ROBOTICS AND AUTOMATION IN INDUSTRY 4.0.

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Robotics and Automation in Industry 4.0

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PREFACE

An automated machine that performs like a human and replaces the efforts of humans is termed a robot. When these kinds of devices get interlinked with other interdisciplinary technologies for better efficiency, speed, accuracy, output, management and operation, it is termed robotics. Research on the interdisciplinary branches of mechanical devices, data science, the Internet of things, solid-state devices, and others can together make automation more efficient, and it can lead to a revolution in robotics and automation in Industry 4.0. Whenever we say Industry 4.0, it means the fourth Industrial Revolution, which will not only lead the manufacturing sector to a greater height, but will also transform the service and communication sector. Industrial Revolution 4.0 will mostly deal with unmanned vehicles, 3D printing, advanced robotics and new materials. This revolution will support organizational efficiency. Many techniques and areas are designed, such as cloud computing, machine learning, nanobots, supply chain management, information security, *etc*. Hence, the main motive of this book is to explore the application and different technologies associated with robotics and automation in Industry 4.0.

THE OBJECTIVE OF THE BOOK

The objective of this book is to get insights into the tools and technologies of the automation-based Industrial Revolution, which mostly increase organizational efficiency by improving manufacturing, communication and services using new technologies. It also helps to understand different aspects of robotics and automation. It can help different users such as students, research scholars, academicians, industry people, *etc*.

ORGANIZATION OF THE BOOK

The book contains 13 chapters that are organized into four sections as follows. **Section 1** discusses the application and advancement of robotics. **Section 2** highlights the application of renewable energy, which indicates the demand for a sustainable future. **Section 3**discusses the systematic analysis and application of financial technology. **Section 4** discusses some multidisciplinary areas along with techniques and applications.

Section 1: Robotics: Applications and Advancements (Chapters 1-3)

The section discusses different applications and advancements of robotics.

Chapter 1

This chapter discusses different types, principles and applications of nanorobots that are used in different emerging areas. It also discusses the principles of different explored and programmed bots for repairing specific targets.

Chapter 2

This chapter discusses robot path planning systems in a dynamic environment. The Deep Q-learning technique is used in this chapter by using a neural network. It helps to avoid different obstacles in the environment, which are dynamically created by the user.

Chapter 3

This chapter only focuses on innovative design analysis of customized solar frames but not the working of the solar frames or air purifiers. This innovative design is going to change the concept of cycling in the future.

Section 2: Application of Renewable Energy: Power for a Sustainable Future (Chapters 4-5)

The section discusses different renewable energy applications for power management based on a sustainable future.

Chapter 4

This chapter discusses a hybrid optimization technique for profit-based unit commitment. It solves the uncertainty issues for energy source management in wintertime and summertime. It helps reduce several noises that are related to gases that are harmful to fossil fuels and cause diseases and sicknesses.

Chapter 5

This chapter illustrates the impact of Industry 4.0 based on the manufacturing system. The chapter contains several challenges and opportunities based on data production and integrating new technology in the sector of manufacturing.

Section 3: FinTech: Systematic Analysis and its Applications (Chapters 6-8)

The section discusses the systematic analysis of financial technology based on new and innovative applications.

Chapter 6

In this chapter, the authors narrow down the overview of smart financial businesses and their complex challenges. It helps to manage the entire smart FinTech Ecosystem using the fusion of artificial intelligence and data science. It helps to enable smart FinTech and discusses some research problems among global academic and researcher communities.

Chapter 7

This chapter provides insight into blockchain methodology applied in IoT healthcare security. It helps to provide the potential for the medical care environment. It also discusses how customary clinical frameworks and organizations have been occupied with the medical services area throughout the previous years.

Chapter 8

This chapter provides a design development for pharmaceutical applications through the fusion of IoT and blockchain. In this chapter, it is suggested to avoid counterfeit drugs, delivering the pharmaceutical products to customers at the right time, and environmental parameters such as temperature and humidity are also monitored throughout the supply chain to avoid spoilage of pharmaceutical products.

Section 4: Multidisciplinary Approach: Understanding, Benefits and Applications (Chapters 9-13)

The section discusses a different multidisciplinary approach based on new technologies and techniques that help in the automation system.

Chapter 9

This chapter presents a holistic view of attrition and retention of employees on psychological aspects during this cut-throat competitive environment in India. Biology has a little role in management, though one cannot ignore biology in psychology. In broader terms, attrition is somehow related to psychology, and psychology and physiology are two sides of a coin.

Chapter 10

This chapter provides a system for predicting the changes in the ecosystem. The changes in the ecosystem affect the living creatures who depend upon the ecosystem. One of the subsets of machine learning that play a vital role in saving the lives of living creatures is deep learning, which is used in this work for prediction purposes.

Chapter 11

This chapter thoroughly examines solid-state drive subjects, ranging from the physical features of a flash memory cell to the design pattern. The subjects pertaining to the flash translation layer are described within the context of interconnected system-level operations.

Chapter 12

This chapter discusses profit-based unit commitment using the global and local search methods. It suggests the combination of chaotic maps with Harris Hawks Optimizer and chaotic Sine Cosine Algorithm advancement strategy and assesses the execution of the proposed improved technique considering Plug-in Electric Vehicles.

Chapter 13

This chapter discusses the classification of deep learning techniques for object detection. It uses an audit on a machine learning approach for classification. The applications of the protest location have been summarized, along with the diverse approaches to the location of the objects using template-based, portion-based, and region-based methods.

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CHAPTER 1

Nanorobots: Types, Principles and Applications

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Abstract: Nanobots or Nanorobots are one of the emerging applications in both nanotechnology and robotics. These bots are programmed to carry out specific applications for a specific purpose. Owing to their properties such as smaller volume, efficiency and accuracy, nanobots are being explored in different fields of study, especially nanomedicine, automation, drug delivery, chemistry, aerospace and others. These bots can be programmed and explored in such a way that they can be used to repair the specific target in the body, which is impossible using bare hands. In this chapter, we are going to explore such types of applications and their principles.

Keywords: Application of nanobots, Nanobots, Types of nanobots.

INTRODUCTION

In 1959, Professor Richard Feynman, through his talk "Plenty of Room at the Bottom", laid the fundamentals of nanotechnology [1]. In one of the chapters, he discussed molecular machines, the application of which includes nanorobotic surgery, drug delivery, and others. As suggested by Professor Feynman, the miniaturization of robotics has been explored, and advancements have been made in this field over time. These are types of nanodevices whose application can be explored in many fields, but currently, it is mostly being explored in the field of biomedicals. One of the first studies on nanobots was conducted by Robert Freitas, which is based on the principle of molecular manufacturing [2]. This nanodevice was created to function like an artificial erythrocyte.

Compared to natural red cells, these artificial devices were capable of transporting a similar amount of carbon dioxide and 236 times more oxygen to tissues. These devices were fabricated using hard diamondoid materials and consist of different types of chemicals, pressure and thermal sensors to monitor complex responses and behavior. Since then, nanobots have evolved in multidimensional fields with increasing applications. Mavroidis *et al*. [3] explained the evolution of fully

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functional autonomous nanorobots and the integration of different components into a system. Owing to its small size, durability, self-replication and mobility, multiple applications of nanobots have been developed to solve problems related to the environment, agriculture, biology and medicine. The design of different nanorobots is inspired by different kinds of species present in the environment to perform specific operations. These nanobots seem to be very promising in areas of invasive surgery, drug delivery, contamination screening, controlling pests and plant viruses, antimicrobial activity, breaking blood clots, parasite removals, and others [4 - 6]. In order to scale up, researchers across different organizations are trying to overcome limitations in terms of high-quality design, cost analysis, biocompatibility, interfacing with blood, which is viscous, and control issues. Overcoming the challenges will help in achieving unlimited applications especially in the field of biomedical. The current trend of nanorobots in precision medicine, which includes surgeries, therapy, imaging and diagnosis, is being studied [7]. These bots will have the ability to locate specific positions in the body and deliver the precise dosage. With noninvasive medication and various groundbreaking innovations, it is expected that the market of nanobots will exponentially increase to 21.45 billion dollars in 2030 from its present value of 6.19 billion dollars.

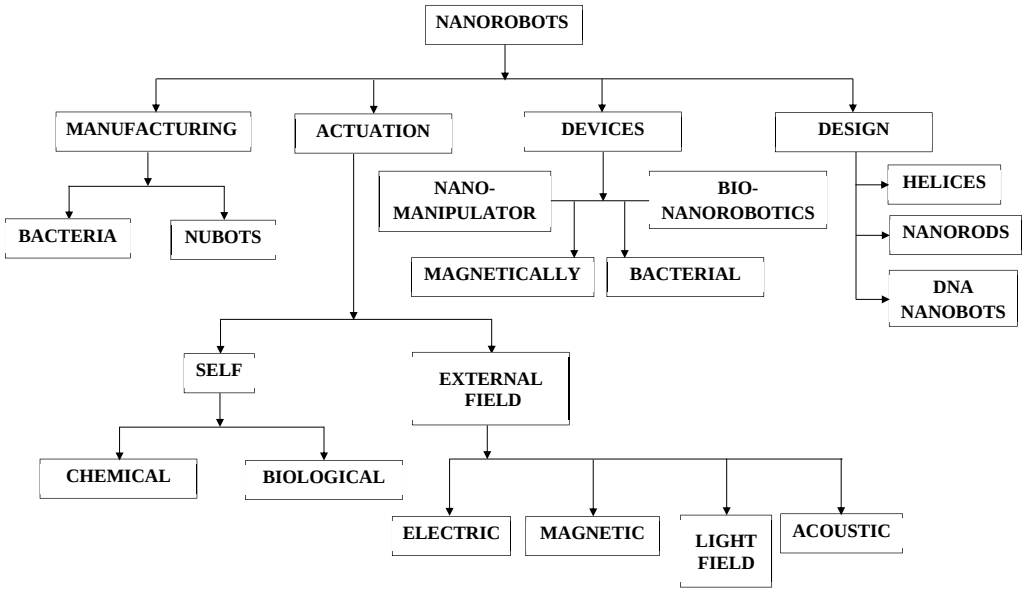

Fig. (1). Types of nanorobots.

TYPES

Further, we are going to discuss different types of nanobots based on a few parameters such as design, nanorobotic devices, actuation types and manufacturing approaches. These are just a few parameters, which can be further subdivided into many categories. Some types of robots based on the subdivision of parameters can be similar in nature. Nanobots classification and their respective subcategories are shown in Fig. (**1**).

- On the basis of design: Based on the applications, many designs of nanobots have been proposed, but they are generally classified into three categories on the basis of design. Arvidsson *et al*. described them as Helices, DNA Nanobots and Nanorods [8 - 11]. They are discussed in detail in further sections.
- On the basis of actuation: In general, the movement of nanobots takes place in a medium having a low Reynolds number, where inertial force is negligible as compared to viscous force. This makes it difficult to operate, and hence nanobots need to be uninterruptedly powered for actuation. Since it is very difficult to load energy sources on nanorobots, researchers have started focusing on actuation technologies for nanorobotics. Xu *et al*. [12] summarized different types of actuation techniques into two sub-categories, which are self-actuation and external field actuation. In order to actuate nanobots using a variant magnetic field, as explained by Dreyfus *et al*. [13], it is subject to get a constant and oscillating magnetic field along the horizontal and perpendicular direction, respectively. Later, many other techniques, such as U-shaped, fish-like structure, freestyle swimmer, sea star and other types of magnetically actuated nanobots, have been proposed for different applications. Although there is a safety issue related to high-intensity magnetic fields, strong pungent power and no harm to the biological system make it viable to experiment on. We know that an electric and magnetic field can be transformed into each other, so robotic systems with certain conditions and without complicated mechanical parts were proposed, which could utilize an external electric field for actuation. For actuation, some researchers use the finite element technique to produce a magnetic field using coil assembly. The concept of quad nanopore devices is also used for the purpose of actuation. Other types of external field actuation include light field actuation and acoustic actuation. Experiments were conducted to establish a relationship between laser intensity and the speed of nanoswimmers for biomedical and soft matter applications. Based on such principles, needle-shaped nanoswimmers, electrochemical actuators, and photoresponsive DNA signaling molecules have been designed over time. On the other hand, researchers used the principle of ultrasonic bubble-gathering effect for the movement of robots. Rod-shaped nanobots that can rotate, arrange, suspend and

CHAPTER 2

Robot Path Planning in a Dynamic Environment Using Deep Q-Learning

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Abstract: Robot path planning is a necessary requirement for today's autonomous industry as robots are becoming a crucial part of the industry. Planning a path in a dynamic environment that changes over time is a difficult challenge for mobile robots. The robot needs to continuously avoid all the obstacles in its path and plan a suitable trajectory from the given source point to the target point within a dynamically changing environment. In this study, we will use Deep Q-Learning (Q-Learning using neural networks) to avoid the obstacles in the environment, which are being dynamically created by the user. The main aim of the robot is to plan a path without any collision with any of the obstacles. The environment is simulated in the form of a grid that initially contains information on the starting and the target location of the robot. Robots need to plan an obstacle-free path for the given points. The user introduces obstacles whenever he/she wishes during the simulation to make the environment dynamic. The accuracy of the path is judged by the path planned by the robot. Various architectures of neural networks are compared in the study that follows. Simulation results are analyzed for the evaluation of an optimized path, and the robot is able to plan a path in the dynamic environment.

Keywords: Artificial neural network, Deep learning, Neural networks, Reinforcement learning, Robot.

INTRODUCTION

Nowadays, with the advancement of technology and a tremendous boom in the field of robotics, robots are taking over most mundane tasks that do not require much cognitive ability and can be performed easily by unskilled laborers. In 2010, Chen *et al*. [1] showed that robots used to serve and cater to customers in a human-interactive environment in restaurants. Later, Chen *et al*. [2] also proposed

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the vacuum robots used for cleaning. In 2015, multiple robots communicated with each other over a shared network and carried loads from one fixed location to another fixed location, as shown by Das *et al*. [3]. Autonomous mobile robots have found their way into industries, military research programs, and many scientific research programs. The Schemes [4 - 6] present additional information on robots used in human-friendly environments like education, entertainment, surveillance and many more. As seen, robots continuously keep evading new human-centric and non-human-centric environments to find vast applications. Robots need to be as autonomous as possible *i.e.*, they should possess the ability to navigate, find paths and perform various activities without the intervention of any kind to accomplish all such tasks. All the activities that are performed by autonomous mobile robots require the design and implementation of a path planning and path optimization algorithm at its core.

Robot path planning, being at the crux, plays a vital role in the design, implementation and manufacturing of autonomous robots. If implemented effectively, path planning significantly improves the following parameters in an autonomous robot:

Robot Accuracy: The algorithm must produce next to zero errors because the robot is expected to work in human-friendly environments where the slightest errors can be catastrophic. Hence, there is a need to test this out and make sure the robot is accurate enough that it stands firm on its capabilities.

Task Repeatability: Once the implementation of the path planning algorithm is complete, including the training phase of the robot, it can perform the same task hundreds of times with high accuracy and effectiveness without any slack.

Product Quality: Based on accuracy and repeatability, we can directly conclude that our robot has been trained well and can assume a result that will depict the high-quality work of our robot.

One can define path planning as the continuous locomotion of a robot from the initial/starting configuration to the final/goal configuration in an unknown environment. The environment in which the robot moves consists of free space and obstacles. The robot needs to ensure that it does not collide with any obstacle during its course. Path optimization deals with finding the path with the least cost and distance and which consumes the least amount of time. Fig. (**1a**) shows an example environment with obstacles and defined configurations for start and goal states. Fig. (**1b**) shows an example of a path planned in the shown environment.

Structure of the Paper

This article is organized into 7 sections. Following the introduction, Section 2 presents different approaches and work, which were used by various researchers in the past to solve the problem. Also, the section ends with a description of the approach used in this article. Section 3 of the article describes the methodology used to solve the problem in addition to the nuances of the algorithm. Section 4 discusses the experimental setup and the various technologies used, along with the various parameters of the algorithm used during the experiment. Section 5 analyses the results and the performance of the experiment with the help of some graphs. The article comes to an end by presenting a conclusion for the experiment in Section 6.

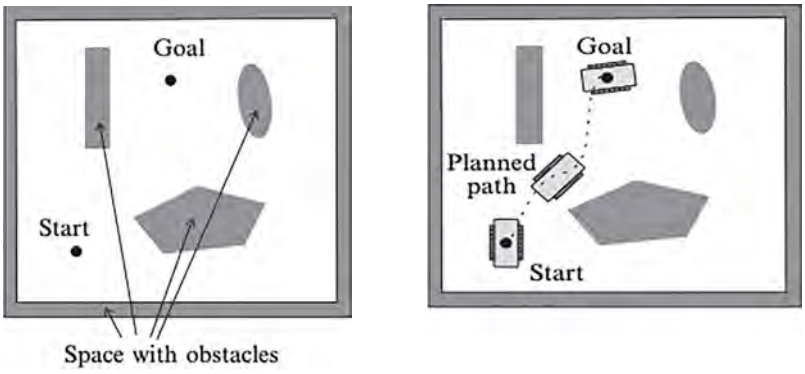

Fig. (1). (a) Environment with obstacles and start and goal configurations, and (b) one out of many possible paths from the start to the goal configuration.

RELATED WORKS

In recent decades, many approaches have been devised by researchers to find a solution to the problem of path planning and optimization for autonomous mobile robots. These approaches range from the use of graph-based algorithms to the use of contemporary neural networks to implement deep learning and reinforcement learning algorithms. Some of these approaches and algorithms have been briefly described as follows:

Graph-Based Approach

In this type of approach, the environment is considered as a connected network consisting of nodes and edges similar to a graph data structure. The nodes that constitute the obstacles are considered forbidden since the robot is not allowed to use these nodes while ascertaining a path from the initial to the goal state. All

CHAPTER 3

Seven Concerns of Innovation Design Process and Analysis of a Smart Bicycle Frame

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Abstract: Though we are improving our living standards with technology, we are neither bothered about our fitness nor our environment. The article focuses on both, this research will not only help to keep an individual fit but also help in improving air pollution. In this article using the concept of seven concerns of the innovation process, a customized Bicycle frame (Photo Voltaic (PV) frame) is selected after overcoming the flaws in many designs and final conception is analyzed for maximum deformation at different loads. In this article, five concerns out of seven are considered to achieve the final design. Flexible Solar Cell (mentioned in a magazine created by Massachusetts Institute of Technology, Energy Initiative) on the frame will help to charge the battery and that battery will operate other devices like Air Purifier, Mobile Charger, *etc.* that's why this bicycle is called smart bicycle by the author. This article only focuses on innovative design analysis of customized solar frames but not the working of solar frames or air purifiers. This innovative design is going to change the concept of cycling in the future.

Keywords: ANSYS design, Customized bicycle frame, Deformation, Finite element method, Seven concerns of innovation, Solidworks.

INTRODUCTION

The problem associated with air quality has increased with the increase in vehicles running on fossil fuels. As an alternative way of transport, the bicycle is promoted by the Ministry of Housing and Urban Affairs, Government of India. It will help in the reduction in air pollution, energy use, high traffic, noise pollution and allow at the same time a healthier lifestyle for riders. In addition to this, the use of a bicycle is one of the inexpensive and adequate modes of transportation.

Much work has been done on designing and aesthetics of bicycle to improve the quality of riding and increase the acceptance by the individuals as customer has

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faced very integration uses requirement and customer into design process [1, 2]. As from previous work on frame design and analysis diamond type frame has been found highest rigidity [3]. To manufacture the frame, materials is selected in such a way that it should be light weight, good strength and mostly [4], Just the Design, material and strength of the frame is not enough and so design of fitting system carried some laboratory test and experiments to investigate the aspects of cycling comforts for pilot were also considered in research [5]. Innovative and integrated procedure for optimizing the road bicycle frame, effort was also taken to reduce the deformation of bicycle frame permanently and lessening the mass from the bicycle frame [6]. With the growth of renewable energy and sustainability research is done on power assisted solar bicycle, battery get charged by using of solar energy were solar panel is placed on carriage, solar plate externally placed [7 - 9].

In this article a frame is designed in such a way that the Flexible Solar Cell is on the frame of bicycle. Customized Frame design is finalized after overcoming the flaws in many designs using the con-cept of 7 concerns of innovation. In final customized frame design ANSYS software is used for the structural analysis of the bi-cycle frame and ANSYS software analyze the problems based on the prin-ciple of "Finite Element Method" (FEM).

Concerns of Innovation

There are 7 concerns of innovation, Cause, Context, Comprehen-sion, Check, Conception, Crafting, Connection, from which five concerns of innovation is used for this design.

Cause is that humans nowadays are being affected with fatal disorders like heart syndromes and cancer. The main cause of this is just breathing polluted air of urban cities and not keeping them fit.

Context is that Cycling is one of the most effective ways by which the problem of increasing pollution as well as obesity of an individual can be controlled to some extent.

Comprehension & Check concluded that in today's market there is no such product targeted for sports enthusiast who live in polluted cities and have potential for a very bright future but are un-able to achieve. Therefore, not doing the sports activity like cycling due to the concern of air pollution that may cause irreversible dam-age to their body, this design will solve the problem for those.

Conception gave multiple ideas to address the problems listed in check. Using the Design Process shown in Fig. (**1**) final design was customized.

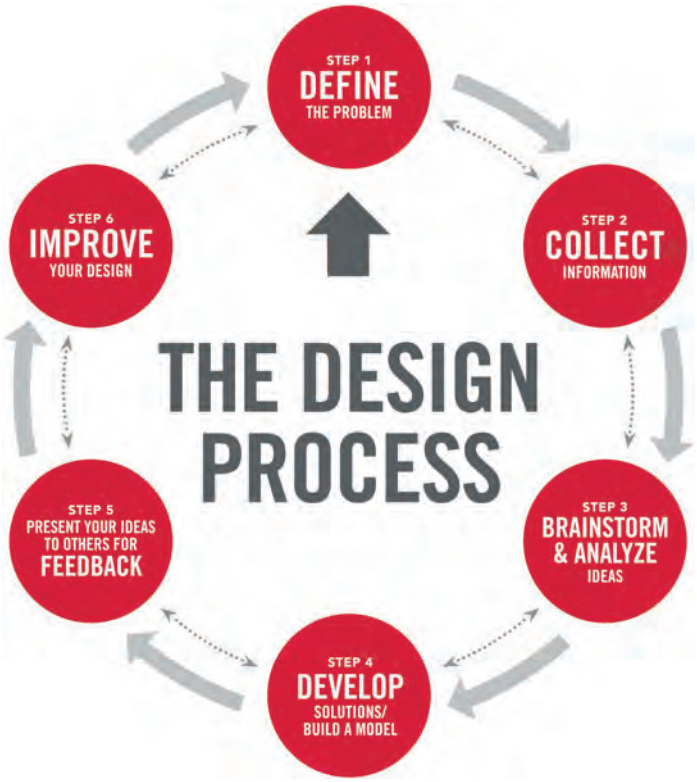

Fig. (1). Design process.

DESIGN CONCEPTS

The main aim of proposed design is to integrate solar panel, bat-tery, and air purifier on to the bi-cycle frame rather than adding them separately. Adding a solar plate separately increases weight due to addition of standoffs and mounting brackets that are needed to hold it in place. This reduces the ergonomics of cycle due to all the wire management issues, reduces ease of maintainability due to all the wires tangling on the frame. It also reduces effectiveness of air puri-fier if it is placed at the back of the bi-cycle frame.

Based on their modification, 4 designs are given:

In Design Concept 1

Main construction: The Bicycle frame, as shown in Fig. (**2a**), incorporates housing for battery and an inverter to charge electron-ics, give power supply to the air purifier and get charged from a solar panel. The solar panel acts as an enclosure to the housing on the bicycle. This enclosure does not need any wires to be separately connected since there are contact pads below the panels that directly

CHAPTER 4

Hybrid Optimization of Profit-Based Unit Commitment Allowing for Uncertainties of Renewable Energy Sources in Summer and Wintertime

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Abstract: Environmental issues, due to the various gases that are harmful to fossil fuels, can cause disease and sickness worldwide. Renewable energy sources (RESs) are a crucial solution for decreasing reliance on fossil fuels. This is because they offer several advantages, such as significant cost reductions in operations, minimal depreciation over time, and the ability to provide electric power for various applications. As a result, they are highly desirable for use in the power sector. This kind of trouble becomes excessively challenging by developing the extent of the electric power market step by step. The authors developed a new optimization technique by combining chaotic maps with various nature-inspired optimization algorithms, such as the Harris hawks optimizer, sine cosine algorithm, and slime mold algorithm. This approach allowed them to improve the performance of these bioinspired optimization methods. The researchers evaluated an improved technique called hCHHO-SCA and hCSMA-SCA for solving the PBUCP considering renewable energy sources. They tested the techniques on both a 10-generating-unit system and a 100-generating-unit system. The authors were able to calculate the profit generated from each system as a result of applying the improved techniques. The adequacy of the analyzer is confirmed for a few benchmark issues that have been observed. The recommended optimizer is helpful in obtaining a solution to problems related to discrete and continuous optimization, including nonlinear types of optimization.

Keywords: Chaotic maps, Harris hawks Optimizer, Metaheuristics, Profit-based unit commitment Problem, Renewable energy sources, Slime mould algorithm, Sine cosine algorithm, Unit commitment problem.

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INTRODUCTION

India is a developing nation, and each state's progress is influenced by how much electricity it consumes. The need to urgently produce a sufficient amount of electrical power to meet our demand for energy is necessary because the demand for electricity is gradually rising. Advancements in the field of automation have significantly influenced the atmosphere to maintain harmony between power generation and the environment; additionally, the cost of generating electric power with increased reliability is considered by minimizing harm to ecology and the environment, for example, by minimizing the release of flue gases through the use of renewable power sources.

Electrical power systems are expanding rapidly due to the increasing demand for electricity from various sectors, such as commercial, agricultural, residential and industrial sectors. This has made the electrical power sector very large in scale, highly interconnected and complex in nature. The rising electricity demand and changes in the power sector, such as deregulation and privatization, have led to overloading problems in the electric grid. To solve this issue, the electric grid needs to keep pace with the growing electricity demand. Effective power generation scheduling and commitment can help manage the time-varying electrical load demand and optimize the available grid resources [1]. Today's power industry has a variety of sources of electricity, including hydro, thermal, and nuclear power-producing facilities. The demand for electricity varies throughout the day, reaching numerous peaks [2]. Unit commitment is the process of determining which power-generating units should be turned on or off to meet the demand in an effective manner. When deciding to turn units on or off, it is important to consider the cost of starting up or shutting down each generating unit. By analyzing these costs, the optimal generating units can be selected to be turned on when needed in the power system network. The same approach can help decide the order in which generating units should be kept in off condition [3]. The daily demand for power in the commercial, industrial, and residential sectors varies. This approach is similar to how e-mobility fundamentally changes real-time jobs in the power sectors. Thus, it is extremely difficult to meet the fluctuating demand for electricity while incurring the lowest possible production costs.

LITERATURE ANALYSIS

Optimization techniques are an important area of research where scientists are constantly working to improve methods and algorithms. Researchers are developing new optimization strategies to overcome the drawbacks of existing techniques. Many metaheuristic and heuristic optimization methods are currently

being used to solve complex problems. Some examples of these methods include genetic algorithms, simulated annealing, tabu search and particle swarm optimization. Overall, optimization research aims to find algorithms that can efficiently find high-quality solutions, as shown in Table **1**.

Table 1. Literature Review of Several Methods.

Glimpse of Some Relevant Work	Reference. No	Name of the Optimizer	Publication's Year
The BEPO method was designed to solve optimization problems with an automatic feature assortment technique. To validate the efficiency of the method, 25 standard benchmarks were used.	[4]	BEPO	2021
The BMRFO technique was implemented to get solutions to feature selection issues. The efficacy of this new method was verified on 18 datasets of the standard functions.	[5]	BMRFO	2021
BSO optimizer had been established to get solutions to the problems associated with optimizing damage detection of structure. It was also used to identify the data related to noise pollution.	[6]	BSO	2021
DSSA technique was designed to get the solution to optimization-related issues. With this method, the exploitation phases were improved to find better optimal points within the search space.	[7]	DSSA	2021
EOA method was implemented to solve the issues in power distributed network reconfigurations and generated electricity allocated in distribution systems.	[8]	EOA	2021
GEPSO optimizer was designed to get solutions for optimization-related problems in local as well as global search space. To verify its efficacy, this method was tested over several well-known standard benchmark functions.	[9]	GEPSO	2021
HHGSO was designed to get solutions for optimization-correlated issues, and this method was applied to improve the phase of exploitations over the search space.	[10]	HHGSO	2021
HLBDA was implemented to get solutions for feature selections in the area of optimization. A case study related to COVID-19 was discussed in this research work.	[11]	HLBDA	2021
A novel IJOA-LV method was designed to get solutions for the existing swarm optimizer, and the viability of this technique was tested over CEC 2011 and CEC 2014 standard functions.	[12]	IJOA-LV	2021
IS-JAYA was used for optimization problems and exploitation and exploration in the search space.	[13]	IS-JAYA	2021

CHAPTER 5

The Impact of Industry 4.0 on Manufacturing: Challenges and Opportunities

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Abstract: The concept of Industry 4.0 emerged in Europe a decade ago, and later, it was investigated and adopted by academics and industries throughout the world. Due to significant technical improvements in various industries over the past few years, the world's industrial systems have transformed. The major technologies, such as IoT and Big Data, have a large impact on Industry 4.0. They affect each and every sector of the economy. The main advantages include advances in productivity, efficiency, flexibility, decision-making process, and quality of goods and services. The challenges include analyzing the data produced and integrating new technology with the staff and equipment that are already in place. Our goal is to summarize the potential and challenges associated with adopting Industry 4.0 in the manufacturing sector.

Keywords: Digital transformation, Industry 4.0, Manufacturing companies, Smart manufacturing, Smart factory, Smart supply.

INTRODUCTION

Industry 4.0 is a ground-breaking method of organizing industrial production that blurs the lines between different physical objects and unifies them into one complex. It is based on a system of interdependent and connected industrial components that has undergone considerable digitization and automation of production and distribution operations [1]. Industry 4.0 is transforming how businesses produce, enhance, and distribute their goods. Manufacturers are incorporating new technology into their operations and manufacturing facilities, such as the Internet of Things (IoT), cloud computing and analytics, AI, and machine learning.

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Advanced sensors, embedded software, and robotics are all featured in these "smart factories", which collect and analyze data to help with decision-making. When operational data from ERP, supply chain, customer service, and othercorporate systems is linked with data from production operations, even more value is generated from the previously segregated information [2]. Increased automation, preventative maintenance, self-optimization of process improvements, and most importantly, a new level of efficiency and customer responsiveness made possible by digital technology are all results of their use [3].

The manufacturing sector has a fantastic potential to join the Fourth Industrial Revolution by developing smart factories [4]. Real-time visibility of manufacturing assets is ensured by analyzing the massive amounts of big data gathered from sensors on the factory floor, which can also provide tools for carrying out predictive maintenance to reduce equipment downtime [5].

Smart factories with IoT technology have higher production and better quality. Manufacturing errors are decreased, and money and time are saved when manual inspection business models are replaced with AI-powered visual insights [6]. A smartphone connected to the cloud can be easily set up by quality control workers to enable remote monitoring of manufacturing processes. Manufacturers can identify mistakes earlier rather than later, when repair work is more expensive, by using machine learning algorithms [7].

All types of industrial businesses, including discrete and process manufacturing, as well as oil and gas, mining, and other industrial areas, can use Industry 4.0 concepts and technologies [8]. Fig. (**1**) shows the transformation from smart factory to smart manufacturing.

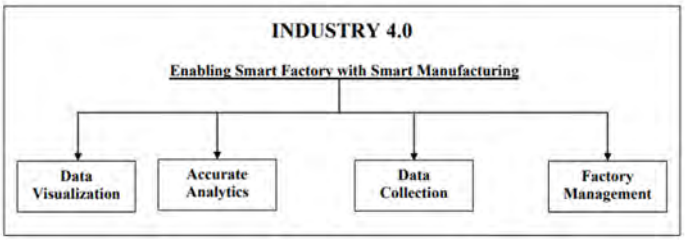

Fig. (1). Smart factory *vs* smart manufacturing.

History of the Industrial Revolution

The Industrial Revolution saw the shift from tiny, hand-operated cottage industries to new, mass-produced commodities built in factories powered by steam and water. Many of the technological advancements that contributed to the Industrial Revolution were developed in Britain, where it all started around the

year 1760. In terms of employment, output value, and capital invested, the textile sector dominated the Industrial Revolution. The adoption of contemporary production techniques was also pioneered by the textile sector. The Industrial Revolution was a significant turning point in history that had some sort of impact on practically every element of daily life.

The rate of population growth experienced an unheard-of increase as a result of the Industrial Revolution. In addition, Great Britain rose to become the top commercial power in the globe, ruling a vast trading empire that included colonies in North America and the Caribbean and political sway over the Indian subcontinent. The Revolution is mainly divided into four phases, which are as follows [9 - 12].

Industrial Revolution-First

During the First Industrial Revolution, manual production methods were supplanted by machines using steam and water power. In Europe and the United States, it refers to the time between 1760 and 1820 or 1840 because it took a while for the new technology to be used.

The first industrial revolution had an impact on the textile sector, which was the first to adopt these innovations, as well as the iron industry, agriculture, and mining. It also had sociological repercussions, such as a growing middle class.

Industrial Revolution-Second

Massive railroad and telegraph networks were built during the 1871–1914 era, sometimes known as the Technological Revolution, to promote the faster exchange of people, ideas, and electricity. Companies were able to create modern production line thanks to increased electrification. During this period, significant economic growth and enhancement in productivity, which, together with the replacement of many factory workers by machines, led to an increase in unemployment [13, 14].

Industrial Revolution-Third

A slowdown in industrialization and technical advancement relative to preceding periods followed the end of the two world wars, which sparked the Third Industrial Revolution, often known as the Digital Revolution.

Industrial Revolution-Fourth

The Fourth Industrial Revolution is a trend in manufacturing technologies and processes that includes cloud computing, cognitive computing, artificial

CHAPTER 6

Emerging Technologies in Fintech: A Case Study

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Abstract: The Financial Technology (FinTech) industry has been playing a pivotal role in driving modern day's economics, social aspects, technology, and many more areas. FinTech is majorly inspired, motivated, and empowered by Data Science and Artificial Intelligence Methodologies (DSAIM). With emerging technology, the smart FinTech industry has revolutionised economic and financial businesses, service industries, and systems. The global research communities have made significant progress in smart FinTech for Banking Tech, Trade Tech, InsurTech, Wealth Tech, Pay Tech, Risk Tech, Cryptocurrencies, Digital Payment Systems, and Blockchain using DSAIM. In this review paper, we narrow down the overview of smart financial businesses, their complex challenges, and the entire smart FinTech ecosystem. The DSAIM enables smart FinTech and poses some research problems among global academic and researcher communities.

Keywords: AI, AI in finance, AI in fintech, Blockchain, DSAIM, Fintech, Financial service.

INTRODUCTION

The financial sector has witnessed significant delivery changes as a result of automation in the span of the last 10 years. This transformation is distinguished by increased connectivity and faster information processing on the part of both customers and financial organisations such as banking institutions (back-office), insurance providers, brokerages, and many other firms involved in financial services. In the 21st century, finance has become an increasingly popular interactive stage for data science and artificial intelligence methodologies

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(DSAIM). DSAIM advances the development of previously unknown and far more sophisticated, effective, convenient, personalised, comprehensible, secure, and assertive financial products and services in addition to the efficiency, expenditure, consumer experience, mitigating risk, regulatory framework, and protection of current financial systems. Here, DSAIM widely refers to (1) Traditional AI areas including expert systems, recommended systems, pattern recognition, and human emotion recognition (2) More advanced DSAIM areas such as intelligent transportation, intelligent machine, advanced data analytics and learning, discovery of knowledge, computational intelligence, behaviour analysis, and social network [1]. In addition, foundational fields like mathematical and statistical modelling play a crucial and necessary role in allowing FinTech. FinTech refers to the financial industry pioneers and disruptors who make use of prevalent technologies such as the Internet and automated data processing. These new solutions can come from startups, defined providers of financial services, or even established technology companies.

Mobile phones, which connect gadgets functioning from home, public spaces, offices, colleges, and schools, are rampant in the current generation. Companies in the banking, finance and insurance sectors can quickly adopt IoT technology. The financial services and banking industries have developed a new method for gathering crucial client data utilising IoT sensor devices and mobile phones. As compared to current financial technology, fintech is similar to electric car innovation in that it deals with finding out the best trading investment, and asset valuation and offers new and better accounting methods. A significant strategy in financial services is the Internet of Things. The internet-connected IoT transmits and receives information that is saved in the cloud when it is linked to the concerned bank. The bank has given these devices authorization to share data on the cloud, which enables all customers to examine account information and provide access while using mobile devices. Messages and awaiting work alerts are the simplest way to communicate with the consumer and also to provide personal information [2].

Big data is the term used to describe the enormous quantities of unstructured and structured information that is produced by people, companies, and other organisations. Big data is essential in the field of fintech because it enables businesses to examine massive volumes of data and acquire an understanding of consumer behaviour, market dynamics, and risk management. Big data is used by fintech organisations to handle and analyse massive volumes of financial data in real time, enabling them to make wise decisions fast and effectively. These businesses can use big data to find trends and patterns that aid in forecasting market trends, dangers, and opportunities. Fintech companies may improve client

experiences, expand their product offerings, and improve service by utilising big data analytics [3].

The adoption of data science in financial services has been substantial. The main aim of this paper is to review existing literary works regarding the application of DSAI for multiple digital finance subject areas and to offer an overview of the various existing use cases and techniques of DSAI for future practitioners and researchers to use.

Motivation

The motivation behind blockchain technology is to provide a secure and transparent way of conducting transactions and storing data without the need for intermediaries. The importance of blockchain lies in its ability to increase efficiency and reduce costs, as well as to improve security and privacy.

The motivation behind AI in finance is to automate mundane tasks, reduce operational costs and provide more personalized experiences to customers. The importance of AI lies in its ability to analyze vast amounts of data and provide insights to inform decision-makers, as well as in its ability to improve customer experience.

The motivation behind digital payments is to provide an easy, fast and convenient way for people to make transactions without the need for cash or checks. The importance of digital payments lies in its ability to increase financial inclusion and improve access to financial services for everyone, especially those who are unbanked or underbanked.

The motivation behind robo-advisors is to provide low-cost investment advice and portfolio management to investors, reducing the need for human financial advisors. The importance of robo-advisors lies in their ability to democratize access to investment advice and to provide more efficient and personalized investment solutions to customers.

Advantages:

Blockchain: Some advantages of blockchain technology include increased transparency, reduced costs, improved security and privacy, and increased efficiency.

Artificial Intelligence: Some advantages of AI in finance include increased efficiency, improved customer experience, and better risk management.

Digital Payments: Some advantages of digital payments include increased

CHAPTER 7

Leveraging Blockchain Technologies in Healthcare Applications

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Abstract: Blockchain innovation recently led to key innovations in the advanced insurgency of medical care, but a few studies have shown that blockchain has the potential to improve the medical care environment. It is prepared to change how customary clinical frameworks and organizations have been occupied with the medical services area throughout the previous very long while. Information and communication technologies (ICTs) and blockchains are key empowering advancements for the decentralization and digitalization of medical care foundations and provide current and digitalized medical care environments to patients, similar to specialist organizations. With regard to blockchain applications for medical service information, the board provides utility for patients, specialists and medical care organizations through patient record access and control, cases and installments, clinical IoT security and exploration of information checks and trades for budgetary evaluation and straightforwardness. In these applications, constant updates to an encoded, decentralized blockchain record are never true, screen, or control clinical data. This likewise encourages medical service foundations to confine unapproved individuals to obtaining sensitive data. This paper provides insight into the blockchain methodology applied in IoT healthcare security.

Keywords: Blockchain technology as supply chain management, Decentralization, Electronic health records, Healthcare concerns in technology management, Internet of medical things (IoMT), Supply chain management.

INTRODUCTION

A blockchain is a dispersed public ledger information/database that is kept up by an organization of checked members or hubs and stores unchanging information that can be shared safely without outside intervention [1]. Information is saved and recorded with cryptographic marks and through the use of agreement calculations that are established as key empowering agents for its application. This capacity for information conservation is a major explanation that has driven

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the utilization of blockchain in medical services, wherein a large amount of information is dependent upon broad trade and conveyance [2]. The development of blockchain innovation and its application in different settings has taken place in different stages [3]. The principal period of blockchain advancement was identified with digital currency, and the second was related to the use of smart agreements in regions, for example, land and funds [4]. The third era of development was centered around the utilization of blockchain in non-financial areas, for example, the government, medical care, and culture. Additionally, determined by creative, innovative highlights, for example, an immutable nature, blockchain is currently viewed as being in its fourth phase of advancement through the fusion of computerized reasoning (AI). The variety of blockchains utilized might be ascribed to its potential for establishing decentralized and trustless exchange conditions [5]. The IoT healthcare industry is a prime contender for blockchain technology, as blockchain can possibly address basic concerns, for example, automated guarantee approval and the general well-being of executives. This innovation may permit patients to claim information and pick with whom it is shared, consequently tending to deal with problems of information proprietorship and sharing. Simultaneously, information records can be bound together, refreshed, safely traded, and accessed opportunistically by suitable specialists *via* the use of agreement conventions. This is a significant favorable position managed by the utilization of blockchain in medical services since current practices expect information to be put away with outsiders for authentication purposes. Because authorized person can only access the medical data when required [6]. Hence, blockchain can directly adopt the technologies to carry straightforwardness to information about broad measures while additionally decreasing the odds of information misuse or abuse due to conceivable human mistakes. Despite the positive implications of blockchain for cultural and business change, there is a discussion on its pervasive favorable circumstances and determined advantages in contrast to recently met requirements. It indicates the requirements of the customers based on real-life applications that are evolving day by day [7]. A report suggests that while organizations may pursue blockchain-based advancements, they may adopt a more simple approach due to concerns about potential advertising excessively. It might be said that this innovation is yet to live up to its promoted desires, a reality that might be ascribed to specific difficulties in the far-reaching usage of this innovation, particularly regarding administrative boundaries [8]. Another significant test in proclaiming the organization of blockchain is the newness of the general population and individual clients, for example, patients or specialists, given the way this innovation works, its specialized highlights or its advantages for healthcare administration [8].

This chapter provides deep insight into healthcare-based privacy adoption using blockchain technologies. The introduction section represents the adoption of

blockchain technologies in healthcare and healthcare-assisting technologies. Section 2 discusses the types of blockchains. Section 3 defines healthcare-based blockchain applications. Section 4 describes a case study based on Ethereum. Section 5 describes the challenges faced by adopting blockchain technologies. The conclusion and future scope are explained in Section 6 and Section 7, respectively.

TYPES OF BLOCKCHAIN

Bitcoin is a digital currency that uses blockchain as its foundation. By upholding its fundamental character traits of decentralization, anonymity, permanence, and suitability for the e-cash exchange measure, it has elevated its sheer relevance in the digital world. There are four different types of blockchains [9].

Public Blockchains

Public blockchains are decentralized, open-source blockchains that are publicly accessible and have no impact on the number of users who might express interest in the project. Since there is no structure for setting up exchanges, anyone can join and read, write, or evaluate the blockchain without the organization being controlled by a single company [10]. According to its objective, public blockchains are the best at ensuring client anonymity. Since this form of blockchain is open to all users, judgments are made *via* a variety of agreement calculations, such as proof of work (POW) and proof of stake (POS) [10]. Additionally, the public blockchain platform retains an incentive component predefined in the convention through some gaming hypothesis, meaning that the group's members are paid monetarily to maintain the framework's best practices and dependability [11]. The public blockchain stage includes Bitcoin, Ethereum, Litecoin, and so on.

Private Blockchains

Private blockchain restricts clients who show interest in the business and conduct transactions there. The blockchain network is under the management of a group of individuals or organizations that are permitted entry into the organization. As a result, a private blockchain has a client personality from the very beginning for choosing its specific tasks inside the organization and managing access, such as reading, creating, or examining explicit data in the blockchain. The plan of the private blockchain, in contrast to the public blockchain, is more incorporated, so the choices are made by an in-control who allots a few rights to the members of the organization [10]. Nonetheless, the incorporated engineering of a private blockchain increases the inclination for security penetration. The private blockchain is utilized by associations that require versatility, information

CHAPTER 8

Design and Development of Blockchain Integrated IoT System for Pharmaceutical Applications

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Abstract: The integration of the Internet of Things (IoT) technology in the pharmaceutical industry has the potential to bring about significant advancements and improvements, particularly in areas like supply chain management, drug discovery, and patient monitoring. By leveraging IoT technology in these ways, the pharmaceutical industry can enhance efficiency, improve product quality, ensure patient safety, and mitigate the risks associated with counterfeit drugs in the market. However, it was essential to address cybersecurity concerns to safeguard sensitive data and maintain the integrity of the IoT ecosystem in healthcare. The concept of integrating IoT with blockchain in the pharmaceutical supply chain is indeed a powerful solution to address the challenges faced by the industry, particularly in supply chain management and the prevention of counterfeit drugs. Integrating IoT with blockchain technology also results in many advantages like accurate location tracking, real-time updates and visibility, counterfeit prevention, timely delivery to customers, environmental parameter control, expiry date monitoring, pharmaceutical warehouse management, automated decision making and many more. By combining the strengths of IoT and blockchain, the pharmaceutical industry can build a robust and secure supply chain ecosystem. This integrated approach not only enhances transparency and traceability but also addresses critical issues such as counterfeiting by ensuring the delivery of safe and authentic pharmaceutical products to consumers. Environmental parameters are also monitored in a warehouse to avoid spoilage of medicines. The date of expiry of medicines and related equipment are monitored and categorized into three levels such as discard the medicines if expired, near to expiry if the expiry date is nearer and store in the warehouse if the date of expiry is far, and a message is sent accordingly to the supervisor for necessary action.

Keywords: Blockchain, Internet of things (IoT), Pharmaceutical industries, Radio-frequency identification, Supply chain management.

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INTRODUCTION

Internet of Things (IoT)

Pharmaceutical drugs have become an integral part of life nowadays in diagnosing and treating patients. In recent years, these essential pharmaceutical drugs and other medical operators and devices have become more susceptible to pharmaceutical crime. Counterfeiting of drugs *i.e.*, replacement of standard drugs and vaccines with substandard products, has increased nowadays, which risks the life of patients [1, 2].

Counterfeiting of drugs have a negative impact on consumers – diseases may not be cured, or future diseases may not be prevented. This results in a loss of confidence in healthcare sectors and service providers, resulting in the expenditure of more money in the future as the disease is not cured completely. There are chances of a shortage of income due to illness. Counterfeiting of drugs has a more negative impact on producers, like reduction in sales, amount and efforts made in branding activities, loss of reputation gained so far, the probable efforts in terms of both cost and manpower required for the disposal of counterfeit pharmaceutical drugs and medical products, litigation costs involving these drugs and products and majorly on people who were unknowingly victimized by counterfeits. Counterfeit pharmaceutical drugs and medical products redirect the resources away from actual treatment, stealing from limited health budgets that are already short of resources [3]. At the same time, counterfeit pharmaceutical drugs and medical products can affect losses in corporate taxes and VAT, increase managerial and enforcement costs to protect the supply chain from theft of medicines carried in vehicles from warehouses to consumers and increase healthcare costs to treat the adverse effects of counterfeit pharmaceutical drugs and medical products.

Pharmaceutical warehouses need exceptional care in maintaining drugs and other products safely as these products are temperature sensitive and also required to be maintained under specific conditions for certain environmental parameters such as temperature, humidity, pressure, light, oxygen, *etc* [4, 5]. If the drugs are not maintained under specified conditions, drugs will spoil and cannot be used for any purpose. This will incur a financial loss to both producers *i.e.*, pharmaceutical industries and the government. This will result in improper usage of resources. To avoid this, there should be some mechanism designed to monitor and control the environmental conditions regularly as required for a particular pharmaceutical drug or any other medical device related to healthcare. If there is any variation in the values sensed by IoT monitoring sensors from the specified values, then the designed system should automatically control or report to the supervisor for

necessary action.

The designed system should also monitor the expiry date of pharmaceutical drugs and medical equipment. Because of the expiry of pharmaceutical drugs and medical equipment, a lot of medicines and other products are wasted. This, in turn, causes a loss of revenue to the pharmaceutical industries and also to the nation. The designed system should continuously monitor the expiry date of drugs and medical-related devices and classify them into three categories based on the expiry date. Three categories are expired, near to expiry, and store in the warehouse.

If a particular drug or medical-related device falls under the expired category, it indicates that the drug or device has already expired and needs to be discarded as usage of these products will risk the lives of humans. If any drug or medical device falls under the near to expiry category, they are immediately circulated for distribution. This avoids spoilage of drugs and prevents the loss of revenue to the pharmaceutical manufacturing company and the government. If the expiry date is more than one year, then the particular product or drug can be stored in the warehouse.

For all the above-mentioned categories, an alert is issued by a system to the supervisor for necessary action. Manual verification of the expiry of drugs and other medical-related devices is very difficult and requires a lot of manpower. Hence, an automated verification system to detect the expiry date of drugs and other medical-related devices is required. This avoids spoilage of medicines and proper use of medicines and drugs without affecting any lives and loss of revenue to the pharmaceutical companies and the nation.

A system needs to be designed for industrial mechanics and maintenance and to store the drugs safely by controlling the environmental conditions. In case any machinery breaks down in a large warehouse, an alert is made by a system that monitors environmental parameters continuously. Manual monitoring of machinery is very difficult and requires manpower to complete the task. In the manual monitoring system, the supervisor will not be able to know immediately about machine failure. This will cause a delay in identifying the machinery failure and repairing the machinery. Until the machinery is serviced, production is halted. This, in turn, causes delays in the supply of urgent drugs and other medical products, resulting in a loss of revenue to both pharmaceutical industries and the government.

To make the supply chain transparent and automate the verification of drugs and other medical-related devices and monitoring of machinery, there is a requirement to transform the current pharmaceutical industry [4, 6]. The Internet of Things has

CHAPTER 9

Attrition in IT Sector: Psychology Behind the Scene

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Abstract: Attrition is often defined as "a reduction in the number of employees as a result of retirement, resignation or death" and also as "the rate of shrinkage in size or number". But the scenario is not so simple. We should always consider premature retirement, sudden resignation and premature death, including suicide. The real scenario is employees do leave, either because they expect extra money, dislike the working environment, get rough behavior, non-cooperation from their coworkers, need a change, or because their spouse gets a more robust chance in another region. Retention is more economical than going for brand spanking new recruitment whatsoever. Organizations should have a good retention strategy to retain their valuable employees. Employee turnover may be viewed as the outcome of unmet expectations and gaps between fundamental employee demands. Employees may simply resign under a few unfavourable conditions, but more crucially, "people depart before they leave", according to the psychology of disengagement. It may be iterated that as they become older, their contribution gradually decreases, much like a slowly fading memory. This text presents a holistic view of attrition and retention of employees based on psychological aspects in this cut-throat competitive environment in India. Biology has a little role in management, though one cannot ignore biology in psychology. In broader terms, attrition is somehow related to psychology, and psychology and physiology are two sides of a coin. A new trend is to relate psychology with physiology to reduce attrition.

Keywords: Attrition, Employee recognition, Meta analysis, Psychology, Physiology, Retention.

INTRODUCTION

The natural process through which employees quit the workforce is known as employee attrition. Attrition is the common occurrence of employees leaving a company or organisation voluntarily (or involuntarily) for reasons related to the environment and culture of the company that can be both professional and personal. Attrition in a corporation is typically calculated using a metric called

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attrition rate, which counts the number of workers leaving the organisation who may be voluntarily resigning or laid off by the company. Churn rate and turnover are other names for attrition rate. However, compared to attrition, turnover has a tendency to be more abrupt. Internal migration in a company may or may not be a factor in overall attrition, but it can affect the attrition of a specific unit. The rate at which employees leave a company is referred to as the attrition rate. The formula shown in Eq. (1) can be used to compute this rate.

Attrition Rate (%) = (Number of Separations/Average Number of Employees) X 100 .....….(1)

The average staff count takes into account both new hires and departures within that specific time period. It provides information on the number of workers quitting the company at any particular time. It is a significant factor because businesses must get ready to begin hiring for crucial roles that cannot be left open. Any firm will inevitably experience attrition. An employee will eventually desire to quit his or her present organisation, whether for personal or professional reasons. It may also include a harsh work environment, a lack of professional advancement, or a loss of faith in the market value of the business, among others. Another issue that frequently contributes to employee's reasons to leave is poor leadership. Notably, all these reasons are directly or indirectly related to psychology.

However, attrition only becomes a problem when it exceeds a certain threshold. For instance, minor employee attrition may be detrimental to the company's diversity efforts, or a major leadership gap in the organisation can result from the departure of top leaders. If employees believe they are being exploited or devalued, employee turnover is more likely. The workplace has a significant impact on employees' lives. If they do not feel protected or appreciated, they may feel compelled to leave. Additionally, if managers do not treat all employees fairly, it will lead to excessive employee turnover.

Basic management practices, such as staff perks and incentives, can also have an impact on the environment. If any of these factors are not correctly and successfully applied, the desired outcomes (motivated employees) can not be achieved.

Additionally, their hiring practices and layoff policies have an impact on the workplace. Due to departmental policies or coworkers' actions, many individuals quit their existing jobs and accept new ones within the same organisation.

Factors Leading to Employee Attrition

There are a number of reasons why workers think about leaving their current employer. Following are some of the primary and general causes of employee attrition:

- Better income and job prospects outside the company.
- Low pay or lack of employee recognition.
- Improper work-life balance.
- Rude behaviour on the part of peers and bosses, which results in poor team management and demoralisation.
- A lower work-life balance and stagnant career progress.
- Poor and inadequate working circumstances that sap motivation.
- Employees' premature retirement or fatal accidents while working.
- Women have many roles to perform throughout their life. They work nonstop, from performing their family responsibilities to achieving their goals. And if they are not content and at ease, they just quit their work. Some choose to leave the company outright rather than take maternity leave. These elements contribute to a higher turnover of women.

Administrators must first comprehend the psychology of praise and gratitude in order to improve employee retention. They will gain a better understanding of what motivates their staff if they do this. In essence, appreciation and gratitude are intrinsic motivational concepts. There are two categories of motivation in psychology: intrinsic and extrinsic. When someone is motivated internally, they operate without expecting any external rewards. A person who is intrinsically motivated will work on a task because they find enjoyment in it and gain internal fulfillment from it. Extrinsic motivation, on the other hand, is the act of performing something in order to obtain an external reward.

According to a study on the psychological impacts of recognition and acknowledgment at work, these two factors are crucial for both employee motivation and organisational performance. Employers can lower their employee turnover rate by frequently showing appreciation to their staff. This study also showed that lower staff turnover and more employee commitment result from treating employees with respect and appreciation for their contributions at work.

The Science Behind the Motivation

All types of motivation are greatly influenced by social psychology, cognitive psychology, cognitive neuroscience, and psychometrics. Motivation is a factor in almost every aspect of human behaviour. Undoubtedly, a person's motivational state has an impact on how they make decisions.

CHAPTER 10

Deep Learning Techniques for Predicting Changes in the Ecosystem

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Abstract: In the modern age, we depend on technology for our daily needs, from groceries to booking tickets for rides. The technology supports us by understanding our requirements. This is done by using Machine Learning. Machine Learning deals with understanding human behavior and providing suggestions for our requirements. The changes in the ecosystem affect the living creatures who depend on the ecosystem. One of the subsets of Machine Learning that play a vital role in saving the lives of living creatures is Deep Learning. Deep Learning is a representational learning of artificial neural networks. Deep Learning keeps on improving so that it can imitate human intelligence more accurately. Artificial Neural Networks is another subset of Machine Learning and helps in the growth of Deep Learning. There are different classes of artificial neural networks, two of the important classes are the Convolutional Neural Network (CNN) and the Recurrent Neural Network (RNN). The patterns in images are recognized by CNN. So, CNN majorly deals with image recognition and processing. RNN helps recognize sequential data and uses this pattern of sequential data to predict the likely scenarios in the ecosystem. The model, which uses the algorithm of RNN and CNN, should be trained and tested with the data for better efficiency.

Keywords: Artificial neural network, Convolutional neural network, Deep learning, Earthquake, P-waves, Seismic waves, S-waves.

INTRODUCTION

An ecosystem is a place where living organisms, like plants, animals and human beings, and other factors, such as weather and landscape, together form a life. Humans make up most part of the ecosystem, resulting in a negative impact on the ecosystem. Due to this, it also affects other living beings as well. Technology is expanding day by day, and we can use it to save the ecosystem. Machine Learning

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and Deep Learning are technologies that can be used to save the ecosystem. Using these technologies, we can measure the longitude, latitude and magnitude through which we can predict the changes in the ecosystem at the earliest.

SEISMIC WAVES

A seismic wave is a vibration that travels through the surface of the Earth's surface and is generated by the motion of the Earth's tectonic plates. It may also be caused by volcanic activities, explosions or other energetic sources. Seismic waves are produced by an earthquake and move through or close to the Earth's surface. Seismic waves are divided into four different categories [1].

P waves, also called primary waves, are the earliest waves that seismographs can detect. The ground is pushed and pulled in the wave's direction by compressional or longitudinal waves. Typically, they do very little harm [2].

S waves, also known as secondary waves, arrive after P waves because of their slower rate of motion. Even though they move in the same direction as the wave, they shake the earth in an opposite direction. S waves have a higher amplitude than P waves and cause the ground's surface to move both vertically and horizontally, making them more dangerous.

Surface waves move slowly and arrive last. They only move across the surface of the Earth. Two types of surface waves are Love waves and Rayleigh waves. Horizontal movement *i.e.*, backward and forward movement, is produced by Love waves. Vertical and horizontal ground movement waves are produced by Rayleigh waves [9]. These waves can be the most harmful because when they pass, they elevate and lower the land as they move along. Seismographs measure the time required by seismic waves to penetrate through different layers of the Earth.

Waves can be reflected and refracted when they pass through materials with various densities and stiffness. Seismologists can determine the type of material the waves are traveling through based on the different ways the waves behave in various materials.

The findings can help us identify fault planes, as well as the pressures and strains operating on them, and provide us a glimpse of the Earth's core structure. In the search for oil and gas, the same wave behavior can also be applied on a smaller scale by monitoring waves produced by explosions or ground vibrators [8].

As we know, seismic waves are one component of earthquakes, and seismologic methods are used for studies on earthquakes [10]. Seismograph locations are

required for dependable earthquake hypocenters and focal mechanisms. Resources have found that one focal depth of epicenter would give accurate hypocentral depth control. To determine source parameters, waveform modeling methods are used for earthquakes of magnitude 4.5.

The earthquake structure can be determined using natural sources such as local, regional, and teleseismic sources. Using forward and inverse models, body and surface waves are generated, and a one-dimensional structure of the model can be obtained. Seismic amplitudes and waveforms are considered for forward modeling, and both forward and inverse modeling are used during the travel time of body waves [20].

The Earth's structure is divided into two parts: seismic refraction or wide-angle reflection and seismic reflection studies. The refraction profiles are explained using a two-dimensional model and forward modeling of travel times and amplitude. Refraction methods provide outstanding estimations of seismic velocities while having a low resolution of structure [10].

For seismic refraction, inverse modeling is used using one, two and three dimensional, which also includes tomography. In the past decade, many geographical insights and the highest resolution of crustal structure have beendetermined by seismic reflection.

Earthquake research analysis requires parameters such as permanent regional seismic networks, temporary dense networks of portable seismographs, and worldwide seismic observatories. Permanent regional networks are employed in areas with a high level of seismic activity or potential seismic hazard.

Due to signal clipping, each seismograph contains a single vertical-component 1-Hz geophone and high-gain analog telemetry circuitry.

The temporary network of movable seismographs may be instated after a major earthquake at the epicenter, where these networks have generally 10 to 20 seismographs spaced 5 to 10 km apart, similar to perpendicular-element smoked-drum or pen-and-ink seismographs. But nowadays, the networks have three-element seismographs and accelerometers, which give further information for the determination of parameters like magnitude, locations, *etc* [30].

To attain information on hypocentral depth and natural falling on earthquakes greater than the magnitude of 4.45 or more, studies on broadband waveforms are carried out.

CHAPTER 11

A Detailed Analysis of Issues with Solid-State Devices

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Abstract: Non-volatile memory technologies, such as NAND flash memory, have improved storage system performance, reliability, durability, and cost. Due to their speed and density, solid-state devices (SSDs) that are based on flash memory are being used as workstations, desktops, and laptops. Despite offering superior performance, stress resistance, and energy economy as compared to mechanical hard drives, NAND flash memory has unique features and operating limits and cannot be employed as a perfect block device. The design of SSDs has developed over time to make use of the benefits offered by flash memory while, at the same time, hiding their drawbacks. SSD concurrency techniques make use of the available parallelism of flash memories. This chapter thoroughly examines SSD subjects, ranging from the physical features of a flash memory cell to the design of SSDs themselves. The subjects pertaining to the flash translation layer (FTL) are described within the context of interconnected system-level operations. These operations include garbage collection, wear-leveling, address mapping and bad block management. This chapter also provides a review of the most current SSD-related studies.

Keywords: Address translation, Bad block management, Buffer management, Flash memory, Flash translation layer, Garbage collection, Wear leveling.

INTRODUCTION

Recently, flash memory has become a dominant computer and mobile device storage technology. Flash memory-based SSDs are commonly employed as secondary memory in current computers owing to their high-performance hard disk drives (HDDs). HDD performance has stalled owing to slow magnetic platters and actuator arms. SSDs lack complicated mechanical elements, leading to decreased latency and failure rate [1].

SSDs have better bandwidth, random I/O performance, power consumption, stress

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tolerance, and system dependability than HDDs [2, 3]. Storage TeK created RAM-based SSDs in 1978. Western Digital launched SSDs in 1989. Early SSDs used the high-performance NOR flash memory structure. M-System created SSDs using NAND flash memory in 1995, but their high cost restricted their deployment (*e.g.*, in industrial or military environments). By 2004, NAND flash memory prices plummeted, and SSDs replaced magnetic storage technologies. Flash memory is utilized in smartphones, tablets, computers, *etc.* Due to their enormous capacity and bandwidth, they are employed in PCs and servers [4]. Despite SSDs' ubiquity and benefits, they have flaws. Due to its physical properties, a flash memory cell must be erased before being programmed. Second, numerous program-and-erase cycles destroy a flash memory cell's oxide layer. This makes flash memory cells unreliable, decreasing their lifespan.

There are two variants of flash memory. Both are known as flash memory, however one is known as NOR flash memory and the second as NAND flash memory. The NOR and NAND flash memory were developed independently by different businesses at separate periods. NOR flash memory is often used to store program code and immediately execute program instructions. This is possible because of the memory's low random-access latency and execute-in-place capability. In lieu of magnetic discs, many consumer devices now make use of NAND memory as an additional storage option. This has been made feasible by the large capacity and low cost of NAND flash memory.

Erase-before-write architecture is one of the fundamental hardware features of flash memory [5]. As a result, FTL system software has been implemented [6]. A table that maps logical addresses to physical addresses is at the heart of an FTL [7]. The mapping table is updated as a result of the newly modified logical/physical address mapping. By doing this, one block is shielded from being overwritten and wiped. There are two main factors to take into account when using the FTL technique in embedded applications: storage performance and RAM capacity constraints. Additionally, embedded programs might benefit from the RAM capacity needed to store the mapping data. Therefore, if an FTL method needs a lot of RAM memory, the product cost will grow. The three different sorts of operations available on flash memory are read, program(write), and erase. The only method to change a bit from 0 to 1 is to erase the block containing the page, which sets all of the block's bits to 1 [8]. Flash has greater performance for random data accesses than HDD since it is built on semiconductor chips that are smaller, consume low energy, and have a lower power need. Additionally, SSDs are heat- and shock-resistant and do not have any moving components or mechanical wear.

However, the workload characteristics have severely affected the relative

performance of SSD versus HDD [9, 10]. For certain writing-intensive scientific tasks, for instance, it has been demonstrated that SSDs may only offer a little advantage over HDDs. Additionally, SSD cannot totally replace HDD due to its higher price [11]. Thus, the system-level research issues of flash memory include lifespan extension by reducing the amount of write/erase operations, wear-leveling, handling bad blocks, memory performance improvements through retention relaxation, and hybrid memory design. Fig. (**1**) represents SSD architecture consisting of a buffer manager, RAM and host interface, flash controller and processor. The processor manages the majority of functions, including the flow of requests/responses to mapping. The host interface acts as a physical interface between SSD and the host.

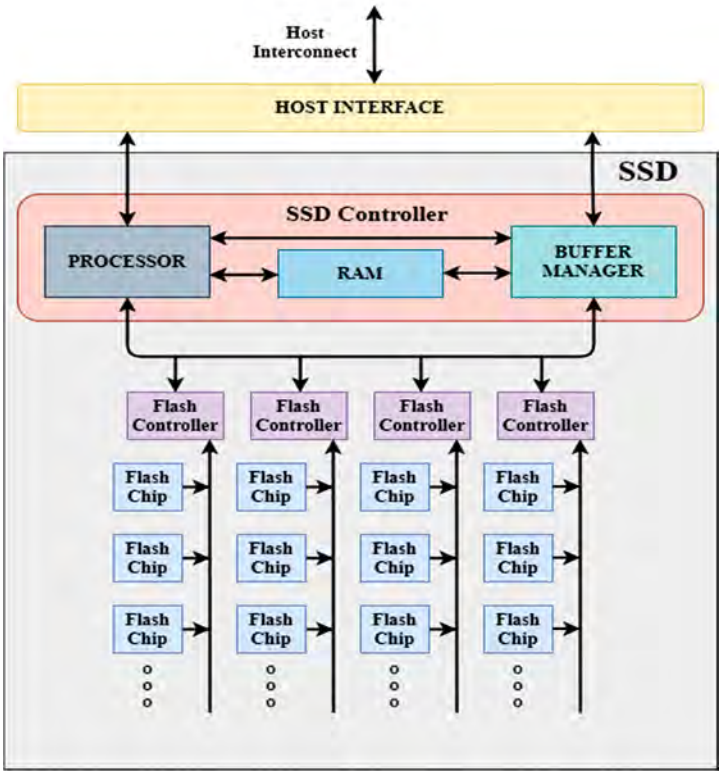

Fig. (1). Architecture of SSD.

SSD designs utilize flash memory's benefits and disguise its drawbacks. To optimize speed, longevity, and reliability, SSDs use FTL.

In comparison to magnetic discs, NAND flash memory exhibits the following five distinguishing characteristics [12]:

CHAPTER 12

Profit-Based Unit Commitment Using Local and Global Search Methods

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Abstract: The availability of clean energy is crucial for both the environment and human health. Numerous harmful gasses released by conventional automobiles cause illnesses and ailments in people all over the world. Nevertheless, there is growing interest in Plug-in Electric Vehicles (PEVs) to help with the energy and climate emergency. It has been noted that the manufacturing of PEVs has dramatically increased over the past ten years. The PEVs may supply the power grid with electricity while both consuming it and storing it in batteries. By effectively managing the electric demand profile and integrating electricity from PEVs into the electric grid, operating expenses can be reduced overall. The study recommends the course of action, which, in this case, is to apply the chaotic mapped Sine Cosine Algorithm advancement method and combine chaotic maps with the Harris Hawks Optimizer. It also evaluates how well the suggested better technique is implemented while taking PEVs into account.

Keywords: Chaotic mapped harris hawks optimization, Chaotic mapped sine-cosine, Plug-in electric vehicles.

INTRODUCTION

Substantial electricity demand across key sectors, encompassing residential, commercial, industrial, and agricultural domains, is driving continuous expansion of the electric power system. Currently, the electrical power industry is classified as being enormously large, highly nonlinear, and highly linked. Overloading of power grids occurs as a result of rising electricity consumption, deregulation, and privatization. Over time, the power demand has changed. In order to attain ideal scheduling, each generating unit's commitment is taken into account. Power availability towards the grid can be used to regulate power for time-varying load demands [1, 2]. Due to significant power fluctuations, the demand for electricity rises in the residential, commercial, and industrial sectors. Comparable to how real-time work in the electricity sector has been radically transformed by

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e-mobility [3]. It is, therefore, extremely difficult to meet the shifting demand for electricity. Every nation has a basic issue with electricity. As a developing nation, India's trajectory is significantly influenced by the extent of electricity consumption in each state, reflecting its potential for progress. Because the demand for electricity is steadily increasing, there is an urgent need to generate enough electricity to meet our energy needs. Nuclear power plants, which have high fuel prices, limited coal availability, and certain detrimental consequences on the environment and ecology, produce the majority of the electricity in India.

As a result, the coal-fired power plant must be operated in concert with various power sources, including nuclear, solar, wind, and hydropower. To achieve low production costs with high reliability, a unit commitment of plants—a phrase used to describe the coordination of plants—adopts the most conservative power plant models. The no-free-lunch theorem states that there is not a single optimization strategy present ideally suitable for every optimization problem [4]. Because of this, an associated algorithm may perform poorly on a different set of issues, even when a particular meta-heuristic method may show promising results on a range of problems. It is clear that the NFL continuously improves on existing methods and provides new meta-heuristics, which makes this study topic incredibly dynamic. Currently, unit commitment problems with various thermal unit systems are investigated and resolved using the research work recommended by Seyedali Mirjalili [5].

NOVELTY AND ROAD MAP OF THE CHAPTER

The current optimization methods show promising progress, but their research is still in preliminary stages and faces several challenges that need resolution. Uncertainties include the following:

1. Figuring out how to compute the best state that is still unattainable after obtaining local or near-optimal solutions, with a focus on Plug-in Electric Vehicles (PEVs).

2. Determining the best method for combining the benefits of characteristic enhancement designs with PEVs' ability to charge and discharge.

3. Establishing effective limitations or parameters for optimization designs that account for the behavior of PEVs.

4. Defining the stopover conditions for the full cycle of iterations in the optimization process.

5. Addressing the significant issue of lacking a well-organized and comprehensive theoretical framework involving PEVs.

Therefore, the problems are easily solved using this unique optimization technique. The proposed optimization procedure is useful for solving the most challenging issues. Moreover, the robustness of the conclusions is notably affected by the limited examination of the profit-based unit commitment problem concerning all pertinent characteristics, such as the initial status of thermal-producing units and shutdown costs. Thus, the effort is justified in continuing the suggested investigation.

LITERATURE REVIEW

The field of exploration in optimization strategies is currently a vast and active area of study where research is progressing significantly. Nowadays, researchers are engaged in various projects addressing diverse issues using multiple methods, demonstrating proficiency in accurately predicting outcomes. Ongoing research is focused on discovering new algorithms and addressing certain limitations of existing techniques. Table **1** presents survey data on heuristic approaches and meta-heuristics. Fig. (**1**) illustrates various Harris Hawks Optimizers.

Table 1. Different kinds of EVs.

Reference	Year of Publication	Research Works	Name of the Novel Technique
[6]	2021	This innovative approach was developed to predict the speed of electric vehicles while ensuring the accuracy of the vehicle's performance.	LSTM
[7]	2021	A novel methodology was devised to enhance the learning rate for optimal solutions and eliminate the non-stationary internal noise of PEVs.	ALRT-CNNs
[8]	2021	The newly implemented method aimed to determine optimal routes and provide essential information about battery recharging or electric vehicle charging stations.	GA
[9]	2021	This method was specifically crafted for multi-objective energy management in Hybrid Electric Vehicles (HEVs), focusing on energy conservation and increased electrical efficiency.	NSGA-II
[10]	2021	The innovative technique was applied to address emission dispatch and dynamic economic scheduling in the electricity market.	CSA

CHAPTER 13

Classification of Deep Learning Techniques for Object Detection

Aras Amruth Raj Purushotham[1], **Manjunath Ravindra**[1,*] and **Chaya Ravindra**[1]

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Abstract: The object detection framework recognises real-world objects within the frame of a moving photograph or computer-generated image. The object has a location to flow to through other objects, such as people or automobiles. Item detection is widely used in sectors where it is necessary for an organization's security and growth. The vast range of applications for protest detection include image recovery, security strategy, reason for inspection, machine framework assessment, and computerised vehicle structure. In contrast to conventional object localization techniques, machine learning-based object identification makes use of the machine's greater capacity to learn and represent knowledge [1]. A difficult problem in the analysis of designs and computer frameworks is object detection. Later on, the relationship between object detection, video analysis and image processing was developed. The complicated structure that is now being constructed includes both fundamental and sophisticated features, and the evaluation is carried out depending on the classifiers used. A complex system that can accurately assess and distinguish between numerous aspects is produced as a result of this combination. Several deep-level characteristics have been developed as a result of machine learning advancements to address the problems in the old design [2]. We conducted research on one-stage and two-stage object detectors, which are further categorised into deep learning methodologies. To enhance object detection, CNN networks employ these algorithms. An evaluation of the machine learning method for object detection is presented in this paper [3]. The protest site's applications have been distilled. The various methods of object localization employ template-based, region-based, and portion-based methods.

Keywords: Algorithms, Computer-generated image, Computer vision, CNN networks, Face recognition, LiDAR.

INTRODUCTION

A crucial topic of research in the computer vision and deep learning fields is object recognition. For increasingly complex computer vision applications, such as scene tracking and light sensing, it is a vital requirement. Other requirements include LiDAR, face recognition, event detection, behavioural analytics, semantic comprehension, and many other technologies [4]. It is intended to find and. It is

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intended to find and determine the target category of interest accurately from the image and specify each bounding box target. The focus should not only be on categorising photographs into different groups but also on properly identifying the idea and placement of the things present in each image. With the introduction of more compact, high-quality, and reasonably priced cameras as well as significant improvements in computing power and parallel processing technology, computer vision is now able to detect objects in real time by using cutting-edge hardware like multi-core processors and GPUs [5]. This has created a wide range of opportunities for businesses and people alike, enabling the development of sophisticated and effective solutions in numerous domains. Computer vision has developed into a crucial tool for navigating our increasingly data-driven environment, from self-driving cars to medical imaging [6]. We may anticipate much more sophisticated computer vision applications in the future, which will spur innovation and influence how we live and work.

The rapid development of deep convolution neural networks (CNNs) and the rise in GPU computing capacity are principally responsible for the rapid advancement in the field of computer vision-based object recognition and tracking [7].

Let's delve into the evolution of Deep Learning (DL) from Machine Learning (ML) and examine the key differences between them. The identification of patterns in data is the focus of machine learning (ML), a branch of artificial intelligence (AI). Whether the data is labelled, unlabelled, or both, a machine's ability to access and learn from it enables a variety of learning techniques, including supervised, unsupervised, semi-supervised, and reinforcement learning [8]. On the other hand, DL is a more sophisticated and precise variation of ML. Through a series of tasks, it requires the application of particular algorithms to learn both the data and the representations of the data [9]. The quantity of samples or experiences that DL is exposed to affect how well it performs. Finding and identifying items in an image is the goal of object detection. Feature extraction, informative region selection, and classification are the three steps used by conventional object detection algorithms to accomplish this goal. To locate all potential places of objects, the image is initially scanned using a sliding window at various scales. When the number of windows increases, and there are too many redundant windows generated, this process becomes computationally demanding [10]. On the other hand, if there are only a few sliding windows, some object sections might be missed. The second phase involves extracting characteristics from the chosen regions in order to represent the objects [11]. The third stage involves using a classifier to identify the kinds of objects that are present in each location. Feature extraction, which aims to discover distinctive traits of various objects in an image, is the second phase in the conventional object detection method. To extract reliable representations of objects, visual features like SIFT

(Scale Invariant Feature Transform), HOG (Histogram of Oriented Gradients), and Haar-like are used [12]. When comparing the similarity of two photos, the features that are extracted from one image are represented as vectors. However, designing reliable feature descriptors that can precisely identify items in an image can be difficult, particularly when there are differences in lighting and backdrop conditions. Because of these variances, it may be challenging to consistently extract useful features that can be utilised to recognise objects in various photos. A computer vision algorithm called SIFT (Scale-invariant feature transform) is used to find, describe, and match features in images. It was created in 1999 by David Lowe and has a variety of uses, including object recognition, robotic mapping and navigation, image stitching, 3D modelling, gesture recognition, video tracking, and animal identification by a human. In order for the process to function, a set of reference images must first have SIFT key points extracted from them and stored in a database. In order to find probable matching features based on the Euclidean distance between their feature vectors, each feature in a newly processed image is compared to the database. The computer then chooses subsets of important points that, after weeding out false matches, depict the object in the new image together with its location, size, and orientation. To accomplish this, a hash table version of the generalised Hough transform is used to efficiently group consistent matches [13]. The method then determines the probability that a given set of features indicates the existence of an object, taking into account the precision of the fit and the potential number of false matches. It is quite certain that object matches that pass this set of tests are accurate. A feature descriptor known as HOG (Histogram of Oriented Gradients) is frequently employed in computer vision and image processing for object recognition [14]. It operates by counting the occurrences of a gradient orientation in particular regions of a picture. There are some significant discrepancies between this approach and edge orientation histograms, SIFT descriptors, and shape contexts. A dense grid of cells with equal spacing is used to calculate HOG, and overlapping local contrast normalisation is used to increase accuracy. In the HOG procedure, the image is converted into a feature vector with a user-specified length. Although the final image might be difficult to read, it is suitable for use in support vector machines (SVMs), an image classification approach that can yield precise results. An instrument used to distinguish a target object from the total image is a classifier. Making the representations more structured, meaningful, and helpful for visual recognition, it serves to distinguish the target object from other categories [15]. A more hierarchical, semantic, and educational approach to visual identification is made possible by the use of classifiers. In the realm of computer vision and image processing, Support Vector Machines (SVM), AdaBoost, and Deformable Part-based Models are three of the most popular classifiers (DPM) [16]. DPM is regarded as the most adaptable of these as it accounts for object deformations

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