack knowledge about the various types of cyber attacks and the legal repercussions associated with them. To assess the awareness levels among young individuals, a survey was conducted among those aged 15-20 years. Additionally, this paper delves into different sections of cyber law and explores the realm of cyber ethics.

**Keywords:** Cybercrime, Cyberspace, Cyber attack, Cyber ethics.

### **INTRODUCTION**

In today's technological era, the majority of economic, commercial, cultural, social, and governmental activities across all levels, including individuals, non-governmental organizations, and government institutions, take place in the realm of cyberspace. Cyberspace itself is the canvas for these activities, and it is where crucial and sensitive information is either transferred or originates. This space hosts most media endeavors, facilitates the majority of financial transactions, and consumes a significant portion of citizens' time and interactions [1].

This heavy reliance on cyberspace has introduced fresh security challenges for governments. The accessibility of this domain, the potential for anonymity, the uncertainty surrounding the geographic origin of threats, the profound consequences of cyber incidents, and the lack of public transparency within

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cyberspace have attracted a diverse array of actors, both powerful and less powerful. This includes governments, organized groups, terrorist organizations, and even individuals, all participating in this digital landscape. Consequently, the threats emanating from cyberspace now encompass cyber warfare, cybercrime, cyber terrorism, and cyber espionage.

The term 'Cyber' has its origins in Cybernetics, a field rooted in the Greek word 'kubernētēs,' which signifies a pilot or steersman. Its modern usage was popularized by the American mathematician Norbert Wiener, who authored the book 'Cybernetics' in the 1940s. In contemporary language, 'Cyber' pertains to or reflects the realm of information technology, virtual reality, or computers. A 'Cyber Attack' transpires when malicious actors attempt to disrupt or harm a computer system or network [2].

In simpler words, Cybercrime encompasses unlawful activities in which a computer serves as the primary tool for perpetration and theft. This expanding category of criminal activities encompasses offenses made feasible through computing technology, like network breaches and the distribution of computer viruses. It also includes computer-based adaptations of traditional crimes, such as identity theft, harassment, cyberbullying, and terrorism, all of which have emerged as significant challenges for individuals and nations [3, 4].

Cybercrime involves a networked system and infrastructure. It may involve the use of a computer in the commission of the crime or be the target of the crime itself. Digital crimes are actions committed with criminal intent against individuals, resulting in harm to their reputation, physical well-being, or psychological state through modern communication methods. These methods include web chat rooms, cell phones, messaging apps, emails, and news feeds. Such crimes pose a significant threat to a nation's security and economic stability. Issues related to these crimes, particularly those involving hacking, copyright infringement, and child pornography, have garnered considerable attention. Additionally, concerns about data security arise when sensitive information is either blocked or exposed, whether legally or otherwise. The substantial expansion of electronic commerce (e-commerce) and online stock trading has contributed to a surge in cybercrime incidents [5].

### **Surge in Cyber Crimes**

According to a recent report by the National Crime Records Bureau, the Ministry of Home Affairs, a total of 52,974 cases were registered under cyber crimes, showing an increase of 5.9% in registration over 2020 (50,035 cases). Crime rate under this category increased from 3.7 in 2020 to 3.9 in 2021. In 2021, 60.8% of cyber-crime cases registered were for the motive of fraud (32,230 out of 52,974

cases), followed by sexual exploitation with 8.6% (4,555 cases) and extortion with 5.4% (2,883 cases) [6].

Indian Computer Emergency Response Team (CERT-In) is a functional organization of the Department of Information Technology, Ministry of Communications and Information Technology, Government of India, with the objective of securing Indian cyber space. CERT-In in its Annual Reports [7], handled around 1400000 incidents (Fig. 1). The types of incidents handled were mostly phishing (Fig. 3), malicious code, website compromise and propagation of malware (Fig. 6), and network scanning and probing (Fig. 4), and other attacks reported (Figs. 7 & 8).

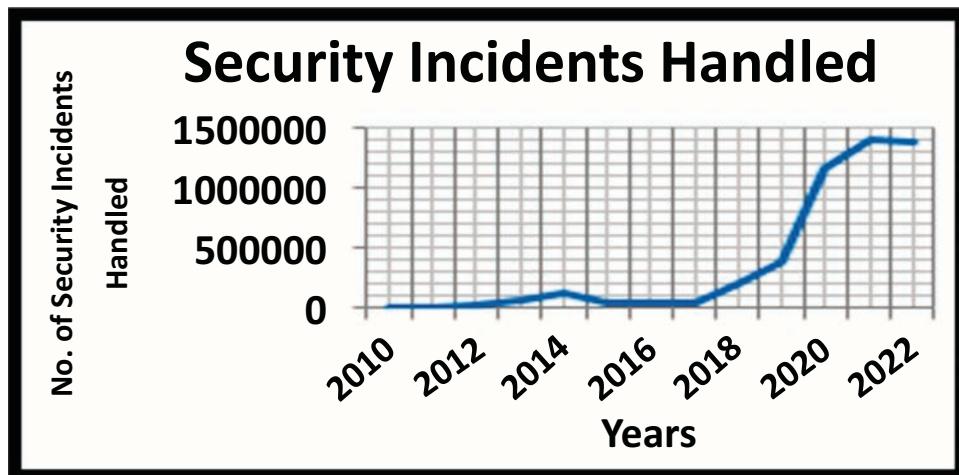


Fig. (1). Security incidents handled by CERT-In.

As per Fig. (1), it is evident that there is a steep increase in the number of security incidents handled since 2017 due to the increase in the number of internet users.

Fig. (2) shows that the number of security alerts issued has been increasing since 2017, prior to that, there was a gradual change.

In Fig. (3), it is evident that there is a steep increase in phishing attacks during 2010-2014 and after 2021.

As per Fig. (4), it is evident that there is a steep increase in the number of network scanning/probing during 2017-2020, and after that it drastically reduced.

## CHAPTER 10

# Re-examining the Vapour Phase U.V. Spectra of O-Amino Anisole

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**Abstract:** The ultraviolet spectra of O-Amino anisole in the vapor phase have been analyzed within the 400–200 nm range. The study focuses on: (i) Correlating the observed spectral frequencies with those of similar molecules and assigning them to their probable vibrational modes. (ii) Investigating the vibrational characteristics of functional groups such as the OCH<sub>3</sub> and amino groups, in relation to the spectral assignments of analogous nitrogen-containing heterocyclic compounds. The principles governing the vapor-phase spectra have been explored, providing a detailed interpretation of wave numbers, spectral bands, and electronic transitions, including  $\pi-\pi^*$  and  $\eta-\pi^*$  bands, along with their respective shifts. Additionally, the analysis encompasses 0–0 bands, as well as the characterization of the molecule's ground and excited states.

**Keywords:** Spectral bands, Transitions, UV spectra, Vapour phase, Wave numbers.

## INTRODUCTION

Benzene and its derivatives, along with nitrogen-containing heterocyclic compounds and methoxy benzene derivatives, hold significant biological, ecological, and medicinal importance, as evidenced by comprehensive spectroscopic studies [1 - 12] and extensive surveys [13 - 23, 52, 53]. Due to the resonance effect of the methoxy group on the aromatic ring, methoxybenzene possesses a higher electron density than benzene (C<sub>6</sub>H<sub>6</sub>). The resonance effect has a stronger influence on the  $\pi$ -electron cloud of the ring than the inductive effect,

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making methoxybenzene more reactive in electrophilic aromatic substitution than benzene, which in turn is more reactive than nitrobenzene [9, 11]. Methoxybenzene derivatives are naturally present in various plants and foods, such as fennel [9]. Studies by Miller, C., and others [10] have contributed to this understanding, while N.R. Drinkwater [12] has documented the genotoxicity, carcinogenicity, and chronic toxicity of allyl methoxy benzene in rats. The chemical, spectroscopic, and biological activities of substituted methoxy benzenes have been extensively explored by researchers, including B.M. Reddy *et al.* [13] and G.N.R. Tripathi [14]. The sensory properties of chlorinated methoxy benzenes were demonstrated by N.M. Griffiths [15]. Additionally, the metabolic activity of methoxybenzene derivatives in rabbits has been highlighted in studies by H.G. Bray *et al.* and W.V. Thorpe *et al.* [16, 17], emphasizing their biological relevance. Satyaprakash [18] presented intriguing research on the fluorescence spectra of vapor-phase methoxy benzene, while K.V.V. Krishna Mohan [19] introduced dielectric studies and a novel bromination technique for methoxy benzene derivatives. Given that methyl benzenes are derivatives of substituted anisole, a comparative study of these compounds is of interest. They hold potential applications in the synthesis of fine chemicals, as well as antiviral and antibacterial drugs. Research on bioactive molecules such as pyridine, pyrimidine, cytosine, methoxy benzene, anisole, furan, uracil, and their derivatives continues to gain prominence in both spectroscopy and medicinal chemistry. Methyl benzenes, in particular, are of considerable biological significance within heterocyclic chemistry [24 - 27]. Extensive experimental and theoretical studies have been conducted on the electronic spectra of azobenzene and its states. These molecules exhibit diffuse but distinct spectral features at longer wavelengths due to  $\eta-\pi^*$  transitions, which involve the promotion of an electron from a nonbonding nitrogen orbital to an antibonding  $\pi^*$  orbital. Theoretical predictions indicate at least two such transitions—one symmetry-allowed and one forbidden [35 - 38, 48]. While there is strong agreement between theoretical and experimental data for  $\pi^*-\pi$  transitions, discrepancies exist for  $\pi^*-\eta$  transitions. Berthod *et al.* [28] have theoretically predicted the absorption spectra of uracil and cytosine nucleosides, while Clark & Tinoco [29] have identified additional electronic transitions beyond  $\eta-\pi^*$  and  $\pi^*-\pi$  in uracil, cytosine, and their nucleosides.

In case of disubstituted anisole,  $\pi^*-\pi$  transitions were observed in various solvents at different wave numbers:

- **Vapor phase:** 35,248, 35,868, and 33,389  $\text{cm}^{-1}$
- **Methanol:** 35,174, 35,987, and 33,670  $\text{cm}^{-1}$
- **Chloroform:** 35,081, 35,855, and 33,501  $\text{cm}^{-1}$
- **Benzene:** 35,001, 35,816, and 33,367  $\text{cm}^{-1}$

- **Carbon tetrachloride:** 35,952, 35,739, and 33,225  $\text{cm}^{-1}$

These findings were reported by S.P. Gupta *et al.* [30]. Further studies by C. Passingham [37] and Baranska [38] examined and interpreted the vibrational frequencies and absorption bands of various nitro compounds, including nitrobenzene and 1,3-dinitrobenzene.

Building upon this foundation, the present study investigates the ultraviolet (UV) spectra of o-Amino anisole in the vapor phase within the 400–200 nm range, with the following objectives: □(i) Correlating the observed spectral frequencies with those of related molecules and assigning them to their likely vibrational modes. □(ii) Analyzing the vibrational modes of key functional groups, such as  $\text{OCH}_3$ , in relation to comparable N-heterocyclic compounds.

A comprehensive interpretation of the *wave numbers, spectral bands, electronic transitions ( $\pi-\pi$  and  $\eta-\pi$  bands)*, spectral shifts, 0–0 bands, and the fundamental characteristics of ground and excited states\*\* in the vapor-phase UV spectrum of o-Amino anisole is provided.

## MATERIALS AND METHODS

### Chemicals and Sample Preparation

Specification-grade benzene and o-amino anisole (hereafter referred to as o-AA) were procured from Sigma-Aldrich Chemical Company, USA, and utilized without additional purification. However, their purity was verified through elemental analysis and melting point determination. A polycrystalline sample of o-AA was finely ground and mixed with reagent-grade KBr, followed by compression into a pellet for spectral analysis. The spectral resolution was maintained at  $0.2 \text{ cm}^{-1}$ , and the scanning speed was set to  $30 \text{ cm}^{-1} \text{ min}^{-1}$ . The frequency precision for all well-defined spectral bands was within  $\pm 1 \text{ cm}^{-1}$ .

### Instrumentation

The vapor-phase ultraviolet (UV) spectra of o-amino anisole were acquired using a Shimadzu UV-1700 spectrophotometer, equipped with a deuterium lamp as the UV radiation source, covering a spectral range of 200–800 nm. The instrument incorporated a monochromator for wavelength selection and a photodiode array detector for accurate absorbance measurement.

To ensure precise wavelength calibration, the spectrophotometer was calibrated using potassium dichromate and holmium perchlorate solutions as primary standards. The absorbance of potassium dichromate was verified at 235 nm, 257

## **CHAPTER 11**

# **Study of Structural and Electronic Properties of ErRuSi Compound with the Help of Density Functional Theory (DFT)**

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**Abstract:** In this study, we present theoretical investigations of the ErRuSi compound. The compound has been investigated using some theoretical approaches, including local density approximation (LDA), generalized gradient approximations (GGA), Becke Johnson (BJ), and modified Becke Johnson (mBJ). This study presents an analysis of structural characteristics and electronic properties with the help of GGA approximation. The structural properties of an ErRuSi material may be characterized in terms of its lattice parameter and the stability curve of energy vs. volume. In this paper, we have calculated the lattice constant as  $a_0=6.9211$  Å,  $b_0=4.2929$  Å, and  $c_0=7.0319$  Å. All these parameters strongly agree with experimental data. The electronic properties of an ErRuSi material may be described in terms of its band structure (BS) and density of states (DOS). Overall electronic properties are confirmed, and ErRuSi material is metallic in nature. This nature is due to the Er-f state. All the features demonstrate a strong correlation with the experimental results.

**Keywords:** Density Functional Theory, Density of state, Electronic properties, GGA, Local density approximation (LDA).

## **INTRODUCTION**

Intermetallic compounds consisting of rare earth (R) and transition metal (T) elements have consistently garnered significant attention within the realm of magnetic materials research [1]. The research endeavours in the domain of magnetism and magnetic materials are seeing continuous growth, exerting a

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substantial impact on both industry and the everyday lives of individuals. The historical development of magnetism demonstrates its inherent connection to practical applications. Applications for magnetic materials are numerous and include memory devices, transformer cores, permanent magnets, magneto-mechanical, magneto-electronic, and magneto-optical devices [2, 3]. The list has been expanded with the inclusion of magnetic refrigeration and spintronics in recent times. Magnetic refrigeration, a method of reducing the temperature of a substance, is regarded as an environmentally sustainable approach and is now being actively evaluated as a potential substitute for traditional gas compression and expansion technology. Similarly, spintronics has significantly transformed the magnetic recording business. R-T intermetallic is significant in the applications due to the appealing magnetic characteristics shown by the constituent R and T elements. The genesis of magnetism in rare earths is widely recognized to be attributed to the presence of partially filled 4f shell electrons. Due to the strong localization of these electrons, their magnetic moments exhibit significant magnitudes. Transition metals, on the other hand, have wandering magnetism. This indicates that the magnetic moments are dispersed throughout the metal's electron sea rather than being restricted to certain ions. As a result, magnetic moments are reduced in comparison with rare earths. In addition, the 'ordering temperature' of the magnetic characteristics of transition metals is generally higher. The coexistence of rare earth elements and transition metals frequently leads to intriguing magnetic and associated characteristics. This phenomenon remains valid even in cases where the transition metal exhibits weak magnetic properties or is nonmagnetic [4]. A considerable quantity of families consists of intermetallic compounds based on rare earth elements. Throughout the course of time, a significant number of these chemical compounds have established their prominence within the realm of applied magnetics materials. Within the realm of intermetallic compounds, the family of RTX (where X represents a p-block element) exhibits a plethora of compounds that possess intriguing basic features and have significant potential for many applications. The diverse range of structural, magnetic, and transport characteristics displayed by them is of special interest. The quantity of RTX compounds is extensive and cannot be comprehensively addressed within the scope of this paper. It has been observed that except for manganese (Mn), none of the other transition elements in the RTX family exhibit a significant magnetic moment. Therefore, in these compounds, the total magnetic moment is only provided by the rare earth element. Multiple molecules from this category have demonstrated captivating magnetic and electrical properties [1]. One captivating subset inside the RTX-type compound is RRuSi, whereby Ru-4d is the transition metal element. Significant fluctuations in the magnetic properties of the RRuSi series have been seen with modifications to the R element. Welter *et al.* [5] conducted an investigation of the compounds

RRuSi (where R represents the elements La-Nd, Sm, Gd) employing neutron diffraction and magnetic measurements. Based on the literature review, these compounds are classified as CeFeSi type tetragonal crystal structure, with space group P4nmm. According to the findings presented in the referenced paper [5], it has been observed that LaRuSi exhibits Pauli paramagnetic. CeRuSi, on the other hand, displays Curie-Weiss paramagnetic behaviour until reaching a temperature of 4.2 K. The compounds SmRuSi and GdRuSi have been seen to display ferromagnetic properties, wherein their magnetic moments align parallel to each other even in the absence of an external magnetic field. In contrast, PrRuSi and NdRuSi exhibit antiferromagnetic characteristics, wherein neighbouring magnetic moments align in opposing orientations. Consequently, the macroscopic scale exhibits a nullification of their magnetic moments. The dissimilarity in magnetic properties exhibited by these compounds can be ascribed to a range of factors, encompassing the electronic configuration of the constituent elements, the arrangement of their crystal lattice, and the interplay between the magnetic moments of the individual atoms. In recent studies, researchers have examined the magnetic and magnetocaloric characteristics of the ErRuSi compound within this series [6]. The magnetic characteristics of the material exhibit ferromagnetic ordering at temperatures below 8 K, as shown by previous research [6]. This situation is like the case of NdRuSi. This phenomenon was previously ascribed to a minor Ru moment that potentially exhibits antiferromagnetic coupling with an Er moment [6]. To validate these predictions, it was necessary to conduct neutron diffraction observations. The chemical exhibited a significant magnetocaloric effect (GMCE) while also demonstrating little thermal and field hysteresis, as reported in reference [6]. It has been generally noted that compounds exhibiting a high magnetocaloric effect (MCE) also tend to have a correspondingly high magnetoresistance (MR) [7 - 9]. The alteration in magnetic structure resulting from the application of a magnetic field is responsible for influencing both the magnetocaloric and magneto-transport characteristics.

## METHOD

The full-potential linearized augmented plane wave (FP-LAPW) method represents a particular instantiation of the density functional theory (DFT) approach [10 - 12]. The method employs a hybrid approach involving plane waves and augmented plane waves to characterise the electronic wavefunctions and charge density present in a crystalline material. This approach is especially suitable for providing an accurate depiction of the electrical configuration of intricate substances, encompassing those exhibiting diverse magnetic properties. The method under consideration incorporates the “full potential” aspect, which signifies its consideration of the complete potential energy of the crystal lattice. This stands in contrast to other approaches that employ simplified approximations

## **CHAPTER 12**

# **Study of Electronic Properties of Rare Earth Transition Metal Gallides $\text{Ho}_4\text{XGa}_{12}$ , (X = Pd, Pt)**

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**Abstract:** The ternary compound  $\text{Ho}_4\text{XGa}_{12}$ , (X = Pd and Pt), displays unconventional physical properties such as heavy fermions behavior, notable magnetoresistance, and future applications in superconductivity. These applications occur because of the molecule's tight connection among its electrons.  $\text{Ho}_4\text{XGa}_{12}$  (X = Pd, Pt) crystallizes in the cubic phase consisting of the  $\text{Im}-3\text{m}$  space group. To exhibit the relevant character of  $\text{Ho}_4\text{XGa}_{12}$  (X = Pd, Pt), we have inquired about the electronic structure, magnetic and thermodynamic properties of  $\text{Ho}_4\text{XGa}_{12}$  (X = Pd, Pt) using density functional theory (DFT) with the help of WIEN2K and Gibbs2 software. Electronic properties show the metallic behavior of both compounds.

**Keywords:** DFT, Electronic properties, Gallium, Magnetoresistance, Ternary compound.

### **INTRODUCTION**

At the end of the nineteenth century, it was assumed that magnetic material did not reveal the superconducting phenomenon. The superconductivity of heavy-fermions was found to be significant after the discovery of their superconductivity in  $\text{CeCu}_2\text{Si}_2$ . This adventure opened a vast area of research to study new intermetallic compounds of gallides with rare earth and transition metals, asubstance or a phenomenon in the field of condensed matter physics that displays characteristics such as heavy fermion behavior, magnetism, significant

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magnetoresistance, and superconductivity. Heavy fermion compounds are a type of material renowned for their ability to exhibit these features. Heavy fermion compounds are a kind of intermetallic compound characterized by the behavior of their conduction electrons, which exhibit an effective mass significantly greater than their intrinsic mass. The observed phenomenon can be attributed to the significant interplay between the conduction electrons and localized magnetic moments present in the material. The existence of localized magnetic moments in the combination can be ascribed to the inclusion of rare earth or actinide ions. The manifestation of heavy fermion behavior is commonly observed under conditions of low temperatures, and it is characterized by the presence of a substantial concentration of electronic states at the Fermi level. The phenomenon gives rise to a significant electronic specific heat, a distinctive characteristic shown by heavy fermion materials. The investigation of correlated electron systems is significantly enriched by the presence of heavy fermion behavior, as it engenders a diverse range of intriguing and technologically significant phenomena, such as magnetism, substantial magnetoresistance, and superconductivity, as previously indicated [1 - 4]. The hybridization of orbital electrons of rare earth and conduction electrons plays an important role in magnetism, superconductivity, and magnetoresistance. Rare earth transition metal gallides exist in different phases with different structures [5 - 9]. At lower temperatures, these interactions have the potential to generate a diverse range of captivating and technologically significant phenomena. The comprehension and utilization of the characteristics exhibited by strongly correlated electron systems possess the capacity to bring about transformative advancements in diverse domains of technology, encompassing energy, electronics, and quantum computing. Scholars persist in investigating these substances to gain basic insights into the field of condensed matter physics and to further the creation of novel technologies. In the present research article, the focus of our research is on  $RE_4XGa_{12}$  ( $RE$  = heavy rare earth elements  $X$  = Pd, Pt) type gallides.  $RE_4XGa_{12}$  compounds are condensed in the cubic phase consisting of an  $Im\text{-}3m$  space group [10]. The metal flux growth method is widely utilized in the field of crystal development for the purpose of synthesizing a diverse range of materials, encompassing ternary layered intermetallic complexes. The present methodology involves subjecting a blend of metallic elements, frequently accompanied by a flux substance, to elevated temperatures, therefore facilitating the formation of the intended compound through the constituents' mutual reactions. Subsequently, the compound undergoes a gradual cooling process, facilitating its crystallization from the molten amalgamation. The selection of gallium is a strategic decision. The substance's relatively low melting point enables it to undergo easy liquefaction and serve as a flux. Conversely, its elevated boiling point allows it to remain in the liquid state across a broad spectrum of temperatures, rendering it well-suited

for promoting the formation of specific compounds. The synthesis of ternary-layered intermetallic compounds by this approach frequently results in the emergence of distinctive electronic, magnetic, or other physical characteristics. These qualities hold significant potential for many applications in fields such as electronics, superconductivity, and magnetism. The properties and applications of the compound will be contingent upon the precise amalgamation of rare earth elements, transition metals, and gallium employed [11] to study magnetic properties. The magnetic study of  $\text{Ho}_4\text{PdGa}_{12}$  and  $\text{Er}_4\text{PdGa}_{12}$  indicates that these compounds are anti-ferromagnetic at transition temperatures. The study of the electrical resistivity of these compounds confirms that these materials exhibit a metallic nature [12]. Based on the literature survey, we can say that a few studies on structural and magnetic properties have been presented by several authors [1 - 12] but no detailed studies have been made on temperature and pressure-dependent electronic, magnetic, and thermodynamic behavior and electronic structure for  $\text{RE}_4\text{XGa}_{12}$  ( $\text{RE}$  = heavy rare earth elements  $\text{X}$  =  $\text{Pd}$ ,  $\text{Pt}$ ) type rare earth transition metal gallides. The aim of the present research work is to express and yield an interpretation of more strong properties of rare earth transition gallides on; (a) band structure (BS) curves; the density of states (DOS) that determine the electronic properties; (b) Electron spin polarization and magnetic moment magnetization, which determine the magnetic properties; (c) Debye temperature, Grüneisen parameter, specific heat, thermal expansion coefficient, entropy and other temperature and pressure dependent properties, which determine thermodynamic properties. Since experimental data for  $\text{Ho}_4\text{XGa}_{12}$  are unavailable, the chapter will emphasize the theoretical predictions using DFT and comparative analysis with related compounds (*e.g.*,  $\text{Ln}_4\text{XGa}_{12}$ ); discuss structural, electronic, magnetic, and thermodynamic similarities and extrapolate potential behaviors; and highlight the need for experimental validation and suggest specific techniques, such as SQUID magnetometer, XRD, and spectroscopic methods, to verify predictions. These revisions aim to provide a comprehensive understanding of the material properties and ensure the chapter meets the reviewer's expectations for depth and clarity.

## COMPUTATIONAL METHOD

In the present research article, the Density Function Theory (DFT) calculations were carried out to explore the electronic structure using an accurate full potential linearized augmented plane-wave plus local orbital (FP-LAPW + lo) method with GGA exchange-correlation as inserted in WIEN2k software [13 - 17]. Optimization has been made with the charge accuracy of 0.0001 ec. The cutoff energy for optimization has been obtained to be -6.0 Ry. The calculated values of Fermi energies for  $\text{Ho}_4\text{PdGa}_{12}$  and  $\text{Er}_4\text{PtGa}_{12}$  are shown in Table 1.

## CHAPTER 13

# Statistical Analysis of Changing Trends in Motor Fitness of Male Individuals by Practicing Strong Moves Program

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**Abstract:** The quest for health and fitness is an ever-evolving journey that spans generations, fostering holistic wellness, self-confidence, and mental acuity. This research delves into the transformative essence of the Strongmoves program in revolutionizing motor fitness among males, focusing on dual primary aims: evaluating the program's influence on male participants and juxtaposing the outcomes across varied age brackets. The methodology encompasses an exhaustive spectrum of fitness evaluations, enveloping aspects such as strength, cardiorespiratory prowess, endurance, flexibility, agility, coordination, and equilibrium. The findings are striking, delineating a significant and applicable upswing in all motor fitness facets across diverse age categories. The data, meticulously dissected through Repeated Measure ANOVA, accentuates marked augmentations in strength, cardiorespiratory potential, endurance, flexibility, agility, coordination, and stability. These insights corroborate the potency of Strongmoves in ameliorating motor fitness, with the age group of 16-20 years reaping particularly remarkable advantages. In essence, this scholarly probe emphasizes the criticality of bespoke fitness interventions in maximizing results and shaping public health blueprints. It furnishes empirical substantiation affirming Strongmoves' positive sway over motor fitness and reiterates the significance of systematic exercise regimens in boosting wellness across a spectrum of demographic clusters. Strongmoves stands out as a scientifically endorsed modality for cultivating comprehensive health and fitness, thus enriching individual existences and communal health.

**Keywords:** Fitness interventions, Health and wellness, Motor fitness, Personalized fitness, Physical education, Physical exertion, Repeated measure ANOVA, Strongmoves.

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## INTRODUCTION

Embracing a health-centric lifestyle and giving precedence to physical exertion throughout diverse life phases engenders a more enriched, vigorous existence, bolstering self-regard, corporeal perception, and mental lucidity [1 - 3]. Physical education, within and beyond formal scholastic confines, endows individuals with the acumen and competencies necessary for judicious health decisions, nurturing a favourable disposition towards physical activity [4 - 7]. By advocating for physical education and a health-focused lifestyle, societies can invigorate individuals to pursue more salubrious, joyous lives, thereby enhancing communal solidarity and elevating the collective quality of existence [8 - 10]. The ancient Indian Gurukul system, where disciples resided with their guru (mentor) in secluded communes, prioritized an all-encompassing education, inclusive of physical training, yoga, meditation, and ethical principles, thus fostering complete well-being [11 - 13]. However, transformative epochs like the Industrial Revolution, initiated in the late 18th century, triggered profound lifestyle alterations, especially in the Occident. This era heralded urbanization, mechanization, and sedentary vocations, curtailing physical activity and escalating health concerns [14, 15].

Explorations in this domain can foster the personalization and refinement of exercise agendas. Adapting fitness interventions to an array of populations, encompassing various ages, sexes, and fitness strata, is crucial for ensuring inclusivity and reach in fitness endeavours [16 - 19]. Conclusively, an in-depth grasp of Strongmoves' repercussions on motor fitness can enlighten public health stratagems and exercise advisories. This investigation tackles vital facets of health and wellness in an ever-mutating global landscape. Various authors have presented mechanisms for statistical analysis [20 - 27].

## OBJECTIVES

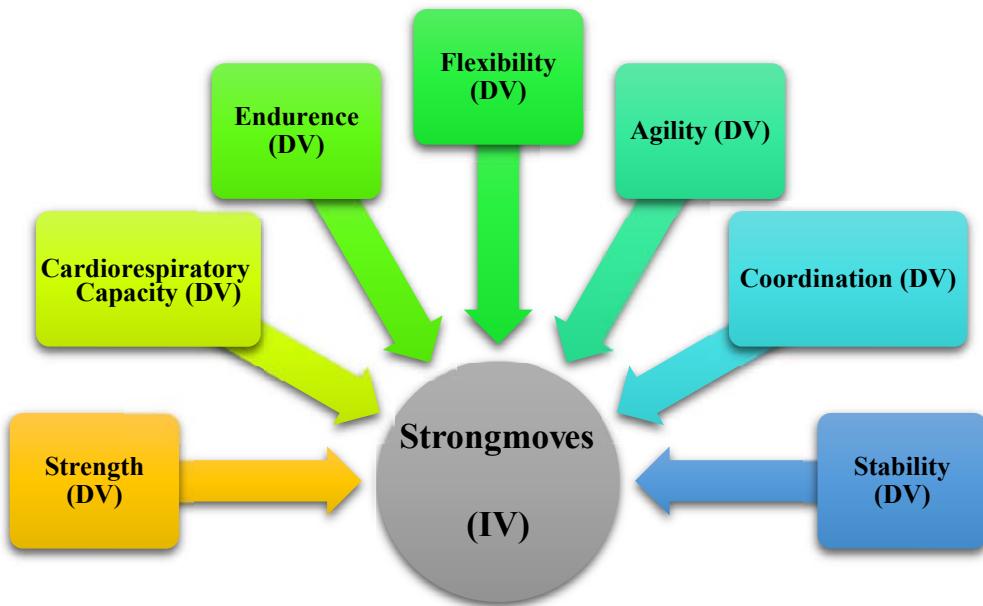
1. To dissect the repercussions of Strongmoves on male participants.
2. To contrast the influence of Strongmoves across disparate age clusters of male subjects.

Under the guiding directional hypothesis for both aims, we posit that male participants and different age groups will experience a significant transformation through the Strongmoves practice.

## MATERIALS AND METHODS

For this study's purpose, a 12-minute Cooper's run/walk test was executed to gauge the population's eligibility for subject selection. Predicated on the pre-test,

the top and bottom 20% from the record sheet were omitted to mitigate experimental bias, with the remaining 60% deemed study subjects. Subsequent grouping utilized a convenience method of non-probability sampling. Post-pr-test, 100 healthy male subjects were evenly bifurcated into Control (50 Males) and Experimental (50 Males) groups. These subjects were further split into two age clusters: 16-20 years and 21-25 years. Consent forms, ensuring physical fitness and voluntary participation devoid of health issues potentially affecting the study, were obtained from each participant. The selected Motor Fitness variables assessed for the impact of Physical Training are shown in Fig. (1).



**Fig. (1).** Smart chart of selected independent variable (IV) and dependent variables (DV).

## ADMINISTRATION OF STRONGMOVES

### Training Tailoring

This blueprint encompasses a weekly extensive array of fitness components to fortify SCEFACS (strength, cardiorespiratory capacity, endurance, flexibility, agility, coordination, and stability). Intensity and exercises are modulated as required to match fitness echelons. Routine conditioning in micro-moves, core program in motor-moves, and recovery routine in mend-moves are integrated for optimal warm-up and cool-down stages to avert injuries and amplify performance. Fig. (2) shows STRONGMOVES protocols.

## CHAPTER 14

# Contributing to Software Security through Machine Learning

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**Abstract:** Enhancing software security is crucial for software developers seeking to optimize resource allocation and programming quality. This paper underscores the effectiveness of Support Vector Machines (SVMs) in predicting software security issues due to their proficiency in handling high-dimensional data and robust classification capabilities. By analyzing software vulnerability data, SVMs enable the early anticipation of security threats, offering a proactive approach to threat mitigation within the software development lifecycle. Comparative analysis across sixteen datasets showcases SVMs' reliability in forecasting software security risk when juxtaposed with eight statistical and machine learning models. This research advances our comprehension of SVMs' ability to predict security vulnerabilities, providing enterprises with insights to weigh the integration of SVMs into their development processes for improved security. The results not only contribute to the field of software security but also underscore SVMs as a dependable predictive tool, consistently outperforming or rivaling other models.

**Keywords:** Logically centralized control, Support Vector Machines, Software defined networking.

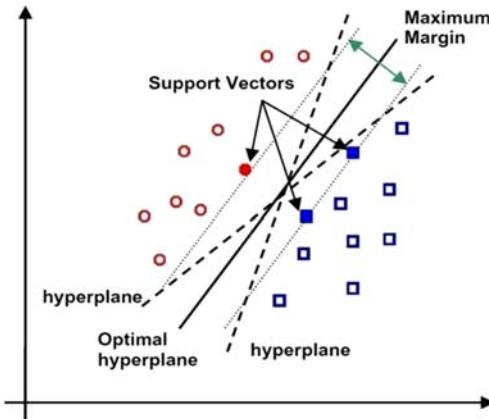
## INTRODUCTION

Software security is of utmost importance in fortifying software systems against malicious hacker attacks and various potential threats, guaranteeing their continuous operation and optimal performance [1]. These security measures encompass the preservation of critical attributes such as authentication, integrity, and availability [1]. Kernel-based Support Vector Machines (SVMs) excel in minimizing generalization errors, even when faced with unforeseen circumstances. These classical SVM classifiers are specifically tailored for binary pattern recognition tasks, effectively partitioning data through optimal hyper-

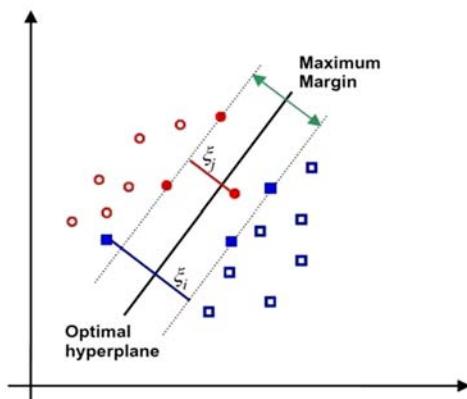
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planes delineated by support vectors [2]. These support vectors, drawn from the training dataset, establish a decision boundary between distinct classes, and notably, SVMs exhibit remarkable generalization capabilities in high-dimensional spaces, a feat achieved with minimal training data, rendering them dimension-independent [2]. SVM's quadratic programming framework guarantees the attainment of a global optimum, rendering them robust to outliers while efficiently managing misclassification errors. This sets SVM apart from other approaches struggling to model nonlinear functional relationships. Consequently, SVM emerges as a valuable model for the prediction of prevalent software security vulnerabilities [3].

A hyperplane may safely divide vectors if the distance between the closest two vectors is maximum. The separating hyperplane for separable and non-separable cases is shown in Figs. (1 and 2).



**Fig. (1).** Separating hyperplane for a separable case.



**Fig. (2).** Separating hyperplane for a non-separable case.

In Figs. (1 and 2), circles indicate class A, and squares indicate class B. The SVM aims to draw a straight boundary or solid line between the classes with as much margin space as feasible between dotted lines [4]. The maximum margin classifier splits vectors with the hyperplane to enhance this. When the training data cannot be separated without error, we try to separate the vectors with the fewest mistakes. Fig. (2) shows the non-separability of the two classes in two dimensions. This case requires changing the reduction problem to include misclassified data items. Positive slack variables in constraints help monitor margin limitation violations. Fig. (3) depicts the feature space transition from lower to higher dimensions.

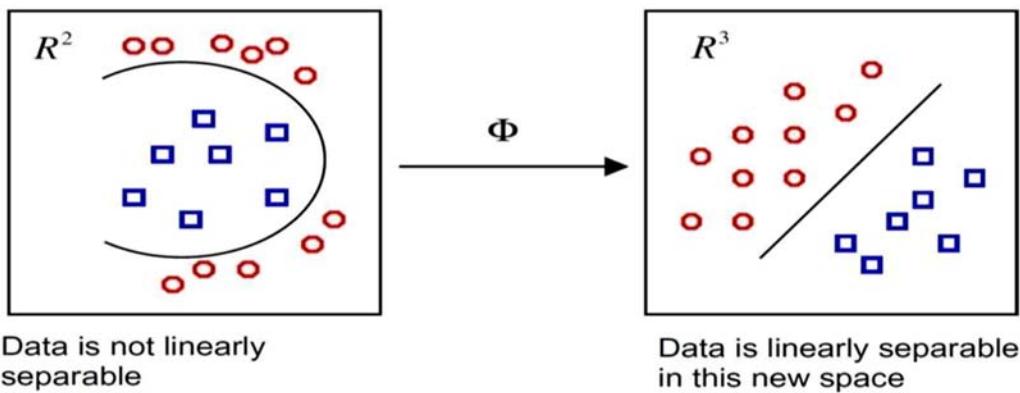


Fig. (3). Mapping of the input data into a higher dimensional space.

Statistical and machine learning techniques are deployed with the objective of forecasting software defects [4], followed by the application of logistic regression to evaluate the influence of object-oriented design metrics [5] on the prediction of fault-prone classes. Guo *et al.* [6] introduced the random forest approach to anticipate software fault-proneness and determined that the random forest method consistently outperformed other techniques in predicting software defects adopted by NASA. Khoshgoftaar *et al.* [7] investigated software quality prediction using a neural network and observed that the neural network model predicted outcomes better than the nonparametric discriminate model. Fenton *et al.* [8] presented Bayesian Belief Networks for software defect prediction. Clemente *et al.* [9] investigated program vulnerability using software quality metrics. They tested a multilayer deep feed-forward network for metrics that predict security issues [10] and observed deep learning and software measurements may create a good prediction model for software vulnerability.

The most realistic programmable network architecture to solve many problems in older networks is Software Defined Networking (SDN). SDN separates and logically centralizes the network control plane from the data forwarding plane

## CHAPTER 15

# Enhancing User Experiences through Human-Centered Design: Integrating Psychology and Sociology in Engineering

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**Abstract:** In an era where user-centricity is paramount, this study explores the integration of psychological and sociological principles into human-centered engineering design, highlighting their role in promoting user-centricity, inclusivity, and ethical responsibility. By examining the intersection of psychology, sociology, and engineering, the research demonstrates how these disciplines enrich product development, resulting in designs that are more aligned with diverse user needs, behaviors, and societal contexts. The study emphasizes the importance of interdisciplinary collaboration, where experts from various fields—such as psychology, sociology, and engineering—work together to create solutions that address complex user experiences and real-world challenges. Ethical considerations, such as privacy, data security, and user autonomy, are explored, underscoring the importance of responsible design in today's data-driven world. Real-world case studies showcase the successful application of these principles across sectors like healthcare, e-commerce, education, and urban design, illustrating how integrating these insights leads to more inclusive, user-friendly, and ethically sound technologies. This research encourages future studies on effective interdisciplinary collaboration, ethical innovation, and the ongoing exploration of user experiences. Ultimately, it underscores the need for innovation that balances functionality with empathy, inclusivity, and ethical consciousness.

**Keywords:** Data security, Ethical design, Ethical innovation, Human-Centered Design, Inclusive design, Inclusivity, Interdisciplinary collaboration, Real-world case studies, Technology adoption, User autonomy, User experience, User-centricity.

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## INTRODUCTION

In today's rapidly advancing technological landscape, the focus of engineering design has shifted from merely achieving functionality to creating solutions that enhance the human experience [1 - 7]. This evolution involves the integration of psychological and sociological principles into the design process, which enriches the understanding of user behavior, cognition, and societal influences. Psychological insights help designers understand how users process information, make decisions, and interact with products, while sociological perspectives shed light on how cultural, social, and economic factors shape technology adoption and use [8].

Incorporating these disciplines into engineering ensures that products are not only functional but also user-centric, inclusive, and ethically sound [9 - 25]. Inclusive design principles ensure that technologies are accessible to all, regardless of abilities, while ethical frameworks guide the development of systems that respect user autonomy, privacy, and informed consent. Furthermore, the study highlights the importance of interdisciplinary collaboration, where experts from engineering, psychology, sociology, and other fields work together to create solutions that address complex user needs and societal challenges. This chapter examines the vital role of psychology and sociology in human-centered design, emphasizing their integration into the engineering process. Through real-world case studies, the research demonstrates how interdisciplinary efforts can foster more effective, inclusive, and ethically responsible designs. By exploring these intersections, this research aims to encourage a shift toward more empathetic, inclusive, and ethically conscious technological innovations [26 - 30]. It also opens doors for future research into the ongoing evolution of user experience, interdisciplinary collaboration, and the role of ethics in shaping the technologies of tomorrow [23].

## LITERATURE REVIEW

### Human-Centered Design Principles

Human-centered design (HCD) places users at the core of the design process, ensuring that their needs, preferences, and behaviors directly influence every stage of product development. This approach emphasizes user empathy, active engagement, iterative improvements, and regular usability testing to refine the product and create highly relevant, user-friendly solutions [3]. By continuously integrating user feedback, HCD ensures that designs align with real-world user expectations, ultimately resulting in more effective, intuitive, and accessible products.

### **The Role of Psychology in Design**

Psychology plays a critical role in human-centered design by providing deep insights into human cognition, perception, and behavior. Cognitive psychology helps designers understand how users process information, make decisions, and interact with interfaces, enabling the creation of experiences that align with natural cognitive processes. For example, designing interfaces that reduce cognitive load or leveraging principles of attention and memory can significantly enhance user engagement and satisfaction [21]. The Fogg Behavior Model, for instance, can be used to design systems that encourage desired behaviors by addressing the factors of motivation, ability, and triggers, as seen in applications like Duolingo and Fitbit, which use gamified features to enhance user engagement and retention.

Behavioral economics informs how users can be influenced in positive, ethical ways through design, such as encouraging healthier behaviors or increasing user retention by tapping into decision-making biases. The application of these principles in design helps to craft systems that not only meet functional needs but also align with how people think and behave. For example, using nudging techniques, such as displaying energy savings when users opt for eco-friendly choices in apps or websites, demonstrates how behavioral insights can optimize user decisions without manipulation [26].

Psychological insights into human perception—visual, auditory, and tactile—are essential for crafting intuitive and engaging designs. By considering how users perceive and respond to different stimuli, designers can create interfaces that are not only functional but also aesthetically pleasing and easy to navigate. For instance, visual hierarchy and color theory from cognitive psychology can enhance the usability and appeal of interfaces, making it easier for users to navigate and interact with technology. Websites that prioritize contrast for text readability and icons for navigation are examples of designs informed by psychological principles [7].

### **The Role of Sociology in Design**

Sociology provides a broader perspective on how social, cultural, and economic factors influence users' interactions with technology [4]. It helps explain how cultural norms shape perceptions, attitudes, and behaviors toward design, guiding designers to create products that are culturally sensitive and widely accepted. For instance, understanding how different cultures perceive color, symbolism, or even interaction styles can lead to designs that resonate more effectively with global audiences [28]. The Social Construction of Technology (SCOT) theory helps explain how societal context and cultural values influence the design and adoption

## CHAPTER 16

# An Analysis of the Effects of Circuit Training on Speed and Agility of School Students

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**Abstract:** The major objective of this study was to study the effect of circuit training on the speed and agility of school students. To achieve the purpose of the study, sixty (60) male students were selected who served as subjects, and their age group was between 9 to 14 years. The selected subjects were divided into two groups *i.e.*, experimental and control group. Total 30 male students were selected for each group as research subjects. The experimental group underwent through circuit training exercise on 8 stations for 12 weeks. The control group only engaged in their normal activities; no additional training was provided. The physical variables that were examined during the study were speed and agility. All the data which was collected before and after the application of the training programme was examined by using a dependent “t” test to find out the significant difference between the means of pre and post-test scores of the experimental group. The level of confidence was fixed at 0.05. The obtained ‘t’ score of Speed and Agility was found to be higher than the required table value of 1.67 to be significant at 0.05 level of confidence at df 58. It clarifies that the post-data score of students in the experimental group is better than the post data of the control group of school students.

**Keywords:** Agility, Circuit training, Motor skills, School students, Speed.

## INTRODUCTION

Physical fitness plays a vital role in the overall well-being and development of school students. Engaging in regular physical activity not only promotes good health, but also enhances various aspects of physical performance, such as speed, agility, strength, and endurance. Among the many training methodologies available, circuit training has gained considerable popularity due to its versatility and effectiveness in improving multiple fitness components simultaneously. In the context of school students, circuit training offers a comprehensive and engaging approach to enhance their speed and agility, two key elements essential for

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various sports and physical activities. Speed and agility are fundamental attributes that contribute to success in numerous sports and physical challenges. Speed refers to the ability to move rapidly over a specific distance, while agility is the capacity to change direction quickly and efficiently. Both attributes require a combination of muscular strength, power, coordination, and motor skills, which can be honed through systematic training approaches.

Circuit training, a form of high-intensity interval training, involves performing a series of exercises targeting different muscle groups and fitness components within a specific time frame or repetitions. It typically involves a combination of cardiovascular exercises, strength training, and flexibility exercises, performed sequentially with minimal rest between stations. The dynamic nature of circuit training not only improves cardiovascular fitness but also enhances muscular strength, power, endurance, and coordination, making it an ideal training method for improving speed and agility.

This study aims to investigate the effects of circuit training on the speed and agility of school students. By implementing a well-designed circuit training program, we aim to assess whether such training can lead to measurable improvements in the students' speed and agility capabilities. Understanding the impact of circuit training on these crucial physical attributes can provide valuable insights for physical education instructors, coaches, and school administrators in designing effective training programs to enhance the overall fitness levels of their students.

The benefits of circuit training are as follows: many people can be accommodated at the same time. The individual works at his own pace within his capabilities. Goals are both immediately attainable and easy to evaluate. The target time, the attempt to complete the circuit in a certain maximum time provides a strong motivational factor. Since the main purpose of circuit training is to improve the strength and circulation of the working muscles, the researcher was interested in testing whether it has any effect on speed after a trial period of circuit training. In addition, it is undeniable that fitness trainers in the workplace are extremely important because first and foremost they must recommend exercise program guidelines to their students. The Health Exercise Department of the Thai Ministry of Health and the Ministry of Public Health recommends that a fitness club exercise program requires qualified health professionals in many areas, such as basic health information, exercise testing, programming, to ensure the success and safety of health exercisers. In recent years, a circuit training program has become a more common form of exercise [1]. The effect of a circuit training program with and without motivational interviewing and behavioral therapy was examined to reduce obesity and risk factors for type 2 diabetes in Hispanic adolescents. As part

of the study, subjects participated in a training program twice a week for 12 weeks. Results show that cardiorespiratory fitness and leg strength were significantly increased, while waist circumference, subcutaneous fat, visceral adipose tissue, fasting insulin, and insulin resistance were significantly reduced compared to the control group. The study concluded that a circuit training program can be an effective initial program to reduce fat storage and improve insulin resistance in overweight/obese individuals. Consistent with another study that evaluated the effects of a circuit training program and maintenance program on muscular and cardiovascular endurance in children, the results showed that a circuit training program was effective in increasing and maintaining muscular and cardiovascular endurance in schoolchildren [2].

Circuit training is a combination of many consecutive anaerobic exercises with very short or no rest in between to achieve cardiovascular fitness [3]. Circuit training has become a common form of exercise due to the efficiency of time planning and because such programs tend to use lighter exercises [4]. Repetitive movements can tire certain muscles during a match. That is why it is important that players include muscle endurance exercises in their strength training [5]. Research has found that the athlete's level of fitness greatly influences performance in various games and sports [5]. The purpose of this study was to determine the relationship between the high scores of high school football prospects on certain strength and agility tests and the best possible high school football players based on the data were included. A football coach's success depends largely on his ability to select the most talented football prospects to report each fall. If the coach can do this, his task of identifying the most representative team becomes much easier [6]. Various machine-learning models can also be utilized for analysis and prediction [7 - 13].

## **METHODOLOGY**

The subjects were selected from Panchwati Scholars' Academy, Meerut. A total of 60 students were selected. For the purpose of the study and before selecting the final subjects of the research, 12 minutes' cooper run/walk test was conducted to assess the performance of the subjects. The age level of the subject was taken between 9-14 years. The physical variables taken into account were speed and agility.

### **Administration of test**

The pre and post-tests were administered before and after the twelve weeks training periods. The tests administered covered physical fitness variables of Speed (30 mts dash), and Agility (4x10 mts. shuttle run). All the tests were administered through a standardized testing procedure.

## CHAPTER 17

# Environmental Sustainability and Cost Efficiency of Bottom Ash Granulated: A Life Cycle Assessment and Cost Analysis

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**Abstract:** This study examines the use of coal-fired power plant byproduct granulated bottom ash as a sustainable construction material, stressing its function in industrial ecology to reduce environmental effects. While acknowledging uneven particle sizes and lower concrete strength, the study recommends adequate processing and granulation to improve bottom ash's building compatibility. Further, the paper provides a literature analysis to stress the significance of waste management accountability to long-term sustainable growth. It includes steps like data preparation, testing, data collection, Life Cycle Assessment (LCA), and Cost Analysis (CA). Specific tools are needed to carry out the test. When compared to conventional concrete, granulated bottom ash performs better in environmental impacts, compressive strength, and thermal stability. Results showed that granulated bottom ash had lower GWP, melting point, and compressive strength than normal concrete, with the former having a temperature of around 1100°C and the latter of about 35 MPa. By far, the best approach was the cost-benefit analysis. These findings provide support for the hypothesis that granulated bottom ash might contribute to the building industry's push toward sustainable development goals.

**Keywords:** Bottom Ash, Cost analysis, Compressive strength, Granulated bottom ash, LCA, Thermal stability.

## INTRODUCTION

The term “industrial ecology” describes a popular approach in modern engineering to sustainable industrial development. Reducing the environmental impact of both sectors, this strategy promotes the reuse of waste products as

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virgin raw materials in another [1]. The production of bottom ash, one of these waste products, is anticipated to increase by hundreds of thousands of tons on a worldwide scale. One often dumped byproduct of coal plants is bottom ash [2]. The construction sector has voiced worry over the abundance of natural resources required to produce concrete [3]. Natural sand has been mined carelessly in certain areas, which has led to environmental degradation. Concrete is not eco-friendly because of the carbon generated during its manufacture, which has prompted concern over its widespread use. There needs to be a way to make concrete more environmentally friendly, both in terms of its basic ingredients and its overall makeup. “Green Concrete” [4] refers to ecologically friendly concrete that is designed, manufactured, and utilized. Efforts are being made to decrease cement usage by enhancing mix composition and substituting natural elements with recycled or waste resources.

The byproducts of coal combustion in power plants are known as fly ash and bottom ash, respectively [5]. Ash from both the Fly and Bottom layers is shown in Fig. (1).



Fig. (1). Fly ash and bottom ash [6].

Granulated bottom ash can be used as an alternative to natural aggregate or as a component in concrete. Utilizing a byproduct of energy generation and decreasing resource use can contribute to sustainable practices. There are also challenges associated with bottom ash utilization, such as the particle morphologies being uneven and abrasive [7]. Another drawback of employing bottom ash in concrete is that it weakens the finished product, makes it more porous, and lightens its weight [8]. Bottom ash is less workable than fly ash because of its bigger particle size and rougher surface, which may interlock readily. Water is needed in larger quantities to make up for the mixture's high porosity and water absorption.

Grinding and sifting bottom ash can lower the particle size, which in turn reduces water usage and voids [9]. However, this treatment method is both time-

consuming and expensive. This study gives a thorough analysis of the benefits and drawbacks of using bottom ash as a fine aggregate substitute in both its fresh and hardened states. Bottom ash's potential to foster a 'green' culture and long-term growth in the building sector is now untapped. This research demonstrates how, with the right processing, granulation may make a material more suitable for use in buildings.

### **Life Cycle Assessment of Bottom Ash Granulate**

The lifecycle analysis (LCA) of bottom ash granulate considers its environmental impacts across multiple stages, starting from raw material extraction to its final disposal or reuse. A detailed breakdown of each stage is presented below:

#### ***Raw Material Extraction***

Bottom ash is a byproduct of coal combustion in thermal power plants. During energy production, coal combustion generates both fly ash and bottom ash. Bottom ash is collected from the base of the furnace.

#### ***Transportation***

After collection, bottom ash is transported from the thermal power plants to processing facilities or construction sites. This stage involves trucks or trains, depending on the distance.

#### ***Processing and Granulation***

Bottom ash undergoes a granulation process to enhance its usability in construction applications. This involves crushing, grinding, sieving, and granulating using rotary drum granulators to achieve uniform particle size and reduced porosity.

#### ***Usage in Construction Applications***

The processed bottom ash granulate is utilized as an alternative to natural aggregates in concrete or other construction applications, reducing the demand for virgin materials.

#### ***Disposal or Reuse***

At the end of its lifecycle, concrete or construction products containing bottom ash granulate can either be demolished for recycling or disposed of in landfills.

## CHAPTER 18

# A Review of Different Catalysts for the Production of Glycerol Derivative Utilizing Waste Crude Glycerol

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**Abstract:** Glycerol is a prevalent molecule called 'Jacks of All Trades' ascribed to its countless applications in the food industry, cosmetics, polymer, and pharmaceuticals. It is obtained as a by-product of three distinct reactions of natural fats and oils: hydrolysis, saponification, and transesterification. In the recent past, the flourishing biodiesel industry has resulted in the accumulation of the by-product glycerol. This surplus glycerol, regarded as a waste in the biodiesel industry, has choked the glycerol market globally. In the era of a greener environment, the utilization of waste into valuable products is highly recommended. However, the crude glycerol obtained from the biodiesel industry being contaminated with methanol left out catalyst, and other organic residues could not be consumed directly in the food and pharmaceutical industries. In this regard, glycerol carbonate has emerged as a promising candidate offering services in the food, polymer, electrolytic, pharmaceutical, and fuel industries. Out of the three preparation routes, the base-catalyzed transesterification route employing glycerol and dimethyl carbonate as the reactants is preferred due to the mild reaction conditions, high yield, and product selectivity. Homogeneous catalysts ( $K_2CO_3$ , KOH, and NaOH) are refrained from due to their separation issues.

To address the issues related to the homogeneous base, Brønsted or Lewis basic groups have been incorporated over the matrix for the synthesis of a variety of heterogeneous catalysts for the production of glycerol carbonate.

**Keywords:** Glycerol carbonate, Glycerol, Heterogeneous catalysts, Homogeneous catalysts, Mixed metal catalyst.

## INTRODUCTION

Glycerol (1,2,3-propanetriol), generally known as glycerin, is a versatile compound known to mankind so far. The Latin-derived name glycerin was coined

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by the chemist Michel Eugene Chevreul for this sweet-flavoured, colorless, odorless, non-toxic liquid with 290 °C boiling point liquid explored during the reaction of natural oil with lead oxide [1, 2]. It is a polyhydric alcohol with three hydrophilic hydroxyl groups (OH) attached to three carbon (C) atoms [3, 4]. Glycerol (GL) has so many applications, such as in food, paint, cosmetics, and pharmaceutical industries, as shown in Table 1 [4 - 7].

**Table 1.** Percentage (%) distribution of industrial applications of glycerol.

S. No.	Industries	Percentage (%)
1.	Cosmetic	37
2.	Food	25
3.	Tabacco	9
4.	Polyurethan	7
5.	pharmaceutical	8
6.	Alkyd resin	9
7.	Other	5

## PRODUCTION OF GLYCEROL

This eco-friendly liquid could be derived from both natural and petrochemical feedstocks. Naturally, it is produced by microbial fermentation utilizing various microorganisms such as yeast, algae, and bacteria [8]. However, in industry, GL could be produced either chemically, employing propane as a starting material (Fig. 1) [9].

At the industrial scale, glycerol is mainly formed *via* three routes, such as (i) natural fats and oils: hydrolysis (ii) Saponification, and (iii) Transesterification, as shown in Fig. (2) [10 - 12].

### Hydrolysis

On an industrial scale, the production of high-quality fatty acids with triglycerides (TGD) is possible with the help of the high-pressure splitting (HPS) process [10, 13]. In this process, undergone oils and water (H<sub>2</sub>O) are mixed in the reactor to get the tiny drops of H<sub>2</sub>O into the oil (Fig. 2). The heating (up to 270 °C) of the triglyceride can produce fatty acids under high pressure (up to 80 bars) for 3 hours [14]. In this process, crude glycerol was produced with so many impurities, such as inorganic salts, fats, and GL-oligomers [15]. Such crude glycerol could be purified from a multiple-step process involving chemical evaporation and distillation to obtain the technical grade (88–99%) purity [16 - 18].

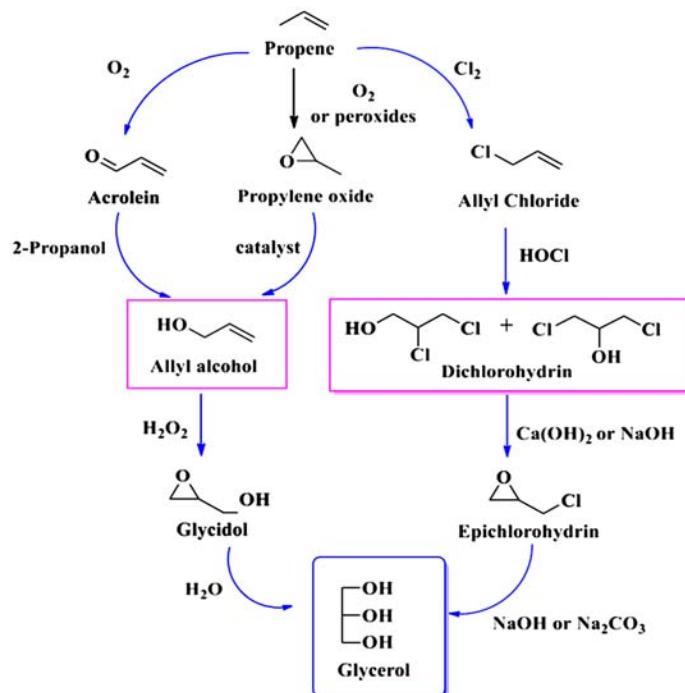
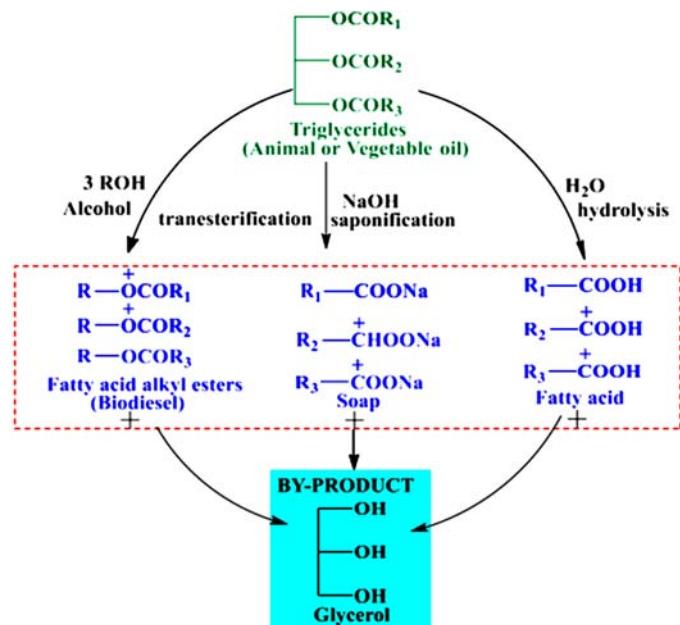


Fig. (1). Glycerol preparation route from propene [4].

Fig. (2). Industrial routes of GL production (where  $R_1$ ,  $R_2$ , and  $R_3$  represent the straight hydrocarbon chain with varied numbers of carbon atoms (14-20)).

## CHAPTER 19

# Impact of Real Estate Regulation and Development Act (RERA) on the Construction Industry in India: A Review

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**Abstract:** In the 21<sup>st</sup> century, the meaning of development has been changed and it is termed as sustainable development to ensure holistic development of all the inhabitants on the planet. This means to transform and modify the earlier inference of the development *i.e.* technological and industrial development. For the desired transformation aligned with SGD 11 and 16, RERA was passed by the Indian Parliament in 2016 and came into effect on May 1, 2017. Its fundamental objective is to assure the interests of home buyers and advocate transparency, accountability, and productivity in the real estate industry. RERA aims to create a fair and transparent real estate market, increase investor confidence, and protect the rights of homebuyers to make cities and human settlements comprehensive, safe, volatile, and sustainable with the end objective of social justice. It has significantly impacted the real estate sector in India, making it more accountable, buyer-friendly, and sustainable. However, its effectiveness may vary from state to state, as the implementation and functioning of RERA are under the purview of the respective state governments. This paper explores the impact of the Real Estate Regulation and Development Act (RERA) on consumers, builders, real estate agents, and buyers. Prior to the implementation of RERA, there was a lack of clarity on the carpet area, which was under the monopoly of builders regarding loading, rates, and modes of payments. This led to fraudulent practices, and there was no clear picture of projects, possessions, and sanctions. The paper attempts to find out the immediate impact of this act on builders and customers, aligned with global objectives. The implementation of RERA has brought about significant changes in the real estate industry. It has increased transparency and accountability, which has helped to build trust between builders and customers. Overall, the paper highlights the positive impact of RERA on the real estate industry and its stakeholders. It concludes that RERA has brought about a paradigm shift in the industry and has helped to create a more transparent and accountable real estate sector in India.

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**Keywords:** Real estate developers, Real estate, RERA, Real estate project, Real estate industry.

## INTRODUCTION

India passed the Real Estate (Regulation and Development) Act, or RERA, as a major piece of legislation to control the real estate industry. In order to protect the rights of homebuyers and address a number of long-standing problems in the real estate sector, RERA was introduced. It brings much-needed transparency, accountability, and fairness to the sector. It is primarily aimed at promoting professionalism and ethics among real estate developers, enhancing consumer protection, and streamlining real estate transactions. RERA achieves these goals through a combination of registration, disclosure, and regulatory provisions that affect developers, real estate agents, and homebuyers.

One of the most significant features of RERA is the mandatory registration of real estate projects and agents with the respective state's Real Estate Regulatory Authority (RERA Authority). Developers are required to provide detailed information about their projects, including timelines, financial details, and ongoing construction progress. A number of detrimental outcomes, including litigation between homeowners and contractors, inflated costs, decreased revenue and productivity, and contract termination, will arise from delays [1]. This information is made accessible to the public, ensuring transparency and allowing potential buyers to make informed decisions. In addition to addressing the concerns of buyers, RERA provides a platform for addressing disputes and grievances related to real estate transactions. The RERA Authority acts as a regulatory body that facilitates the resolution of conflicts and ensures compliance with the Act's provisions [2].

Overall, RERA had a compelling impact on the Indian real estate industry by making it more buyer-friendly and professional. It has brought about a level of accountability and transparency that was previously lacking, giving homebuyers greater confidence in their real estate investments. "About 45% of developers in India do not have a formal process in place to manage the RERA compliance mechanism, while 44% have made some modifications to their MIS (Management Information System), according to a recent survey conducted by FICCI and Grant Thornton Advisory," he writes. "Over 40% of developers have no formal process in place to comply with RERA: Survey." [3] The real estate sector is divided into five categories: housing, infrastructure, retail, hospitality, and commercial. The promoter is now the most prominent casualty of RERA in the construction industry. Because the Indian building industry is rising to global norms and practices, the real estate sector is likely to grow in the future. The construction

industry has a number of issues, including a lack of transparency and accountability, building delays, and inaccurate information provided by developers, all of which can be addressed by the Real Estate (Regulation and Development) Act [4].

## **SCOPE OF RERA**

The primary aim of RERA is to regulate and reform the real estate industry, creating a more transparent and accountable environment for both developers and homebuyers. Here's an overview of the key aspects and scope of the RERA Act. RERA requires that all new and ongoing real estate projects, with a certain minimum number of units or land area, must be registered with the respective state's Real Estate Regulatory Authority (RERA Authority). This registration includes comprehensive project details, timelines, and financial disclosures. RERA restricts developers from demanding an addition 10% of the property's cost as a leading payment before signing a sale agreement. This provision helps to prevent developers from demanding excessive amounts of money upfront, which can be a major concern for homebuyers. Developers must adhere to the project completion timelines they provided during registration. If there are delays, they must compensate buyers for the same. This provision helps ensure that projects are completed on time. It is essential for developers to deposit 70% of the funds possessed by buyers into an isolated escrow account. This money is to be worn exclusively for the development of the project, preventing its diversion for other purposes. Developers are responsible for addressing structural or workmanship defects within five years of possession. Buyers can file complaints regarding these issues with the developer, ensuring accountability for construction quality. RERA establishes a mechanism for addressing disputes and grievances related to real estate transactions through the RERA Authority. This offers a platform for resolving conflicts between buyers, developers, and agents.

## **IMPACT OF RERA ON NEW PROJECTS**

It is significant to remember that any project larger than 500 square meters or comprising more than 8 flats must be registered under RERA. It is required of the developers to register every phase of construction separately with the state tribunal. RERA mandates that developers must provide detailed project information, including the project plan, layout, approvals, and financial disclosures. Contractors are obligated to comply with the project completion schedule they provided during registration. RERA holds them accountable for delivering projects on schedule. It is worth noting that RERA mandates that developers sell properties firm on the carpet area, which is the existing usable area within the walls of the apartment. This area does not include the thickness of the

**CHAPTER 20****Density of Air Pollutants and its Measures in the Streets of Brahmapur, Odisha- A Case Study**

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**Abstract:** The air pollutants in the urban environment of Pink City, Brahmapur, Odisha, include formaldehyde (HCHO), total volatile organic compounds (TVOC), PM<sub>2.5</sub>, and PM<sub>10</sub>. The objectives of the experimental work were to determine the level of air pollution and clarify any possible health effects. Data from air quality monitoring shows that these concentrations of pollutants are cyclical, with significant examples of PM<sub>2.5</sub> and PM<sub>10</sub> surpassing legal limits and posing increased health hazards. To lessen the negative consequences of these pollutants, mitigation measures were being put in place. These tactics combine technology interventions with campaigns to raise public awareness. By absorbing pollutants and limiting their spread, green infrastructure, such as tree planting and vegetated buffers, tries to improve air quality. Furthermore, strict vehicle emission limits are being put into effect, which is reducing the number of pollutants released by road traffic. Residents are made aware of the significance of lowering personal contributions to air pollution by ethical behaviour through public awareness initiatives. Fighting air pollution is still necessary to protect public health and enhance the quality of the environment as a whole. In order to improve the air quality in Pink City, Brahmapur, and create a sustainable urban environment for its residents, it is crucial to keep an eye on pollutant densities and to consistently adopt mitigation measures by the Govt. of Odisha and India as well as alertness of general public is very much required. Here, the main goal of our experimental investigation is to analyze Brahmapur's air quality and the measures to reduce the pollution of this PINK CITY of Odisha.

**Keywords:** Air pollution, Air quality management, Particulate matter, Pollution control.

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## INTRODUCTION

The growing urbanization and industrialization of cities have led to an alarming increase in air pollution, a critical issue affecting both human health and the environment. Among the array of pollutants, formaldehyde (HCHO), total volatile organic compounds (TVOC), and particulate matter with diameters of 2.5 micrometers ( $PM_{2.5}$ ) and 10 micrometers ( $PM_{10}$ ) have garnered considerable attention due to their significant impact on air quality and public well-being [1]. This work investigates the assessment of these air pollutants and explores the measures undertaken to mitigate their adverse effects in the streets of Brahmapur, located in the southern part of Odisha, India (Fig. 1). Here many rapidly urbanizing areas face substantial challenges in maintaining air quality amidst the rising influx of vehicles, industrial activities, and population density [2]. The need to understand the spatial and temporal distribution of pollutants is paramount for formulating effective air quality management strategies [3].

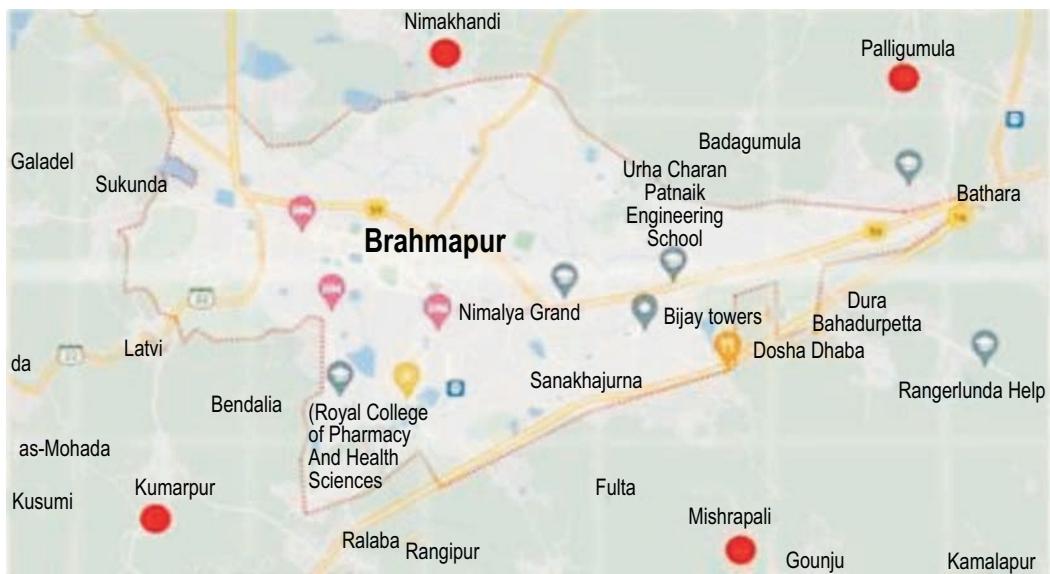


Fig. (1). Map of Brahmapur with the spotted outskirts.

This research endeavors to provide a comprehensive analysis of the density of HCHO, TVOC,  $PM_{2.5}$ , and  $PM_{10}$  in Pink City's streets, offering insights into their seasonal variations, potential sources, and associated health risks. Moreover, the study investigates the measures adopted by local authorities and community stakeholders to combat air pollution. These measures encompass a range of interventions, from green infrastructure initiatives aimed at enhancing natural pollutants' absorption, to regulatory actions aimed at curbing vehicular emissions

[4]. Public awareness campaigns also play a pivotal role in encouraging responsible behaviors and fostering a sense of collective responsibility in reducing air pollution [5].

By shedding light on the current air quality scenario and the efficacy of implemented measures in Pink City, this study contributes valuable knowledge that can inform future urban planning, policy formulation, and community engagement efforts [6]. Ultimately, the findings of this research can pave the way for a healthier and more sustainable living environment in Pink City and serve as a model for other urban areas grappling with similar air quality challenges [7]. Various mathematical models can be utilized for analysis and data visualization presented by many researchers [8 - 13].

## **MATERIALS AND METHODS**

A city situated in India's east coast area named Brahmapur is surrounded by beaches and several adventure spots as its two biggest draws [14]. It is one among cities of Odisha with the quickest growth city, well renowned as the main business and trading center in Eastern and Western India [15]. With a population of nearly 400000, the city of Brahmapur expanding with its vibrant culture, beautiful beach environment, and historical landmarks, but unfortunately, air pollution is a growing concern for the residents of the city [16].

A study has been managed in two areas:

1. Brahmapur city
2. Outskirts of Brahmapur City

The spatial locations and transport of emissions in the larger portion of both urban and nearby village areas are highlighted [17]. Some accounts have been taken from very crowded locations like marketplaces, traffic areas, residential areas, medical centres, *etc.* around a 4km radius from the center of the city [18]. We have collected the data from Big bazaar to MKCG Medical Square and then from Kamapalli to Gosani Nuagaon, and also from villages like Kumarpur, Nimakhandi, Mishrapalli, and Palli Gumula, which are on the outskirts of Brahmapur City as shown in Fig. 1. The main roads of the city are always crowded with vehicles of a different kind and continuously renovation work is going on. Different types of pollutants are added to the surrounding air [19].

### **Air Pollution Meter**

Sensors that measure air pollution keep an eye on its prevalence in the neighborhood, are adaptable to both indoor and outdoor settings, and can be

## CHAPTER 21

# The Analytical Study on the Impact of a Small-Sided Game Conditioning on the Agility of Female Soccer Players

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**Abstract:** This study examines the effect of small-sided games on the agility of 60 female soccer players at LNIPE in Gwalior. The participants who were selected were divided into two equal groups' *i.e.* experimental group and the control group. The age range of the participants was from 18 to 25 years. A pre-post intervention design was employed, wherein 30 participants were in the experimental group and 30 participants were in the control group. The selected players underwent a 12-week training program based on a small-sided game which helped to improve the agility of the players. Final agility measurements were taken of both groups, allowing for a comprehensive analysis of any changes that occurred. Analysis of the data revealed statistically significant differences in the agility of the experimental group whereas no significant difference occurred in the control group. After the 12-week training intervention, the dependent t-test was applied and the experimental group demonstrated an increase in agility. These findings recommend that training based on a small-sided game can lead to improved agility, as indicated by a reduction in timings of the test, potentially contributing to better efficiency and overall health in players. In conclusion, this study shows the significance of training based on a small-sided game in the lives of soccer players to promote physical fitness and improve the skill-based performance of female soccer players.

**Keywords:** Agility, Physical fitness, Small-sided game, Soccer players, Training.

## INTRODUCTION

In the dynamic realm of women's soccer, the multifaceted nature of player development is a subject of continual exploration. Agility, a pivotal component of athletic performance, plays a crucial role in the success of soccer players, influencing their ability to swiftly change direction, evade opponents, and execute precise movements on the field. Recognizing the significance of agility in soccer,

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this analytical study delves into the influence of small-sided game conditioning on the agility of female soccer players. As the sport continues to evolve, understanding and enhancing agility through targeted training methodologies are essential for optimizing player performance and reducing the risk of injuries. In this study, we aim to contribute valuable insights to the existing body of knowledge by assessing the effectiveness of small-sided games in cultivating agility among female soccer players.

Sports science has underscored the importance of agility in soccer performance. Agility is a multifaceted quality involving perceptual-cognitive processes, decision-making, and rapid changes in direction [1]. Furthermore, the demands of soccer, characterized by intermittent high-intensity activities and the necessity for rapid transitions between offensive and defensive actions, emphasize the necessity of agility as a key determinant of success on the pitch [2 - 5]. Given these considerations, it becomes imperative to investigate and implement targeted training interventions that specifically address the agility requirements unique to female soccer players.

Small-sided games, characterized by reduced player numbers and smaller playing areas, have gained prominence as an effective training tool in soccer [3]. The adaptability of small-sided games allows for the integration of various technical, tactical, and physical elements of the sport, making them an ideal platform for enhancing agility. There are numerous studies that observed improvements in aerobic fitness and skill performance among elite female soccer players following a small-sided game intervention [2]. By extending this line of inquiry of agility, we seek to build upon existing evidence and offer applied insights that can inform coaching practices and player development strategies.

This analytical study addresses a critical gap in the literature by investigating the influence of small-sided game conditioning on the agility of female soccer players. By amalgamating the foundational principles of agility in soccer with the versatile training modality of small-sided games, we aim to provide coaches, researchers, and practitioners with evidence-based recommendations to adjust the agility development of female soccer players, thereby contributing to the ongoing evolution of training methodologies in women's soccer.

## **METHODOLOGY**

For the resolution of the study, 60 participants were selected for the study. Total 30 female soccer players, who had already participated in senior nationals, were selected and were given the training, and the other 30 participants were considered in the control group and were not given any training. The age of the subjects for the study was between 18-25 years. The selected players possessed at

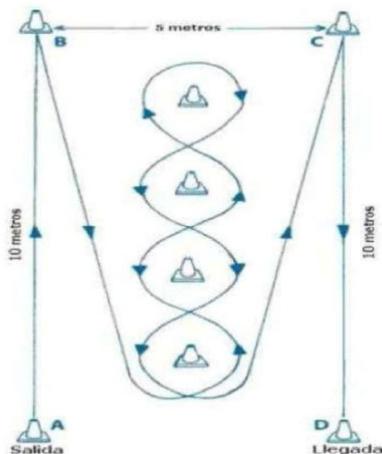
least 4 years of experience in football training and competition. All subjects were found to be in good health.

### Training Protocol

The eight-week training program was created with a focus on the need for female soccer players between the ages of 18 and 25 to improve agility. For eight weeks, training sessions were conducted five days a week, Monday through Friday.

### Administration of Test

The Illinois agility test (IAT) was used in the study to determine the ability to accelerate, decelerate, turn in different directions, and run at different angles (Fig. 1). Illinois Agility Tests: The course was 10 meters in length and 5 meters in width. The start, finish line, and the two turning points were all marked with four cones. Four more cones were positioned down the middle, spaced equally apart. Every cone in the middle was separated by 3.3 meters. With his chin resting on the beginning line, the player is in the prone posture. When the researcher said, "Go," the stopwatch began, and the participants got to their feet as fast as they could, running around the course in the designated direction and trying not to come into contact with any of the cones that had been put. After that, he dashed in the direction of the middle cone of the starting line, weaved around the cones both upward and downhill, rushed to the final cone on the far side, and crossed the finish line. Timing ceased as soon as the competitor crossed the finish line. With a minimum of two minutes of break in between tests and trials, the subjects gave each exercise their best effort twice. The quicker amount of time, measured in seconds



**Fig. (1).** Illinois agility test.

## **CHAPTER 22**

# **Dynamics of Love-type Elastic Waves in a Two-layered Corrugated Anisotropic Media**

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**Abstract:** In this article, the main focus is to study the propagation pattern of the Love-type surface wave in an orthotropic medium that lies on the isotropic half-space. The two-layered media is constructed in such a way that the corrugation lies in the interface of the two layers and the directional rigidities, densities, and initial stress of both the medium varies as a function of  $z$ . The displacement for both the layers has been calculated with the help of Biot's equation of motion and then by applying the intrinsic boundary condition, the frequency relation can be formed. To clearly understand our findings, graphical interpretation has been performed with the tool of "MATHEMATICA", which reveals the influence of the heterogeneity constants and corrugation on the velocity of the seismic wave.

**Keywords:** And corrugation, Dispersion, Half-space, Homogeneity, Love wave, Strain, Stress.

### **INTRODUCTION**

In recent years, the study of love wave propagation in different inhomogeneous and anisotropic materials has increased significantly. Previously, it was assumed that the Earth is isotropic, however, it was Shearer [1] who changed the concept by discovering the presence of anisotropy in it. Various research works have also been carried out in the presence of anisotropy on the Earth's surface, in which Bullen [2] has discovered an important theory named density law inside the Earth. Sari and Salk [3] proposed that the wave propagates in a medium by considering the density that varies hyperbolically towards the inner core.

Anisotropy is the term used to describe how seismic wave velocity and other characteristics vary based on the direction of propagation and polarization in the Earth's medium. The complex arrangement and organization of Earth's minerals,

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encompassing various mineral orientations, fractures, and stress fields that create directional dependence, are responsible for this phenomenon.

Seismologists followed the footprints of A.E.H Love [4] to study the elastic waves in both isotropic and non-isotropic problems of seismic waves in a layered medium situated over a half-space. Love wave is also defined as a horizontally polarized wave, which is the result of SH -waves that can be detected near the Earth's surface. We may add the contribution made by different researchers such as Singh *et al.* [5], Rupinderjit *et al.* [6], Guha and Singh [7], Panigrahi *et al.* [8] and Vishwakarma *et al.* [9, 10] in this reference for their constructive effort towards the research of elastic surface wave propagation. Many researchers have also presented mathematical models in their work, which can be seen in these references [11-15].

In the present study, the dispersion relation for the Love-type wave propagating in an irregular anisotropic inhomogeneous layer over an irregular anisotropic half-space has been obtained in the closed form. There is a significant effect of wave number, irregularity and inhomogeneity parameters found on the phase velocity of Love-type wave. In order to analyze these effects more profoundly, numerical computation and graphical demonstration have been carried out. The analysis of Love wave propagation is a critical aspect of applied geophysics, enabling solutions across scientific, industrial, and environmental challenges. These waves play a critical role in understanding Earth's surface dynamics, ensuring safety and efficiency in various sectors.

### Notations

$[\tau_{ij}]_1$ , ( $i, j = x, y, z$ ): incremental stress components,  $[e_{kl}]_1$ , ( $k, l = x, y, z$ ): strain components,  $u_1, v_1$ , and  $w_1$ : displacement components,  $c_{ij}$ : elastic constants,  $c > 0$ : velocity for the Love-type wave,  $N, L$ : Directional rigidities,  $k > 0$ : wave number,  $P$ : Initial stress,  $\rho$ : density,  $\mu$ : Rigidity,  $t$ : time,  $i = \sqrt{-1}$ ,  $H_U$ : Hypergeometric U,  $L_L$ : LaguerreL.

### GEOMETRY OF THE PROBLEM

The study here is carried out on a two-layered model in which the upper layer is an anisotropic heterogeneous medium having finite thickness  $H$  with  $\xi_1(x) - 2H \leq z \leq \xi_2(x) - H$ , whereas the lower half-space is an isotropic crustal medium. The geometry of the problem is designed with the help of the Cartesian Coordinate system with the origin 'O', as shown in Fig. (1).

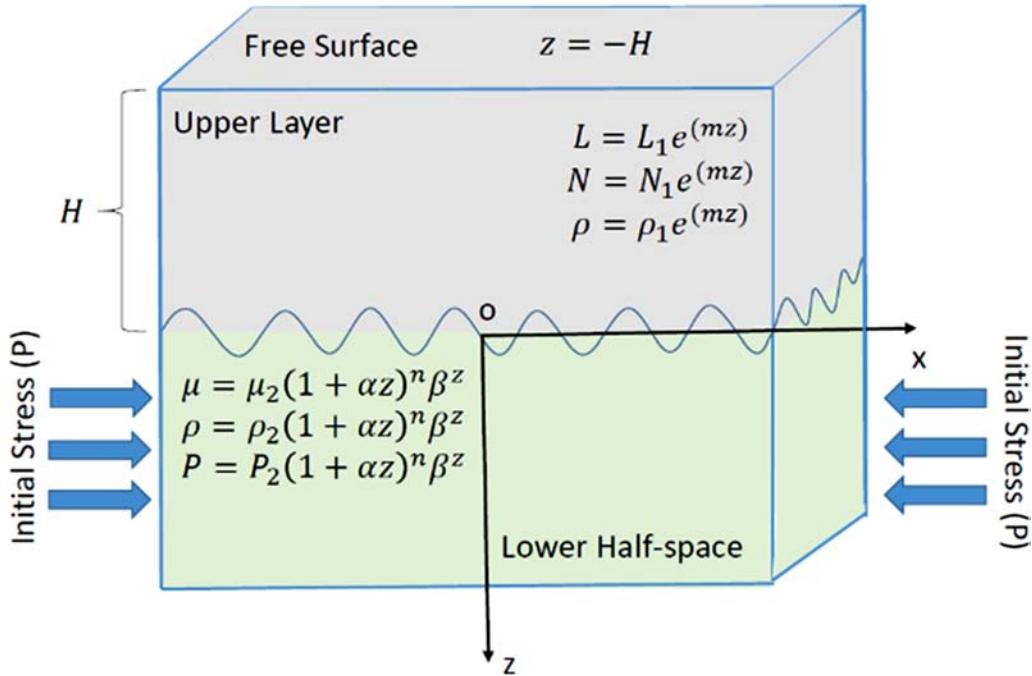


Fig. (1). Geometric presentation.

### DISPLACEMENT FOR THE UPPER LAYER

The following equation of motion for the Love-type surface wave propagation without body force has been derived with the help of Biot's theory [16].

$$\begin{aligned} \frac{\partial[\tau_{xx}]_1}{\partial x} + \frac{\partial[\tau_{xy}]_1}{\partial y} + \frac{\partial[\tau_{xz}]_1}{\partial z} &= \rho \frac{\partial^2 \tilde{u}_1}{\partial t^2}, & \frac{\partial[\tau_{yx}]_1}{\partial x} + \frac{\partial[\tau_{yy}]_1}{\partial y} + \frac{\partial[\tau_{yz}]_1}{\partial z} &= \rho \frac{\partial^2 \tilde{v}_1}{\partial t^2}, \\ \frac{\partial[\tau_{zx}]_1}{\partial x} + \frac{\partial[\tau_{zy}]_1}{\partial y} + \frac{\partial[\tau_{zz}]_1}{\partial z} &= \rho \frac{\partial^2 \tilde{w}_1}{\partial t^2} \end{aligned} \quad (1)$$

The following matrix gives the stress-strain relationship, *i.e.*

$$\begin{pmatrix} \tau_{xx} \\ \tau_{yy} \\ \tau_{zz} \\ \tau_{xy} \\ \tau_{yz} \\ \tau_{zx} \end{pmatrix} = \begin{pmatrix} c_{11}^* & c_{12}^* & c_{13}^* & 0 & 0 & 0 \\ c_{21}^* & c_{22}^* & c_{23}^* & 0 & 0 & 0 \\ c_{31}^* & c_{32}^* & c_{33}^* & 0 & 0 & 0 \\ 0 & 0 & 0 & 2c_{44}^* & 0 & 0 \\ 0 & 0 & 0 & 0 & 2c_{55}^* & 0 \\ 0 & 0 & 0 & 0 & 0 & 2c_{66}^* \end{pmatrix} \begin{pmatrix} e_{xx} \\ e_{yy} \\ e_{zz} \\ e_{xy} \\ e_{yz} \\ e_{zx} \end{pmatrix} \quad (2)$$

## **CHAPTER 23**

# **Antecedents of Entrepreneurial Intention among the Management Students**

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**Abstract:** This research examines the impact of entrepreneurial culture and education on entrepreneurial intention. The study's participants are students exposed to subjects related to entrepreneurship development, providing them with insights into the pros and cons, as well as the scope of entrepreneurship. These students also experience the entrepreneurial culture within their university. A random sample of 187 students, out of a total of 360 in their final semester, was selected for this research. Path analysis utilizing SPSS was employed to explore the relationships among the antecedents of entrepreneurial intention. The findings indicate a positive association between entrepreneurial culture and education with entrepreneurial intentions. However, it is essential to note that this research is limited to universities in a single state, Odisha, and further investigation in universities across different states is recommended for generalizability. The practical implication of this study is that universities nationwide can adopt a conceptual framework to cultivate an entrepreneurial culture, thereby fostering entrepreneurship for the economic development of the country.

**Keywords:** Entrepreneurial culture, education & intention, Entrepreneurship, Management students, Path analysis.

### **INTRODUCTION**

Numerous studies have demonstrated a significant correlation between entrepreneurship and a nation's economic development [1 - 7]. They have also established a clear link between the level of entrepreneurial activity and a country's economic advancement. This relationship holds true not only for well-developed economies but also for emerging ones like India.

The core focus of this investigation is to uncover the primary drivers behind entrepreneurship. Recognizing that the youth constitute the backbone of any

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nation and possess abundant energy, it is imperative to channelize their potential, particularly during their college or university years, to stimulate their entrepreneurial aspirations. In addition to personal attributes, this study places special emphasis on the role of entrepreneurial education and culture in shaping an individual's inclination towards entrepreneurship.

## REVIEW OF EXISTING STUDIES

Entrepreneurship education, fostering knowledge, skills, and attitudes [8], profoundly influences students' entrepreneurial perspectives and intentions. This university course, combining theory and practice [9], molds multifaceted entrepreneurial roles. Studies at a British university revealed heightened entrepreneurial learning and inspiration among students exposed to entrepreneurship education [10]. Additionally, it significantly enhances business knowledge, leading to increased post-graduation involvement in small ventures [11 - 13].

*H1: Entrepreneurial Education is positively related to Entrepreneurial Intentions*

Entrepreneurial culture, characterized by values of creativity, innovation, and risk-taking, significantly shapes students' intentions toward entrepreneurship. Within universities, this culture fosters confidence, awareness, and motivation, encouraging students to see entrepreneurship as a viable career path rather than just employment [14]. Studies suggest that a strong entrepreneurial culture, combined with relevant education, develops an entrepreneurial mindset that positively influences students' intentions.

*H2: Entrepreneurial Culture is positively related to Entrepreneurial Intentions*

## PROPOSED METHODOLOGY

The proposed model is illustrated in Fig. (1)

The study is all about empirically testing the influence of entrepreneurial education and entrepreneurial culture on the intention to engage in entrepreneurship among the students from the different colleges of universities in the state of Odisha. This can be confirmed through the hypotheses provided below.

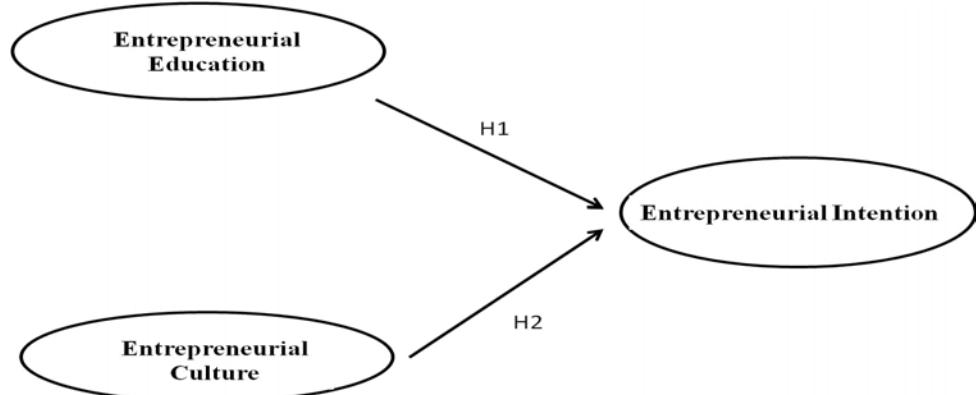
*H1: Entrepreneurial Education is positively related to Entrepreneurial Intentions*

*H2: Entrepreneurial Culture is positively related to Entrepreneurial Intentions*

## EXPERIMENTATION AND RESULTS

### Research Design

This study uses linear regression modelling to produce a structured equation. The regression analysis evaluates how entrepreneurial education and culture influence the prediction of entrepreneurial intention.



**Fig. (1).** Hypothetical Model (Source: Authors' Own Compilation).

### Study Population and Sample Selection

A total of 187 management students who had completed an entrepreneurship course as part of their program participated in this study. Among them, 59% were male (110 students) and 41% were female (77 students). The data was collected from three universities in Odisha: BPUT, GIET University, and Centurion University as shown in Fig. (2). Approximately 48% of the participants (90 students) were from GIET University, 39% (73 students) from BPUT and 13% (24 students) from Centurion University.

### Sampling Procedure

The approach applied for this sampling is the stratified-convenience method, where students of the college or university were sorted in prior according to the course entrepreneurship development offered to them in their concerned degree program.

**CHAPTER 24****AR Technique based Electrocardiogram Signal Analysis with K-Nearest Neighbor Classifier**

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**Abstract:** Recent statistics reveal a significant rise in deaths from heart failure over the past four years, highlighting the need for improved signal processing and classification techniques. The Electrocardiogram (ECG) is essential for accurately measuring heart rate and detecting arrhythmias by isolating key waveforms like the P-wave, QRS complex, and T-wave. Auto-Regressive (AR) coefficients are used to analyze these waveforms. For classification, the methods of K-Nearest Neighbor (KNN) and Principal Component Analysis (PCA) are applied separately, following AR modeling of the ECG signal.

**Keywords:** And Principal Component Analysis (PCA), Auto-Regressive (AR) coefficients, ECG, K-Nearest Neighbor (KNN), P-wave, QRS-wave, T-wave.

**INTRODUCTION**

The Electrocardiogram (ECG) signal provides valuable information about the heart's rhythm, structure, and function [1]. The main components of the ECG signal are P, QRS, and T waves [2]. The Electrocardiogram (ECG) signal is critically important in cardiology and medical diagnostics for several reasons [3]. Fig. (1) illustrates a standard ECG waveform.

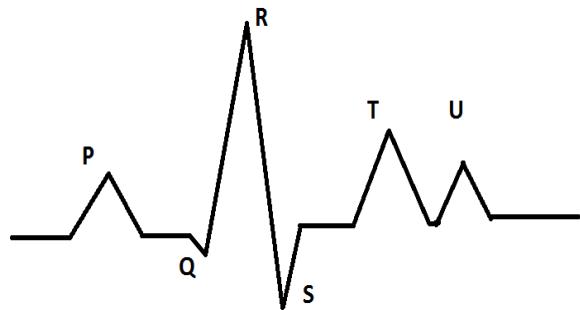
In the current context, the identification of cardiac components is crucial on a global scale. To highlight the key cardiac elements, Auto-Regressive (AR) modeling and its coefficients are examined across three distinct cases. The

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calculation of AR coefficients involves analyzing the temporal dependencies in a time series by either solving the Yule-Walker equations or using the least squares method. These coefficients are important in feature extraction because they encapsulate the past behavior of the series, which can be used for prediction, classification, or clustering tasks. By extracting the AR coefficients, the dimension of the time series is reduced while retaining essential information about its structure.

## RELATED WORK

P. Jafari Moghadam Fared *et al.* [5] identified ECG signal components using a Hybrid Complex Wavelet approach. They analyzed forty clinical recordings and thirty MIT-BIH database recordings. Donna Giri *et al.* [6] suggested decomposing heart signals using Discrete Wavelet Transform (DWT). They applied PCA, LDA, and ICA on DWT coefficients for multi-resolution analysis and dimensionality reduction. MPS Chawla *et al.* [7] proposed a PCA-ICA algorithm for QRS complex classification. ICA was used for noise reduction and PCA for dimensionality reduction, improving R-peak detection accuracy. T. He *et al.* [8] addressed noise and artifacts in ECG signals using ICA for effective filtering and revealing hidden information.



**Fig. (1).** Components of an ECG signal [4].

The dynamic features of an ECG signal are the characteristics that capture the temporal variations and patterns within the ECG waveform. These features are crucial for accurate diagnosis and analysis of cardiac conditions. Here are some key dynamic features of ECG signals: The key dynamic features of ECG Signals are discussed below. These dynamic features of ECG signals involve various temporal and morphological aspects that are essential for diagnosing and understanding cardiac health.

- **P-Wave Characteristics:** The shape and form of the P-wave can indicate atrial enlargement or other issues.

- **QRS Complex Characteristics:** The configuration of the QRS complex, including the presence of R-waves, S-waves, and any deviations from the normal pattern.
- **T-Wave Characteristics:** Form of the T-wave, which can be indicative of repolarization abnormalities.
- **Morphological Variability:** Variability in the waveform shapes and intervals due to physiological changes or pathologies. It provides insights into different types of arrhythmias and cardiac conditions.

In the next section, materials and methods are discussed with duality performance evaluation parameters.

## MATERIALS AND METHODS

The classification of R-peaks plays a crucial role in the analysis of ECG signals [9]. A significant challenge in this research area is the presence of various types of noise and artifacts. The objective of the preprocessing stage is to enhance the clarity of the signal by applying filtering and dimensionality reduction techniques [10].

### Pre-processing

Given the independent characteristics of Power Line Interference (PLI) and Baseline Wander (BLW) in ECG signals, ECG is well-suited for separating noise from the actual signal [11]. The main observations on PCA are discussed below-

### Principal Component Analysis (PCA)

- Applied to obtain average variance values of 99.73%, 99.71%, and 99.27% for three subjects.
- Aims to achieve a high signal-to-noise ratio (SNR), with values of 9.81 dB, 11.23 dB, and 8.35 dB for subjects 1, 2, and 3, respectively.
- Reduces dimensionality by retaining components with the highest variance and discarding less significant components.

### Clinical Diagnostics

12-lead ECG signals are required for detecting various cardiac diseases due to the heart's elastic and solid structure.

Short recording durations limit the classification categories, complicating detection and classification.

## CHAPTER 25

# Stock Trading in Odisha: An Analysis of Growth Performance and Investors' Perception

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**Abstract:** At the turn of the century, the stock market is undergoing profound transformations. To improve efficiency, liquidity, and transparency, the NSE launched a countrywide online fully automated Screen-Based Trading System (SBTS) in which orders are matched on a strict price/time priority, lowering costs. Today, India can brag that computerized order matching accounted for nearly 100% of all trade. For data collection, the study employed both primary and secondary sources. A questionnaire was used to collect primary data from 100 retail investors from Odisha in order to understand their opinions and identify the difficulties and opportunities associated with online stock trading. Secondary data was gathered from the SEBI and RBI Handbooks, as well as the NSE Fact Book. The study looked at the factors that influence trade volume and liquidity in the Indian stock market. The study discovered that FII has an influence on NSE turnover. It also investigated the expansion and performance of stock trading activities in India. The results demonstrated that the NSE is expanding and is the largest exchange in the country in terms of turnover, as well as providing superior securities trading services to investors nationally.

**Keywords:** Capital market segment, Determinants, Liquidity, National Stock Exchange (NSE), Perception, Retail investors, Stock trading, Turnover.

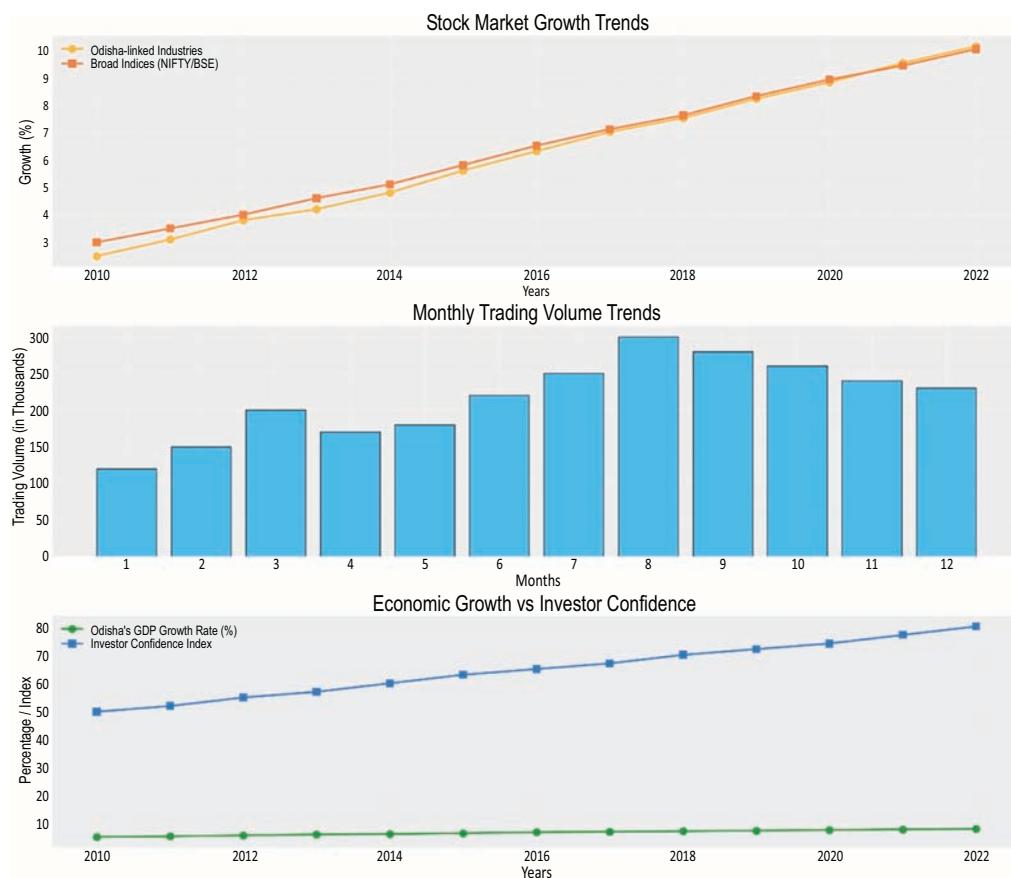
## INTRODUCTION

The Indian stock market has witnessed remarkable growth and volatility over the past 45 years, shaped by evolving trading practices, technological advancements, and regulatory reforms as illustrated in Fig. (1). This dynamic environment has often been compared to a “roller coaster,” reflecting the market's complex and multifaceted nature. Amid these changes, the credibility and transparency of trading systems have become critical in fostering investor confidence and market efficiency [1 - 4].

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This article focuses on Odisha's unique regional context within this broader landscape. Odisha's economy is underpinned by its vast natural resources, robust industrial base, and distinct socioeconomic attributes, all of which play a significant role in shaping stock trading trends and investor behavior in the state. The state's economic fabric, encompassing key industries such as mining, steel, and agriculture, is further influenced by government policies, infrastructure development, and evolving employment patterns.

This study aims to provide an in-depth analysis of stock trading in Odisha by examining the growth and performance of key sectors, as well as the perceptions and behaviors of regional investors. By exploring these factors, the article highlights the interplay between local economic drivers and broader market dynamics, offering insights into how regional characteristics shape investment patterns and stock market performance in Odisha.



**Fig. (1).** The Indian stock market has witnessed remarkable growth and volatility.

The stock trading trends in Odisha:

1. **Stock Market Growth Trends:** This line chart compares the growth of industries strongly linked to Odisha (e.g., mining, steel) with broader indices like NIFTY or BSE over the years.
2. **Monthly Trading Volume Trends:** This bar chart illustrates trading volume trends across months, showing potential seasonal activity spikes.
3. **Economic Growth vs. Investor Confidence:** This line chart shows the correlation between Odisha's GDP growth rate and a simulated investor confidence index, highlighting the relationship between economic performance and market sentiment.

## **OBJECTIVES OF THE STUDY**

Securities trading through the Internet will have a significant impact on the security market [5]. Further studies were also mentioned by different authors [6 - 9]. The different stock trading intermediaries have realized that if they do not make use of the chances that online trading provides, they will lose a significant amount of volume. By adopting this trading method, *i.e.*, over the Internet, the Indian stock market has made the proper move. Given the young status and enormous potential of online stock trading in India, the current study is being conducted with the following goals in mind:

1. Research the procedures and metrics of Indian stock trading.
2. To investigate the factors that influence trade volume and liquidity in the stock market of developing India.
3. Research the stock trading regulatory framework and current changes.
4. To investigate investors' perceptions of stock trading in India.
5. To identify the issues and opportunities in Indian stock trading.

## **Experimentation and Results and Discussion**

Personal investigations incorporating actual field interviews with investors provide a more comprehensive understanding of all practical facets of the study subject. Pilot surveys of the first concepts aid in the refinement of the final questionnaire. The study benefits greatly from the use of descriptive and diagnostic research. The qualities of a situation are described in descriptive research investigations.

## CHAPTER 26

# Revolutionizing Quantum Key Distribution: NLP-Based Generation and Verification of Quantum Keys

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**Abstract:** This paper discusses the utilization of Natural Language Processing (NLP) techniques for generating and verifying quantum keys, within the context of Quantum Key Distribution (QKD). QKD is a secure communication protocol that employs quantum mechanics for key exchange. While QKD is resistant to classical computing attacks, quantum computers pose a threat. NLP introduces innovative methods for quantum key generation and verification. Quantum Linguistic Patterning (QLP) is one such method that leverages statistical language properties to generate quantum keys. Quantum Natural Language Processing (QNLP) is used to verify these keys. This paper outlines the process, emphasizing the potential efficiency, scalability, and security advantages of NLP-based quantum key generation and verification methods. It also highlights areas for future research, including the development of more advanced NLP techniques, enhanced security measures, and novel NLP-based applications in quantum cryptography. Finally, an efficient and unique algorithm is presented, showcasing how NLP can be used to generate and verify quantum keys, thus demonstrating its superiority in terms of efficiency, scalability, and security compared to traditional methods.

**Keywords:** Quantum linguistic patterning (QLP), Quantum natural language processing (QNLP), Quantum keys, Quantum computing, Secure communication.

### INTRODUCTION

In the realm of secure communication, Quantum Key Distribution (QKD) stands as a pioneering protocol that harnesses the principles of quantum mechanics to establish cryptographic keys between distant parties. Immune to traditional computational attacks, QKD, however, faces potential vulnerabilities in the

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advent of quantum computing. To address these challenges and forge a path toward more robust and innovative solutions, we propose a novel approach that leverages the power of Natural Language Processing (NLP).

Numerous researchers have studied the different applications of machine learning in recent years. [1 - 5]. Quantum Key Distribution (QKD) operates on principles of quantum mechanics, leveraging phenomena such as superposition and entanglement to securely exchange cryptographic keys [6 - 11]. The BB84 protocol, for instance, enables key exchange by transmitting polarized photons, making it resistant to eavesdropping [11, 12]. However, the rise of quantum computing poses a threat to this protocol's security, necessitating advanced techniques like NLP to augment its resilience.

NLP techniques, particularly Quantum Linguistic Patterning (QLP), generate cryptographic keys by analyzing linguistic structures [13 - 15]. These keys, derived from large and diverse text corpora, exhibit inherent randomness and statistical robustness. Quantum Natural Language Processing (QNLP) further verifies these keys, ensuring their authenticity and enhancing QKD's overall security [14].

NLP, a burgeoning field in computer science, focuses on the intricate interplay between computers and human languages. In this context, we explore the application of NLP techniques to not only generate but also verify quantum keys, introducing a unique algorithm designed to enhance efficiency, scalability, and security in the quantum key distribution process.

Our algorithm introduces the concept of Quantum Linguistic Patterning (QLP) for quantum key generation and Quantum Natural Language Processing (QNLP) for verification. By analyzing vast corpora of diverse text sources, we extract patterns using sophisticated NLP techniques. These patterns, inherently unique and statistically robust, serve as the foundation for generating and validating quantum keys, thus combining the strengths of quantum physics and language analysis.

In this paper, we delve into the details of our algorithm, illustrating its functionality through Python code examples. Furthermore, we discuss potential optimizations and areas for future research to refine and expand the application of NLP in the context of quantum cryptography.

As we navigate this intersection of quantum mechanics and language processing, we envision a paradigm shift in the way we approach quantum key distribution. The integration of NLP not only augments the efficiency and scalability of the process but also introduces a layer of security that is challenging to breach. With the continual evolution of NLP technology, we anticipate further breakthroughs,

propelling us toward more sophisticated and secure methods for generating and verifying quantum keys.

## LITERATURE REVIEW

Federated ML Secure communication in the era of quantum computing demands innovative solutions. Quantum Key Distribution (QKD) has emerged as a promising protocol, utilizing the principles of quantum mechanics to distribute cryptographic keys securely. However, vulnerabilities to attacks from quantum computers necessitate further exploration and enhancement of existing methodologies. This literature review explores the intersection of QKD and Natural Language Processing (NLP), presenting a unique algorithm designed to revolutionize quantum key generation and verification.

QKD is a cornerstone in quantum cryptography, ensuring secure communication by distributing cryptographic keys between parties using quantum principles. Conventional computers struggle to breach this protocol, yet the advent of quantum computers poses new challenges. Researchers emphasize the need for innovative approaches to strengthen the security landscape of QKD [6].

NLP, a field of computer science, focuses on the interaction between computers and human languages. It has found applications in various domains, from sentiment analysis to language translation. Leveraging NLP for quantum key generation introduces a novel paradigm, tapping into the statistical properties of language to enhance efficiency, scalability, and security.

The proposed algorithm introduces Quantum Linguistic Patterning (QLP), a technique that utilizes NLP to generate quantum keys. By analyzing a large corpus of text, the algorithm extracts linguistic patterns using NLP techniques. These patterns serve as the basis for quantum key generation, introducing a unique and efficient approach [7].

Beyond key generation, the algorithm employs Quantum Natural Language Processing (QNLP) to verify quantum keys. This technique leverages the statistical properties of language to confirm the authenticity of generated quantum keys. The integration of NLP in the verification process enhances the security and reliability of quantum keys [8].

The literature suggests promising areas for future research. Developing advanced NLP techniques for pattern extraction holds the potential for more accurate quantum key generation and verification. Research focused on utilizing NLP to detect and prevent attacks on quantum key distribution networks is crucial for further enhancing security. Moreover, the exploration of NLP-based applications

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