ARTIFICIAL INTELLIGENCE AND NATURAL ALGORITHMS

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Artificial Intelligence and Natural Algorithms

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PREFACE

This book is based on Applications of Artificial Intelligence and Nature Inspired Algorithms in different areas of Computer Science. Artificial Intelligence (AI) encompasses by means of computers to do things that customarily need human intelligence. It also includes acting on data, learning from new data, and improving over time, just corresponding to a small human kid growing up into a smarter human adult. Nature-inspired algorithms are a set of original problem-solving practices and approaches and take enticing substantial consideration for their respectable act. Typical examples of nature-inspired algorithms contain evolutionary computing (EC), artificial neural networks (ANN), swarm intelligence (SI), and fuzzy systems (FS) and they have been useful to resolve several actual problems. Even with the fame of nature-inspired algorithms, several tests endure, which need extra research efforts. In this book, we focus on Artificial Intelligence (AI) and optimization algorithms for data analytical processes. Each chapter in this book is written by topic experts on applications of Artificial Intelligence (AI) and nature-inspired algorithms in data science.

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CHAPTER 1

Data Computation: Awareness, Architecture and Applications

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Abstract: There has been a tremendous revolution in computing technologies to handle the vast amount of data in recent years. Big data is the large-scale complex data in which real-time data is available and mushrooms the development of almost every field. In recent years, the demand and requirement of big data produced an opportunity to replace traditional data techniques due to their low efficiency and low accuracy. It shows adequate responsiveness, absence of versatility, execution, and precision for meeting the convolution of Big Data challenges. As an outcome, this created different dispersions and innovations. Big data does not mean that the data is humongous but additionally excessive in range and speed. This factor makes them tough to deal with the usage of conventional gear and techniques. Decision-makers read the extension and expansion of big data to understand and extract valuable information from rapidly varying data using big data analytics. In this chapter, we can analyze big data tools and techniques useful for big data. This chapter presents a literature survey covering various applications and technologies that play an indispensable role in offering new solutions dealing with large-scale, high-dimensional data. By summarizing different available technologies in one place from 2011 to 2019, it covers highly ranked international publications. Further, it extends in the context of computing challenges faced by significant Data Healthcare, Clinical Research, E-Commerce, Cloud Computing, Fog computing, Parallel Computing, Pervasive Computing, Reconfigurable Computing, Green Computing, Embedded Computing, Blockchain, Digital Image Processing and IoT and Computing Technology. The survey summarizes the large-scale data computing solutions that help in directing future research in a proper direction. This chapter shows that the popularity of data computing technology has steeply risen in the year 2015, and before 2011, the core research was more popular.

Keywords: Big Data, Big Data Analytics Applications, Challenges, Data Computation, Decision Making.

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INTRODUCTION

Data refers to bits or chunks of information represented in a digital format in the computational world. This data is available in multiple forms, such as text, symbols, numbers, *etc*., that are formatted peculiarly (refer to Fig. **1**). It is considered an element for modelling or representing real-world events, such as a line segment representing the location of a road. Data represents a binary format for interpreting the process and converting computer data into meaningful information during its transfer. According to Michener, the concept of meta-informatics describes the context, content, structure, accessibility, and quality aspects of the data [1]. Computing covers the activities that require a computer to perform any task, such as processing, managing, transferring, or communicating a piece of information. Here, the concept of hardware and software came into existence.

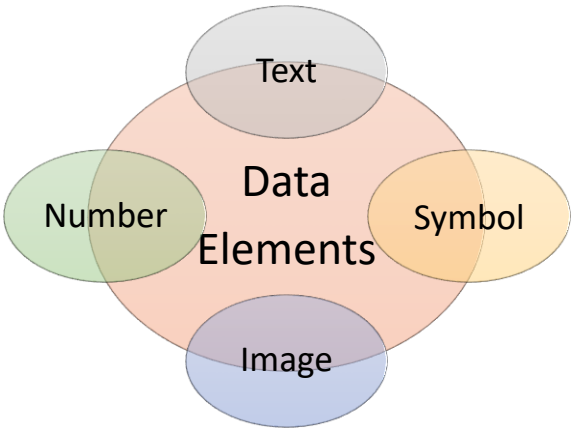

Fig. (1). Data Elements.

With the emergence of the latest revolutionized tools and technologies, Darmont described the advancement of data-centric computing compared to earlier times [2]. Data analytics and large-scale data mining attracted the interest of various researchers, which led to the existence of a cost-effective solution for online and offline data storage and manipulation, as shown by Sandor *et al*., while addressing mobile clouds. They proposed "Multi-Authority-based Encryption" to solve the "Key Escrow Problem" in authority-based encryption [3]. From cloud technology and online computing solutions to data storage techniques, all these inherit the risk of threats and attacks. The necessity of data security and privacy has also grown on these grounds. In the last few decades, data has risen to many folds in

each field, whether it is dealing with Online Social Media [4], E-Commerce [5], Internet-of-Things [6], Cloud, Healthcare, Bio-Research, or Clinical Data [7]. These big data analytics are characterized by proper data management strategies with supporting architecture to offer better visualization, user interaction, and the development of models. The present review provides a survey of the approaches to deal with the enormously growing demand for a higher level of data computing. Highly cited research articles and relevant research studies are accessed and mined during the process. The work covers the literature supporting applications and approaches based on various technologies to deal with vivid kinds of massive data.

The survey is divided into five sections, including an introduction. Section 2 discusses the survey strategies and provides the application-wise literature review about various approaches; Section 3 provides a descriptive analysis of the work, and Section 4 enumerates the data computing challenges. Finally, the paper summarizes and concludes in Section 5.

SURVEY STRATEGIES

The study design involves intensive data mining, which is related to research articles published from 2011 to date in journals and indexed in PubMed, Science Direct, IEEE, Google Scholar, Scopus, SCI with reputed publishers such as Springer, Elsevier, Taylor & Francis, *etc*. The keywords like “Data Computing”, “Big Data”, “Massive Data”, “Healthcare”, “E-Commerce”, “Cloud”, “Image Processing”, “Biomedical”, “IoT”, “Clinical” are useful with and without “applications”, “tools”, technologies”, “solution”, “approaches”, “analytics” and “server”. The section includes Social Networking, Biomedical Research, E-Commerce [8], Internet-of-Things [9], Online Media, NGS Technologies [10], and Education Sector [11], which is continuously adding up to the data volume and variety. This has irresistibly flooded the network with organized and unorganized data types. Here, the computing framework has revolutionized various data mining, analysis, and visualization strategies. It has also reduced manual efforts. Cloud environment strengthened by fog and parallel computing offers an interesting platform to deal with large-scale multifaceted computing challenges. The technology eradicates the necessity of maintaining the costly computing hardware required to perform various tasks. Moreover, it also effectively addresses software and space requirements. Recent time has seen a tremendous increase in the big data technologies touching the medical and informatics field. We can use data mining by selecting the most recent and relevant research papers in this area. The paper is selected based on variously defined approaches:

CHAPTER 2

Different Techniques of Data Fusion in Internet of Things (IoT)

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Abstract: An IoT (Internet of Things) technology is a dynamic area of research, which has been growing at a remarkable rate for the last few years. The IoT is a mammoth network of associated things and people, which accumulates and shares data about how they are used and the environment around them. It is the discernment of connecting any device to the internet and other associated devices. When something is associated with the internet, it can propel or receive information, or both. This ability to propel and/or receive information makes things smart. IoT permits businesses and people to get more insights from the world around them and do more evocative higher-level work. Data fusion techniques are used to extract eloquent information from dissimilar IoT data. It ferocities dissimilar data from sensor sources to mutually find a consequence, which is more dependable, precise, and comprehensive. This chapter briefly designates the IoT by the characteristics of data procurement and data fusion.

Keywords: Bayes rule, Data Fusion, IoT, Markov model, Multi-sensor, Real-time data processing.

INTRODUCTION

The Internet of Things (IoT) novel technology has almost completely expanded the internet to computers and smartphones to a wide range of other objects, processes, and environments. Those compatible items are used to trim, send data back, or both. IoT transforms dumb devices into intelligent ones by providing them with an online data connection, allowing the device to connect with people and additional IoT-enabled devices. Compact devices in a smart home are some of the best examples of IoT. Fire-powered firefighters, thermostats, and security

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alarms create an interconnected hub where data is shared between mobile devices, and users can remotely control the objects in that hub (*i.e.*, control the temperature, open doors, *etc.*) *via* a mobile app or website. Far from being just a home block, many devices, industries, and settings can access the Internet of Things. From smart blackboards in classrooms to medical devices, IoT quickly makes the world smarter by connecting portable and digital gadgets with sensor-connected devices to the Internet of Things platform, which scans data from different devices and data analytics to address specific needs. IoT control platforms can pinpoint exactly what information is relevant and what is being overlooked. This information can familiarize you with commentary patterns, make recommendations, and comment on obvious problems before they occur. The insight provided by illuminated analytics makes processes more efficient. Smart systems and resources mean you can turn industrial operations quickly if this is tedious, labor-intensive, time-consuming, or dangerous. To separate the IoT concept, a real-life example can be taken. If I want to know which options are the most popular, then a device with the Internet of Things technology can automatically back up data. Compatible devices make smart decisions based on real-time information. In the Internet of Things (IoT), the process is organized into three stages:

Accumulating and Sending Information

This means the senses. Sensors can be temperature sensors, air quality sensors, moving sensors, light sensors, moisture sensors, *etc.* These senses, in turn, enable us to gather information from space, which in turn allows us to make more intelligent decisions. At the same time, as our vision, hearing, touch and hearing, smell, and taste allow us humans, to create the concept of the world, the senses allow machines to create the concept of the world [1]. In Grange, uncontrolled access to information about soil moisture can determine farmers where their crops are forcing irrigation. Instead of overirrigation (either over-irrigation and environmental degradation) or significantly reduced irrigation (which may be crop loss), the farmer can protect the plants from getting the right amount of water.

Receiving and Acting on Information

We are fully familiar with machines that receive data and operate it accordingly. For example, your printer prints the record on receiving the data, and your car gets the car key and opens the doors. It does not matter if the order is open or not; we can see that we can order equipment from afar. The real strength of the Internet of Things comes when things can do both things mentioned above. For example, it can collect and send data, besides receiving and tracking it.

Doing Both

Sensors can collect data about moisture content in the field and advise the farmer to irrigate the field. Also, these sensors can detect the moisture in the yield and provides information to the seller/buyer about the content of moisture without the need of a farmer. Instead, the structure of the water system may change differently, depending on the moisture content of the mud. You can do it again and again. In the event that the water framework receives weather data from its web organization, it can also detect when it will rain and choose not to irrigate the crops today because the rain will rain anywhere. And, not only that! This data about the humidity of contaminants, how well irrigation systems produce yields, and how well the crops grow can be collected and sent to supercomputers using sophisticated algorithms that can comprehend this data. Moreover, that is just one type of sensor. On installing various sensors such as light, air quality, and temperature, and these algorithms one can read these weather parameters in detail. With handfuls, many ranches collect this data, through these algorithms, which can create unusual pieces of information on how to create yields to improve the best, helping to take care of the developing world community [2].

Key Challenges of IoT

IoT can offer a wide range of novels to the Internet, document the widespread financial benefits, and pose some challenges [3, 4]. Selected from them are listed below:

1. *Unparalleled Identity Management:* IoT aims to connect millions and billions of information, which should be seamlessly distributed across the Internet. As a result, much-needed patent management is required to provide and fulfill specific terms for a wide range of mobile devices.

2. *Consistent and Efficient:* Sundry Wholesale is familiar with its devices with modified technologies unknown to everyone. There must be an unconventional approach to allow full interaction of physical and sensory devices.

3. *Confidentiality of Information:* IoT uses many identification technologies, such as RFID, 2D-barcode, *etc.* Since tolerance will enhance these identities, it is essential to obtain confidential information, which is why it prevents unauthorized access.

4. *Equipment Protection:* Items independent from premises deal with physical damage and unauthorized importations for ensuring their safety.

CHAPTER 3

Role of Artificial Intelligence in Medicine and Health Care

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Abstract: With the passing decades, Artificial Intelligence (AI) is gaining high popularity in various domains. In this chapter, we aim to present the current scenario of the application of AI in the field of medical science. Firstly, we will introduce the early and basic role of AI in the medical field. We preceded the chapter with a summary of the most current applications of AI in various areas of medicine and health care. In this review, we have discussed the latest developments of applications of AI in biomedicine while predicting the risk of disease. Estimating the success ratio of the therapy also manages or reduces the severity of complications, taking care of ongoing patients, living assistance, biomedical information processing, biomedical research, and medical imagining. We also present a survey on AI techniques, which were used by many authors with different objectives in medical science. Furthermore, we showcase the effects of the usage of AI by highlighting the reduction in the rate of mortality, and fast and accurate diagnostics which help in decreasing errors related to human fatigue and lessening medical costs. Finally, we draw attention to some of the possible weaknesses, apprehensions, and uncertainties in using AI in medical science. We briefly review the efforts being made to improve the healthcare industry by offering various AI-based healthcare products.

Keywords: Artificial Intelligence, Biomedical, Health Care, Machine Learning.

INTRODUCTION

Artificial Intelligence (AI) was introduced in the field of medical sciences in the year 1984. AI was limited to the programs that were being used in the performance analysis, recommending treatment, and suggesting cures. Furthermore, it focuses on observing the performance of these programs with human intelligence [1]. The solution for this said problem was checked by using

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the Turing test. It is stated that these programs are intelligent as a human and they report positive results in more than 50% of cases.

Thereafter, the researchers aim to explore the field of AI in medical sciences. Initially, AI obtained results in the development of devices useful for disease diagnosis, information retrieval, and expertise [2]. Over the past decades, AI has played a role in medicine and healthcare system. Several authors worked in the area of intelligent tools and devices, which became a great aid in the medical field. Nowadays, medical knowledge engineering has been introduced as a new stream of artificial intelligence for research purposes [3]. Due to the large availability of data, AI is also proving its significant role in the supremacy of decision making by using AI based algorithms [4]. Some authors [5] reported that doctors are being helped in classification, segmentation, detection, and other medical practices by integrating deep learning with AI [5].

RECENT APPLICATIONS OF AI IN MEDICINE AND HEALTH CARE

Diagnosis of Disease and Prediction

These days, cardiovascular disease is one of the major healthcare issues where AI is playing an influential role in handling this problem. It is an estimation using an Artificial Neuron Network (ANN) model which is similar to the biological neural network. This model is designed for informal learning and is used in predicting the hazards of congenital heart disease (CHD) in pregnant women. Their observation reported that the model was aiding in the identification of patients who have a greater risk of CHD in their early stages of pregnancy [6]. The ANN was applied in a multicentre comparison study evaluation. Here, the authors aimed at determining a comparative study between the diagnosis precision of an ANN-based diagnosis system and conventional quantization [7].

The application of machine learning is beneficial in improving the accuracy of predicting cardiovascular disease risk in a group of over 3,700,000 disease-free patients. They could benefit from preventive treatment. This study also concluded on patients not requiring any treatment [8]. Jelliffe Jeganathan *et al.* [9] evaluated the analysis of the mitral valve's performance using AI. It was a manual process to diagnose patients with mitral valve disease. After careful observation, they suggested that a good reading could be found without user intervention through self-diagnosis. JW Timothy *et al.* [10] concluded that the prediction of the machine learning model using three-dimensional heart movement. They were able to achieve results without the usual risk factors in patients with newly diagnosed pulmonary hypertension. Aliza Becker *et al.* [11] show that researchers have developed a neural network model to identify reduced human speech patterns at MIT. During the implementation of the model, it did not include the information

that the speaker shares with their physician. In line with the previous work, various authors presented their work which detailed the translation of brainwaves into decipherable speech. The contribution of their work benefited those patients who were not able to talk [12].

In Reduction of Complications

AI is not only helpful in disease diagnosis but also in alleviating or reducing complications during disease creation. Dente J C presented a study on machine learning algorithms used to identify predictive profiles of bacteremia [13]. In a European Union-funded MOSAIC project, type 2 diabetes mellitus complications were predicted by employing a machine learning-based predictive model. It was helpful in the study of retinopathy, neuropathy, and nephropathy with the help of the available medical records online [14]. Additionally, Wise *et al.* [15] estimated preoperative factors in patients undergoing bypass grafting for the coronary arteries. They focused on optimizing the identification of patients at risk before surgery using the artificial neural network [16]. Jirsa K. V. *et al*. used AI based model for focal epilepsy patients. AI has also been used in the prediction of stroke [17]. Hu *et al.* applied a machine learning model to identify common problems in electronic health records [18]. Zhen Hu *et al.* [19] also put their efforts to collect data for research.

Taking Care of Patients Under Treatment

AI also plays a significant role in taking care of those patients who are under treatment. In the study, the authors used the computer-aided detection of brain metastasis by radiologists' diagnostic performance. They employed the technique in the assessment of 3D brain magnetic resonance imaging. The authors concluded that this aid is shown in the improvement of their diagnostic performance [20].

Hyunkwang Lee *et al.* [21] used AI to evaluate the ability of patients to face major surgery or complex therapies by studying age and muscle quantification relatedness. Hyunkwang Lee *et al.* [22] also assessed the bone age of patients by using AI. Other investigations also indicated that AI has entanglement in intraoperative pathological diagnosis [23], evaluation of patients suffering from echo cardio graphics [24], and breath samples for determining the status of the patient's health [25].

In Assisting to Improve the Success Ratio of Treatment

AI can play a significant role in reducing the mortality rate. AI learns from the past reports of the patients and can prioritize those who need immediate attention.

CHAPTER 4

Threat Detection and Reporting System

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Abstract: We live in a world brimming with technology and crime. Even being in large numbers, law enforcers lack the required presence and resources. Although there are a lot of surveillance devices being installed in a general view of the public, most of them require an operator to monitor them. Even if they are smart devices, they lack the ability to cover all aspects of a situation. The proposed solution emphasizes computer vision to develop software that leverages the widely available network of surveilling cameras to detect criminal threats using object detection, violent activities such as CNN, detection of a person in need of medical aid, and sending the same to ground zero. Thus, effectively covering all 3 major aspects of a threat, namely, the crucial time before a crime is conducted, detecting an ongoing act of violence, and finally sending help as soon as possible to the victims in the aftermath. This would serve as an additional eye for law enforcement and will certainly aid in reducing the response time from authorities and mitigate most of the rising threats.

Keywords: CNN, Computer Vision, Violence detection, Weapon detection, YOLO object detection.

INTRODUCTION

Modern technologies are thoroughly assimilated into our daily routine life in the past decade. One of the prominent reasons for this rapid advancement is the consistent breakthrough of innovations in computer science. It is quite clear from the fact that police and law enforcement agencies have been regularly increasing the count of surveillance cameras. This ensures a wider coverage and monitoring of the general population. With a large number of cameras, there comes the great responsibility to monitor them. A conventional approach would be to increase the workforce, but we can assume that this field belongs to computer vision with recent breakthroughs. Recent pioneers in computer vision further promote the feasibility of deploying it and the established network of cameras. Common

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threats to the general public are weapon exposure in public places, violent incidents & unreported medical emergencies. This chapter will cover these "threats" in detail. Hence, similar motivations can be derived for detecting other outlier activities like kidnapping, robbery, *etc.*

Motivated by these factors, along with a zeal to build something for society, we came up with a solution that considers the future, past, and present of any calamity. Foremost, detecting a threat is pivotal in averting it, and the first case of our solution is to detect any publicly exposed weapon in which a person might commit a crime. Thus, averting a threat before it converts into a felony. The second case is based on detecting an act of violence in progress and raising an alert. It is not dependent on whether a weapon is being used, as this is targeting violence in the video feed. This case deals with any threat in transit as the event is currently taking place. The last case is specially fabricated to detect any victim who needs medical attention as a part of the aftermath of the mishap. In a lot of cases, it is observed that the victims succumb to their injuries after surviving the tragedy due to the delay in medical treatment provided to them [1 - 3]. In the worst cases, no treatment is provided to them as the onlooker often tends to ignore or hesitate before calling for help for the victim. This way, we propose a system that could target any threat, whether it is life-threatening, on multiple levels, *i.e.*, before its initiation, during it, and providing immediate caution to medical services in the event of an unmitigated threat.

RELATED WORK

There is an established precedent regarding deploying computer vision to identify the basic anatomy of the human body, *i.e.*, movement of the head, arms & legs concerning the torso. Further research in the domain enables pose detection even in a situation where multiple people are involved. These detected poses were in turn, classified as threatening or peaceful depending on different parameters. Understanding the pivotal difference between a person aiming a gun at another and the victim currently in a submissive pose paves a straight path for the authorities to be alerted when threatening actions are taking place. There were 5 instances used in this project, 80% of the algorithm detections for 5 body parts were positive, and 20% that could not be detected had problems because the body parts were not distinguishable due to shadows and arms being very close to the body [4].

The observation occurred during a study at the AGH University of Science and Technology in Krakow, Poland, titled "Automated Detection of Firearms and Knives in CCTV Images". It used computer vision through sliding window mechanisms, background detection, and canny edge detection with already

existing surveillance c-+cameras, CCTV cameras provided interesting results. This project worked in the direction of detecting both knives and firearms. The way the Computer-Vision works is that from the frames it has fed, it looks for individuals and once found, it detects the arm of that person to check for the objects of that person. If they are holding any object, it attempts to determine if the objects they have in their hands are knives or firearms by looking into their database of positive and negative results. With a specificity of 94.93% and sensitivity of 81.18% for the knife detection algorithm, the project showed a specificity of 96.69% and 35.98% sensitivity for the firearm detection algorithm in videotapes and CCTV recordings containing lethal objects. The algorithms showed a specificity of 100% for video with harmless objects for firearm detection. This implies that the algorithm will consider all cases detected with 100% firearms whenever detecting any firearms. Not all cases here gave true positives for firearms [5]. From the statistics which were observed during the experiment, it was shown that guns are more detectable objects than knives. These are because of several facts, including the database, which comprised guns and knives or not being of a broader spectrum of situations. For a particular movement in the day time, indoor or outdoor pictures of the weather can be captured. However, the main issue was that they were using images from CCTV recordings and videotapes, which had really low resolution and blurriness because of the poor quality of inexpensive cameras. Due to all these issues in front of the project, they had finally sent an alert to a human who would operate the entire system, and this person would be the responsible one to decide about informing any activity to the cops. To overcome this scenario, one solution is to train algorithms using CCTV videos, and the other would be to take a super-resolution image and process it.

Another parameter that is of great significance is detecting vicious behavior. The usual norm to tackle this problem was to separate descriptors around the fascinating spatiotemporal focus and concentrate measurement highlights inside the movement districts. These advancements are superb and profiling yet have restricted capacity for distinguishing video-based viciousness exercises [6]. The impediments of past advances lead to the proposal of a novel answer for recognizing brutality groupings. Initially, the movement restricts portion according to the dispersion of optical stream fields. Besides the local movements, the proposal to extricate two sorts of low-level highlights to speak to the perception and elements were for fierce practices. The low-level highlights are the Local Histograms (LHOG) of Oriented Gradient descriptors extricated from RGB images. Furthermore, the Local Histogram of Optical Flow descriptor (LHOF) is separated from the optical stream pictures. Thirdly, the extricated highlights are coded utilizing [7] Bag of Words (Bow) model to wipe out repetitive data, and a particular length vector is got for each video cut. Finally, the video-level vectors

CHAPTER 5

Offbeat Load Balancing Machine Learning based Algorithm for Job Scheduling

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Abstract: In cloud computing environments, parallel processing is required for large-scale computing tasks. Two different tasks are taken, and these tasks are independent of each other. These tasks are independently applied to Virtual Machines (VM). We proposed Offbeat Load Balancing (LB) Machine Learning algorithm using a task scheduling algorithm in Cloud Computing (CC) environments to reduce execution time. In this paper, the proposed algorithm is based on the concept of Random Forest Classifier and Genetic Algorithm and K-Means clustering algorithm for optimized load. The proposed algorithm shows that the average execution time of 3.5104 seconds (20 jobs, 5 Machines) and 15.85 seconds (20 jobs, 10 machines) is based on a study of load balancing algorithms that needs less execution time than other algorithms.

Keywords: Improved Genetic Algorithm, K-Means Algorithm, Machine Learning, Optimization, Random Forest Classifier, Task Scheduling.

INTRODUCTION

Cloud storage services are scarce, so it is not possible for cloud vendors to meet all user demands within a short timeframe. Cloud services must be shared in an equal way such that no job is waiting in queue for the resource, and all resources need to be fully used. It is also a big problem for cloud providers to provide customers with QoS satisfaction.

Standard methods for the allocation of jobs are not sufficient since they lack the versatility of the environment and the scalability of the available resources. A significant benefit of cloud computing is that it offers hardware heterogeneity, predicting the workload to fulfill the objectives of the Cloud Customer Service Level Agreement. The basic aim of resource utilization in the cloud world is to

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maximize the income of the cloud supplier and reduce the costs of the cloud consumer.

Cloud computing helps a wide range of customers to use cloud resources free of geographical restrictions. Users send their roles or activities to the cloud system and order cloud services. Scheduling this vast mumber of tasks is a problem for the cloud world due to the need for the shortest possible time of execution along with equal Load Sharing between jobs [1]. The need for a secure and flexible scheme with relatively low overhead is also a core prerequisite for job execution. Another problem with scheduling is Data Locality and Task Relocation (TR) from one node to another at any time. Load balancing is also a crucial parameter for optimum resource sharing to be considered in cloud computing that results in higher QoS and cost benefits. The extremely competitive cloud computing world often poses problems and needs to be constantly tackled as servers become accessible and unavailable while consumer demand varies suddenly. LB is one of the most challenging problems we face right now [2]. LB can be defined as the uniform distribution of workloads at all nodes to avoid a condition where some nodes are overloaded whereas other nodes are overloaded or idle. LB system importantly disturbs the presentation of the system. It is supposed that agents have modern computer programs that work automatically for consumers once too much work is done [3]. Voguish most cases, multiple agents are frequently needed before there are more apps to meet the user's needs resourcefully. Resource management & task scheduling (TS) are the main issues that need to be addressed in CC. Therefore, cloud providers need to define services & implement scheduling policies that allow VMs to deploy & deploy VMs [4]. There are 2 categories of TS in CC; Static TS, dynamic TS, and static scheduling allows the advancement of data & pipelines needed for various performance phases [5]. Static scheduling imposes some runtime overhead. In the case of dynamic scheduling, job mechanisms/task information is not known in advance. Therefore, the performance phase of the task may not be identified & the distribution of tasks to flies while solicitation is consecutive. Several machine learning algorithms were used for job scheduling in a cloud computing environment. The classifying algorithms used with VM scheduler are capable of scheduling each task in a more efficient manner [6]. In IoT-based frameworks, machine learning algorithms play an important role in the scheduling process. It distributes the load in which different tasks are distributed and the load-balancing process will occur [7]. Classification algorithms help in separating the classes from each other within the machine learning domain. Random Classifier algorithm is a machine algorithm based on a classification technique, which is a set of decision trees [8].

The framework of the machine learning algorithms, plays an important role in the scheduling process. It distributes the load in which different tasks are distributed,

and the load balancing process will occur [7]. In the machine learning domain, classification algorithms were used to separate different classes which are completely separated from each other. A random Classifier algorithm is a machine algorithm based on the classification technique, which is a set of decision trees [8].

In this paper, the proposed algorithm offers a method for vigorously achieving process-based most favorable load balancing with low computational power. The major contributions to this article are as follows:

1. Incorporate the idea of process-based load balancing in the cloud computing world in contrast to the immediate load balancing techniques in the current literature. The advantages are multiple: to minimize excessive computational overhead and improve implementation reliability when providing service output to customers using a machine learning algorithm.
2. Incorporate the generating algorithm, random forest, and K-means clustering algorithm on the optimum deployment of activities to determine the probabilities of optimal physical hosts.
3. We proposed an Offbeat Load Balancing Machine Learning based Algorithm for Job Scheduling.

RELATED WORK

The static algorithms only use some static information that cannot accurately represent complex load shifts in the host cluster and have low adaptive capabilities. Today, most open-source IaaS platforms have used static algorithms for resource scheduling. Sreelakshmi, S. *et al.* [9] proposed a multi-objective particle cluster optimization for function determination, target time, time frame & communication cost. It has been shown that the proposed method helped to reduce the time & communication cost of the makespan to complete the task on time [10].

This chapter presents a method based on a Parallel Genetic Algorithm (GA) for preparation tasks done in a cloud computing environment. The main goal of the research in this paper is to use all available resources efficiently and reduce the expenditure of resources in cloud computing environments. This can be achieved by refining the LB rate and selecting the best resources to complete the tasks in a short span of time. When our proposed method is implemented, it is replicated through MATLAB software. Two methods are compared, the hybrid agent colony-honey technique and round-robin (RR) scheduling based on LB technique. Y. Samadi *et al.* [11] proposed an algorithm to realize a balanced load in VM by reducing specific applications' makeup. In this application, they increased the

CHAPTER 6

A Pattern Optimization for Novel Class in Multi-Class Miner for Stream Data Classification

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Abstract: Stream data classification involves a predicament of new class generation through pattern evaluation. The evaluation process of the pattern raised new ways of data classification. The evolving decoration discrepancies dispensed the session for rivulet data arrangement. Now, the twisted pattern fashions innovative classes for cataloging progression. For this method of regulation, multi-class sapper method is used. A catastrophic spread of new decorating appraisal methods for multiclass mine workers is used nowadays. We cast off the pattern optimization performance using a transmissible algorithm aiming at the group of patterns and their heightened process for instructing multiclass. The enhanced pattern stables the new class while enhancing the successful multiclass miners. For the empirical appraisal, we used health care data such as cancer and some other deride for the evolutionary progression of the pattern optimization process.

Keywords: Feature evaluation, Genetic algorithm, Pattern, Stream data classification.

INTRODUCTION

Stream data classification is a basic personality in stream data organization. The component examination technique of stream information instigates a problem for the course of action, for example, boundless length [1]. Hence, it is not potential to store the information and use it for preparation. The boundless term, idea development, and idea float are the principal challenges in information streaming [2]. The endless durational issue isolates the stream into equivalent estimated pieces so that each lump is put away in memory and handled on the web. Each

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lump is used for preparing association models when each example in the piece is renamed. Idea float occurs when the view of time changes bigger than normal time. Idea development happens when new classes are embroiled in the information. The ensemble arrangement framework is utilized to recognize the episode of the idea, float, and immense estimation, where every classifier is set up with a novel class indicator. In this method, an agreeable set of mockups is utilized to organize the unlabeled information, notwithstanding identifying novel classes [3]. Each model in the get-together is assessed and it was then estimated that old, obsolete models are not vital. The information stream is isolated by getting shared by indistinguishable sizes called pieces, and the assortment characterizes the information point encompassed by the lumps. Each outer stream is checked with an anomaly module. If there is a production of an exception, it is additionally put away from the boundary. However, on the chance that an exception is not made in vagueness, it is named a predominant period utilizing an assortment strategy. Ensemble procedures need to streamline tasks to some degree to change the current impression of their single model partners and handle the idea. An information stream multiclass digger is utilized further to identify the novel class front line. Multiclass excavator is a gathering of OLINDDA and FAE approaches. This gathering works with a dynamic example course sees novel classes. OLINDDA is utilized to detect the novel class using FAE arrangement of the information lumps. MCM identifies exception plans and is furthermore utilized in perceiving novel class occurrences. MCM is the quickest technique in all datasets [4]. MCM is generally 25% quicker than the Mine Class. For the updating of the assortment cycle of the new property process, the step design framework was utilized by intrinsic calculations. Put away example practice is an improvement of a characteristic example that blended during the examination of another class. To store design creation, a specific point genetic capacity is used. The genetic capacity pedals are put away as an example for the evaluation of highlights [3], where the paper respites are structured as surveys. In Sector-II, the confer-related work is for stream classification discussing Sector III for proposing a technique. Sector IV offers a comparative result of the methods followed by a conclusion in Sector V.

RELATED WORK FOR STREAM CLASSIFICATION

In this area, the discourse strategy is pointed to partner downpour information for limiting and eliminating reprobates like limitless length information, float impression assessment, and example assessment. Each one of these techniques gathers such issues. Yan-Nei Law and Carlo Zaniolo [5] assign a strategy for stream information order by adjusting the lining groupings. This happens as the procedure achieves uncommon execution by devouring more modest arranged ventures, where examination mistake areas are sure to terminate with each

consistent size. Mohammad M. *et al.* [4] articulates an act of stream information association by novel meeting acknowledgment. In Concept-Drifting Data Streams Under Time Limitations as novel class acknowledgment delinquent revamps moving in the sign of idea float after the vital information spread improvement in streams. Qing Chen *et al.* [3], in this strategy, articulate an interaction of stream information arrangement by Concept-Evolution worry of unique classes advancing in the stream. This inside Concept-Drifting Data Stream as Concept-advancement happens as a meaning of new classes undeveloped in the stream. This interaction discusses the idea of advancement in computation up to the close to the face of limitless length, moreover idea float. Valerio *et al.* [6] creator expected a technique for stream information characterization by Kernel-Based keen Cooperative Learning as kernel practice allowed the portrayal of setting up information during information calculations, though they are computationally troublesome. In this cycle, Li Su Xi *et al.* [7] depicts an act of stream information order through associative arrangement (AC). These affiliated groupings depend on relationship rules uncovering colossal embraces over various other characterization procedures on still datasets. Earth Woolam *et al.* [8], in this procedure, portrays a strategy for stream information arrangement by creating stream information with restricted names. The reason is convenient as it assumes a little division of occasions in the stream to be marked. Mohammad M. Masud, Qing Chen, Jing Gao, Latifur Khan, Jiawei Han, and Bhavanim Thuraisingham [3] are a portion of the creators who depicted the technique for stream information arrangement by DXMiner. It addresses the four most basic conflicts with order information streams unequivocally with the boundless span, idea float, idea advancement, and example development. Information streams are implicit and long, used for single-pass steady with versatile hierarchical strategies. Idea float happens in an information stream, albeit the essential hypothesis changes over time. Most introduced information stream order procedures address singular endless length and idea float issues. [Charu C. Aggarwal, Jiawei Han, Jianyong Wang, Philip S. Yu] [9]. This model reproduces the genuine requirements ingeniously since it gets stricken to categorize examination streams in exact time in the pointless of an expanding direction and exploration stream.

Xiangjun Li *et al.* [10] expected a requesting and novel class appreciation calculation dependent on the cohesiveness and takeoff record of Mahalanobis separation. The preliminary results show that the calculations capably mitigated the effect of idea float on characterization and novel class uncovering.

K. Vasantha *et al.* [11] extended a novel approach of the Concept Drift Detector and Resampling Ensemble (CDRE), assessing calculation for dazzling culpable of discernment float in multi-class. Mis-arrangement falls irregularly because of harshness, proportion, and information conveyance. It carried out definite

CHAPTER 7

Artificial Intelligence in Healthcare: on the Verge of Major Shift with Opportunities and Challenges

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Abstract: In the last few decades, artificial intelligence (AI) has shown rapid growth in medicine with the evolution of computer vision, robotics, natural language processing, and deep neural networks. The technology has also been applied to healthcare with an inexact thought that AI will replace the workforce. AI works as a helping hand for human clinicians because a machine can never replace a human brain. Present healthcare systems can implement AI technology for diagnosing patients and their treatments, drug invention, prediction of disease outbreaks, real-time monitoring of critical patients, radiology, and many more. The latest achievements by Google for the diagnosis of cancer, and diabetic retinopathy by JAMA using deep learning algorithms and surgical robots show substantial shifts in medicine. A simple assessment of electronic health records (EHR) provides more opportunities for the medical experts during the invention and application of improving medicines. The coming future of health care depends on the advancement of AI. However, with ease comes difficulty, such as the privacy of data and causality problems which should be considered when deploying such strategies.

Keywords: Artificial Intelligence (AI), Deep Learning (DL), Medicine epidemiology, Natural Language Processing (NLP), Neural Network, Support Vector Machine (SVM).

INTRODUCTION

Artificial Intelligence (AI) has a tremendous capacity to perform in science and technology. It has already over-ruled almost every sector of society, whether it is social, economic, or industrial. It helps to communicate ideas to society with a large range of algorithms for making life easier. The science behind AI provides a large amount of data in the electronic form of the algorithm to achieve a certain conclusion. AI can make better use of the data to improve the quality of care people need. The beginning of the 21st century has marked its rapid growth in the field of healthcare and medicine [1]. It has created a large confusion among

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people that it may replace physicians in the future, but this is not true because a machine will never overcome a doctor's brain, and in the end, a patient can always need a human touch. Instead, it will make the work easier, like diagnosis, treatment, or keeping a real-time record of critical patients. Medical health records are a massive collection of data in healthcare organizations. Searching for important hidden information within these data is a tedious job that can be done in seconds by using AI technology. Eventually, AI will make our work fast with accuracy, further helping in decision-making [2].

AI algorithm has the potential to improve pathology to enhance the service required by the patient. There are algorithms that can detect cancer and improve the performance with accuracy. Such algorithms work faster than human pathologists and make their tedious, time-consuming tasks easier, saving an enormous amount of time that can be utilized later by doctors to focus on more high-level intellectual tasks. AI technology can learn from a large amount of healthcare data and further implement it for future use. Its self-learning capability from feedback makes it more accurate with time. It can assist physicians in providing ideal care for patients and further reducing therapeutic and diagnosis errors. AI has proved its patronizing execution in many fields like translation and recognition of speech, classification of images and objects, detection, decision-making in sport and law [3]. Due to the results shown by AI technology, radiologists have been advised to use it while performing diagnoses over medical images.

Fig. (**1**) shows different areas which have been empowered by AI technology. There are various algorithms like Natural Language Processing (NLP), the concept of Neural networks, machine learning (ML) techniques, *etc.*, using the models for building and working accordingly. The vast section of medical data management has become easier and available in a real-time environment with security. Treatment plans can be easily designed to reduce the waiting time of patients. Drug creation has also been highly affected to make it available earlier than ever before. Medication can be easily managed as it depends less upon human interaction and more upon smarter machines. The benefits of AI cannot be ignored as it affects the pharmaceutical industry, clinicians, as well as patients. In the next few decades, it will improve the sector greatly for the betterment of society.

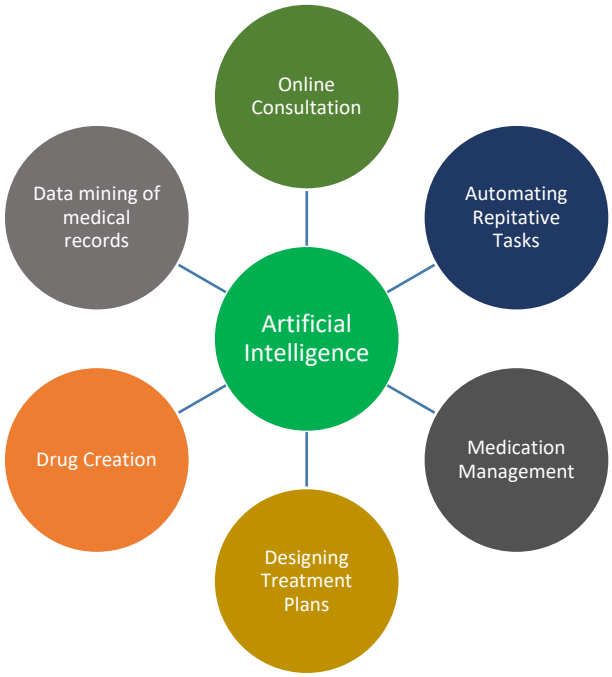

Fig. (1). Impact of Artificial Intelligence in Healthcare.

Why AI in Healthcare

In recent years, there has been an integration of technology in all realms of life, and healthcare has been no exception. Technology has infiltrated virtually all aspects of healthcare, starting from patient data records to diagnosing, biomedical investigation, research, pharmacotherapy, and even assisted living at home for the elderly and differently-abled. According to Frost &Sullivan, AI systems are projected to be a $ 6 billion industry by 2021, and McKinsey predicted healthcare to be one of the top five industries using AI. With such forecasting, AI is definitely a game-changer, poised to be the transformational force of the future.

AI, a concept of the 1950s, aims to teach machines to think like humans, here machines think like human minds in learning and analysis but much faster and with greater accuracy and thus work in problem-solving. This kind of intelligence is also referred to as machine learning [4]. AI has a software as well as hardware components. The software part deals with algorithms having a conceptual framework for executing AI algorithms in a sequence functioning like the neurons of the brain, hence called the neural network. These NNs have been devised to do

CHAPTER 8

A Review on Automatic Plant Species Recognition System by Leaf Image Using Machine Learning in Indian Ecological System

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Abstract: India is the land of agriculture with many varieties of plant species. These species have different uses in the medical, food, and harvesting industries. Despite having such a large collection of plants and agricultural assets, most of the Indian population is not aware of the goodness and properties of these precious plants except the usual ones. In this chapter, discussion and possibilities in this area are given and explored for the awareness of Indian people regarding the Indian plants. In this area, artificial intelligence and machine learning will likely develop an automated detecting machine that can classify and describe the plants by their images of leaves, bark, flowers, and stems. Looking forward in this direction, this chapter discusses an AI and ML based technique to recognize vegetation by the image of its leaves. In this approach, SIFT and ORB-based technique removes leaf image features and then tests the data set to match with a trained data set. The system is trained with 32 plant leaves. Henceforth, this system can recognize these plants by the image of their leaves. The uniqueness of this system is its data set. In the data set, the image of the leaf is prepared so that both sides of a leaf can be used to recognize the plant. This increase distinguishes the image irrespective of its color and shape. The system is still in an evolving phase that has the target of including all rare and useful plant information in this dataset. This system is very useful to preserve the information of all users, rare plants and those plants that are about to be extinct.

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Keywords: Agriculture, Image Feature extraction, KNN Classifier, KNN/BF Matcher, Machine learning, ORB, Plants, SIFT.

INTRODUCTION

We all are surrounded by plants. Plants are the lifeline of this planet. Let's consider the Indian scenario about the plant varieties and the availability of those varieties. It is large because India has a diverse climate, so almost every type of plant is found here in India. It is quite challenging to identify trees, but their availability in protecting agricultural sectors, industries, medicine, environment, and pale ecology is reliable. These assistances are trifling these days due to global warming, which is caused due to environmental damages and rapid urban expansion. Humans forget to assess vegetation destroying flora and fauna in bulk. This results in the quick extinction of enormous plant species every upcoming year. Protecting vegetation and its species isn't a movement but a necessity. The acknowledgment of the plant can be the first step towards protecting them and crosschecking their nativity. However, many species still prove to be a mystery to humankind. The development of a traditional system is efficient in recognizing and storing information of all the species. Researchers are working towards classifying plant parts such as its skin, leaves, flowers, fruits, seeds, and many more. Besides being the most important organ of a plant, the leaf is considered the most convenient reason for advancing several methods to recognize any plant species [1]. It is impractical to pick up positive results once the shapes of leaves are in substantial variability [2]. Despite these difficulties, plant recognition by leaves is a very popular and convenient method, so researchers and academicians are trying to find new ways to recognize plants by leaf images.

In this area, image processing, artificial intelligence, machine learning, and deep learning are applied to develop an accurate and automatic solution/system. To develop these systems, many features of the leaves are considered to identify the plants. These features include color, texture, and shape. Recognizing the tree in advance of its full development is beneficial to farmers in so many aspects, like whether this tree or plant is beneficial for agriculture and the economy. This also alerts the farmer to create a favourable conditions for trees and plants for better growth of plants. The advancement in machine learning (ML), along with model lapsing and classification, recognition of objects, and computer vision, steadily protects crops during intense potential cases while helping to decide agricultural management. These assistances include fungicide spraying systems, specific periodic issues which vary according to the environment, good harvesting period, production and estimation of fruits, and flowers according to each area unit, *etc.* [3]. Automation in agriculture technology and the area is in full swing and many things are being developed, but not properly in recognition of the plant species.

The leaf of a plant isn't the only medium to identify the species of a plant. Even a plant's skin, flowers, seeds, branches, and fruit can contribute equally to the identification process. However, the vigorous attributes of a leaf are still a topic of discussion in scientific studies such as computers, algorithms, botany, image processing, and machine learning. The identification of plant species is more than just a study. Thus, it can rapidly help and influence several botanists and environmentalists across the world to protect species diversity [4]. Plant taxonomical theories suggest that the leaves and flowers of plants are capable enough to distinguish a plant's nativity. The 2-dimensional structure of a leaf and the 3-dimensional structure in flowers widely help automated identification of plants to provide accurate results. However, the problem with the flower is its presence only in certain plants and its availability in specific seasons. Whereas, if compared to leaves, their existence can persist during the entire life span of a plant or a tree. Besides this, their shape, consistency, scale, rotation, movement, reflection, and limited dependability dynamically prepare to contribute to the inter-class discrimination and intra-class discrepancies of a leaf [5]. Plants leaf images are easily available entities to recognize the plants, as well as these methods, may be handy for all. In this scenario, image procession and computer vision essentially process and classify the leaf images. Image processing in the field of computer science in which images are processed digitally as a stored medium. Computer vision is the field of study of the perception of visuals by computers, making them human vision alike. Using AI and machine learning techniques, this task is impossible to complete. The k-nearest-neighbor approach can be perhaps the easiest of every technique to predict the test class example. A clear drawback of the k-NN method has the time complexity of creating the predictions.

Moreover, neural networks may be tolerant to noise inputs. However, in neural networks, it is very tricky to appreciate the structure of methods. SVM found a competitive as well as the best accessible machine learning techniques in the classification of high-dimensional information sets. The computational of SVM complexity can reduce the quadratic optimization difficulty, and it is very easy to manage the difficulty of the decision rule with the error of frequency. The disadvantage of SVM is that it is hard to decide the optimal parameter when the training information cannot be linearly separable.

Furthermore, SVM is very complex to comprehend and execute [6]. These days, plant taxonomy follows classical measures to considerably help create a conventional automated system for recognizing plants. The major aid is to increase production frequency and streak to operate industries where the products of plants are commonly used.

CHAPTER 9

Recognizing Rice Leaves Disorders by Applying Deep Learning

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Abstract: Rice is one of the staple crops in the world, as it is a rich source of protein, minerals, fibre, and vitamins. It is cultivated almost in every part of the world, but its productivity decreases due to several diseases. If these diseases are identified at the initial stages, then preventive measures can be taken, but their symptoms are quite similar for human eyes to recognize them correctly. Therefore, there is an immense need to apply automated techniques for recognizing rice diseases. Various Artificial Intelligence (AI) based prototypes have been surveyed in this chapter. These techniques were proposed by researchers for diagnosing rice disease. Here, our main goal is to present ideas on how Pretrained Neural Networks can be used in the recognition of rice diseases. Therefore, a brief description of AI techniques and their comparison is also outlined.

Keywords: Convolution Neural Networks, Deep Learning, Disease classification, Image Classification, Machine Learning, Pretrained models, Rice diseases, Transfer Learning.

INTRODUCTION

The introduction section includes the background and aims of the research in a comprehensive manner. Rice is cultivated in every part of the world and plays a vital role as it is a rich source of protein, minerals, fibres, and vitamins. The biological name of Rice is (Oryza sativa), commonly known as Paddy [1]. Consumption of Rice is highest in Asian Countries, among which China, India, Bangladesh, Indonesia, Thailand, and Vietnam are its leading producers [2]. High yield and high-quality rice are essential, but quality and yield both degrade due to the attack of several diseases, pests, and weeds. Plant disease can occur in several

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parts (leaves, fruit, stem, root, *etc.*) of plants, but while surveying the literature, it is found that in most of the literature present, the researchers [3-11] have used leaves because the majority of diseases occur in plant's leaves in comparison to other parts of a plant.

In earlier times, farmers used their own experience, referred to guidebooks, or contacted experts for recognizing disorders in their crops, but now a days, with the enhancement of technology, it has become possible to detect and classify diseases without the help of books or experts. Although several Artificial Intelligence (AI) techniques are found in the literature to identify and classify types of disease in plants, the current scenario is mostly shifted towards Deep Learning to simplify the process. In the current era, several deep learning models have been proposed by researchers all over the world; among them, CNN (Convolution Neural Network) is widely being used for the process. CNN has been used in image recognition, video classification, human action recognition, traffic sign recognition [12], feature extraction [13], face recognition, character recognition, generic object recognition, pose estimation [8], *etc.* The working of CNN is inspired by the biological vision and the nervous system, where unsupervised deep learning is employed for classifying and recognizing the object with very high accuracy [3]. CNN models can either be trained from scratch or can be pre-trained by using their existing architectures. Training the network from scratch may require a large number of images (thousands to millions), which will be a time taking process, but the existing architecture of CNN requires only a few images (hundreds to thousands), and they can be modified with the help of transfer learning for solving similar problems [14]. Bera *et al.* [1] discussed several diseases of rice crops and presented several approaches for identifying these diseases using data mining and image processing techniques. The authors presented an extensive literature survey on decision support systems in the agricultural domain and concluded that several disease identification systems are already present, but there is a need for improving the accuracy of such systems. Lu *et al.* [12] proposed a novel technique for identifying 10 common rice plant diseases using CNN andtenfold cross validation techniques, different resolution, images, orientation, *etc.* The authors concluded that the proposed system gives accurate results and requires very little computation effort; future work will enhance models for estimating severity and classifying more diseases from banana leaves. Phadikar S. *et al.* [4] aim to recognize multiple rice diseases by using diseased regions of rice plants to extract features. The author proposed a Fermi-based method for segmenting diseased pixels from the background pixels. Consequently, using the extracted features, a rule-based classifier was developed to classify several rice diseases.

Rezende *et al.* [15] used image processing to enhance multiple diseases of multiple plant species, which belong to the XDB plant dataset (VGG16 and VGG 19); the architectures of the CNN model were used for classifying diseases, and the results were compared with other existing models. Finally, the authors concluded that VGG16 architecture performance was better than VGG19. Suresha *et al.* [5] used a KNN classifier along with global thresholding for identifying Rice Blast and Rice Brown spot diseases. The overall accuracy of the proposed model was 76.59%, and in the future, the author aims to identify bacterial and viral diseases in rice crops. Baranwal *et al.* [6] used CNN to automatically detect apple leaf disease. First, the Plant Village dataset was used, later, techniques of image compression, image filtering, and image generation were applied, and finally, GoogleLeNet architecture was used for training the proposed model. Alfarisy *et al.* [16] used the CaffeNet model for detecting diseases and pests of paddy crops. Firstly, 4,511 images were collected, and the dataset was formed; these images were later augmented and fed into the CaffeNet model for processing. Overall accuracy achieved for this model was 87%. Singh *et al.* [8] explored several loss functions and optimizers for optimal schemes for detecting several diseases in the plant's leaves. CNN was used in the proposed model, later compared with Random Forest with high-performing CNN. For improving accuracy, a combination of loss functions and optimizers was provided. Singh *et al.* [9] aim to develop effective methods for determining diseases of mango leaves. This paper used Multilayer Convolutional Neural Network (MCNN) for classifying Anthracnose disease in Mango tree leaves. MCNN was trained and could achieve 97.13% accuracy, much higher than the existing models. Venkataramanan *et al.* [10] used deep learning approaches for identifying and classifying various plant diseases using leaves. Using the YOLOv3, detector, features of the input image are extracted, and then ResNet18 models are trained using transfer learning for identifying the disease type. Mohan *et al.* [11] proposed a system that could detect and classify several diseases of paddy plants. For disease detection, AdaBoost classifier, and Haar-like features, the extractor was used, and an accuracy of 83.33% was achieved. For recognizing disease, SIFT (Scale Invariant Feature Transform), Support Vector Machine (SVM), and K-Nearest Neighbor (KNN) were used, whereby using KNN, 93.33% accuracy was achieved, and by using SVM, an accuracy of 91.10% was obtained. Singh *et al.* [17] presented a survey for plant disease detection, and the general structure of plant disease identification systems was discussed. The next section summarizes some of the diseases occurring in paddy. The remaining chapter is subdivided as Section 2 outlines some of the diseases occurring in rice plants, Deep Learning, its comparison with Machine Learning, and its models are summarized in Section 3. In Section 4, several pre-trained networks are discussed and finally, several layouts about how these PNNs can be used in classifying rice diseases.

CHAPTER 10

Shallow Cloud Classification using Deep Learning and Image Segmentation

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Abstract: Shallow clouds play a significant role in the earth's radiation balance, but they're still poorly represented in climatic models. Our project analyzes the cloud images taken from satellites and attempts to build a deep learning model to classify cloud patterns. This will help us to identify the cloud formations and help improve the earth's climate understanding. We will use various deep learning and image segmentation techniques like UNet to produce a model which can classify the shallow layers of clouds into various labels (fish, flower, gravel, and sugar). Various data augmentation techniques are implemented to improve the proposed model. Additionally, transfer learning is implemented by using ResNet backbones to improve the performance of the segmentation model. This will help gain insights into the matter of shallow cloud effects on the earth's climate, there by helping in the development of next-gen climate models without having to go through the tedious task of classifying the clouds present in the images first.

Keywords: Deep Learning, Image Segmentation, RAdam, Shallow Clouds, UNet.

INTRODUCTION

What are Shallow Clouds?

Weak convective currents create shallow cloud layers due to the dry, stable air, preventing continued vertical development. Shallow clouds over land are usually only several kilometers wide and rarely produce rain. They are generally many and quite effective at resisting the sun and maintaining the evaporation of water from the land. They can occur quite locally; they can also be widespread, covering the mesoscale.

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Why is it Important to Study Shallow Clouds?

Shallow clouds have a significant role in the world's temperature balance, yet they are most represented in climate predicting models. It is important that Earth system models accurately take the effect of these shallow clouds considerably on the trading of water particles and vitality between the surface and the atmosphere.

Cloud mistakes can have wide arriving impacts on the exactness and nature of results on climate figures. This study explains the need to precisely consider the impact of shallow mists in barometrical models that can be used to imitate climate and atmosphere. It will go about as a manual for enhancements for the portrayal of shallow convection in Earth framework models.

Motivation for an Automated System for Cloud Classification

It is simple for a researcher to take a look at a picture and recognize the highlights of intrigue. The premise of recognizing designs is distinguishing comparatively organized highlights over various pictures. AI strategies can imitate this human capacity to recognize designs; however, they require adequate training data information. The application and appraisal of such strategies turn into a dull undertaking.

Shallow clouds have a significant role in the world's temperature balance, yet they are most certainly represented in climate predicting models. Most of the studies conducted were on 'whether clouds are present or not', and the classification of clouds based on their type (Cirrus Cumulus, Stratus Nimbus). Limited research work has been done in Mesoscale cloud identification [1]. Gauging shadiness precisely stays one of the significant difficulties in numerous pieces of the world.

This undertaking will assist researchers with a better insight into how mists will shape our future atmosphere without experiencing the dreary work of distinguishing designs. Specifically, the center is extremely shallow during cumulus convection in the exchange wind region. This task will control the advancement of cutting-edge models, which could decrease the vulnerabilities in atmosphere projection.

Benefits

It can reduce the workload of those people who will try to identify cloud patterns in satellite images. They can directly study its effect on weather. It will guide researchers in developing a more accurate weather prediction model. It will help the aviation sector, which has strict cloud-related safety guidelines.

RELATED WORK

There has been very little research regarding the development of a robust model for detection as well as segmentation of shallow layer clouds. Patterns of shallow clouds at the mesoscale (20 to 2,000 km) level in the downstream observed from space were subjectively defined and learned by trained scientists. Four patterns in the mesoscale organization were recognized, which could be labelled in a reproducible manner. These cloud patterns were introduced by 811902:19367082 [2], which was based on mesoscale cloud patterns present in the trade winds, and they were labelled as Sugar, Gravel, Fish, and Flowers.

In 2019, researchers from Max-Planck Institute of Meteorology conducted research on a crowd-sourcing activity to detect and label cloud structures from satellite images [1]. Through crowd-sourcing, they hoped to label many more images than was possible in the previous study. They hypothesized that this research would help in exploring how deep learning methods could be applied to extend the analysis and learn more about the patterns.

Researchers [3] briefly discuss previous efforts for applying deep learning models. They presented two models as proof of concept and comparison. They mention the use of a Retina net with Resnet50 backbone for object detection. Images were downscaled from 1400 by 2100 pixels to 700 by 1050 pixels to fit batches of 4. UNet model with Resnet50 backbone was used for segmentation. Images were downscaled to 466pixels by 700 pixels with a batch size of 6. The models were primarily used to compare with human labelling performance using the mean accuracy of correctly labeled pixels.

Our problem is to segment the images into various cloud patterns. Image segmentation, a part of computer vision, can be done using Fully Convolutional Networks. This idea was well presented in 2014 by Jonathan Long [4] in his research. Biomedical imaging introduced a powerful model for image segmentation, *i.e.*, U-NET, in 2015 by Olaf Ronneberger. This model is now used in various other fields. Fabian Isensee [5], in 2020, conducted research on biomedical image segmentation, introducing us to 3D biomedical segmentation models using UNet. Here, segmentation of organs is performed. It also introduces the idea of using a combined loss function (bce and dice loss) for training the model. The idea for using RAdam as the optimizer is taken from the research conducted by Liyuan Liu [6] in 2019. It introduces the idea of a warmup to reduce the variance that might be caused in the initial stages of training. The name Rectified Adam corresponds to the rectified version of the standard Adam optimizer.

CHAPTER 11

Artificial Intelligence Based Lung Disease Classification By Using Evolutionary Deep Learning Paradigm

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Abstract: Pattern classification is also called pattern reorganization. The classification of pattern is one of the critical problems in Artificial Intelligence. COVID-19 is the most viral lung disease that has put the whole world in such a difficult situation that it has become necessary to develop a machine-learning algorithm to classify lung disease. This research paper is ready to propose Artificial Intelligence Intelligence-based Lung Disease Classification by using an Evolutionary Deep Learning Paradigm to solve the said problem. It delineates an integrated bioinformatics approach in which different aspects of information from a continuum of structured and unstructured data sources are put together to form user-friendly platforms for physicians and researchers. The main objective of the proposed system is to find the probability, diagnosis, and treatment of the COVID-19 disease. Artificial Neural Network-based tool for challenges is associated with COVID-19. There is some specification of our platform as it includes various forms of input data containing medical as well as clinical data. This helps in improving the performance of the system. Experimental results are calculated and statistically analyzed. For benchmarking, the performance of the proposed approach is compared and statistically analyzed.

Keywords: Artificial Intelligence, COVID-19, Deep Learning, Lung diseases, Pattern classification problem.

INTRODUCTION

In December 2019, coronavirus originated from Wuhan and soon spread globally, causing above 150,000 deaths and 2 million confirmed cases until April 18 throughout the globe. It is a Contagious Respiratory and vascular disease that occurs when one gets infected with this virus. It causes difficulty in breathing as it

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gives rise to viral pneumonia in a patient. The incubation period varies from person to person but mainly lies in between one to fourteen days. Right now, there is no therapeutic treatment or vaccine available for it.

Due to its faster and easy transmissibility and seriousness, "COVID-19" is declared as a pandemic by WHO. The constant increase in cases alarmed an impact on the health care department. The serious patients were required to be treated with the help of mechanical ventilators to stabilize their condition.

As a result, it has become vital to diagnose COVID-19 as early as possible, to reduce the pressure on the healthcare system. Immediate isolation was required for the suspected patients to decrease the chance of them coming in contact with the healthy population.

Usually, pneumonia is diagonalizable by using a person's chest x-ray image. X-rays play an important role in diagnosing pneumonia as they are cheaper and faster, and patients get minimal exposure to radiation than CT scans. This facility is easily available in all healthcare systems, making them a primary source for evaluating a patient for pneumonia caused by COVID-19.

Mainly data like X-rays are interpreted by a medical expert. However, it is restricted due to the extensive variation that exists across different interpreters, the complexity of the image, and its subjectivity.

COVID-19 diagnosis can be made with the help of the patient's chest x-ray images. Radiological expertise is the one who interprets this data to make the results completely dependent on them. The large number of patients in this enormous situation turned the work quite hard and increased the frequency of errors. A substituted system or application for diagnosing disease or examining x-ray images is believed to reduce the load on health workers as well as on the system.

Due to the major development in deep learning and its successful implementation in different real-world applications, it has become a key method for ongoing problems in the healthcare section. Its natural potentiality expects to provide a promising accurate result for the problem.

RELATED WORK

Here, an architecture based on CNN has been presented in [1] to identify different lung diseases. A dataset of 110,000 X-ray images is trained in [2] by using CNN model for the identification of more than 13 diseases.

Rajaraman S. K. *et al.* [3] used the genetic deep learning convolution neural network (GDCNN) technique in their research. They trained the data from scratch and after extracting the required features, it is classified into Covid-19 images and normal images. 5000CXR images of the dataset were used. It is proved that this technique gives us better results with an accuracy of 98.84%, sensitivity of 100%, and specificity of 97.8% with the precision of 93% in the detection of covid-19 infections in comparison to other transfer learning techniques.

Ramchandani A. *et al.* [4] tried to detect using the transfer learning method, in which they used a residual network using two architectures ResNet-34 and ResNet-50. They also used Opencv and Python programming language with pytorch framework for preprocessing and augmentation of data. Results were as follows where ResNet-34 gives an accuracy of 66.67% and the error rate of 33.33%, while ResNet-50 gives an accuracy of 72.38% and an error rate of 27.62%.

Anthimopoulo M. *et al.* [5] used an iterative pruned deep learning model with the combination of chest X-ray images for the prediction of COVID-19. They tried to improve the performance using the RSNA CXR dataset using pretrained CNNs and customized it according to requirements. They also used modality-specific knowledge transfer techniques. As a result, the best performing model gave an accuracy of 99.01%.

Ramchandani A. *et al.* [4] used a dataset of 6249 chest X-ray images from the GitHub repository and used pre-trained models such as ResNet-50, MobileNet, Xception, Inception V3, etc. These architectures were further compared based on their performance, in which MobileNet was the best with a maximum score of F1 and specificity of 995.

In AlexNet, a pre-trained CNN is used to arrange the images by making small adjustments to achieve the desired output with their lung CT data. CNN is also used for the prediction of pneumonia [2, 6].

A new algorithm named as PathNet algorithm is proposed by Anthimopoulo M. *et al.* [5]. COVID-19-Net is used for detecting pneumonia caused by corona virus using CXR images in [1]. Similarly, Coronet-named CNN model is used for spotting COVID-19 in [7]. A deeper model was stated by categorizing images [6].

A small dataset consisting of just 50 images was compared using seven different pre-existing deep learning neural network architectures [2, 8]. Arranging chest x-rays in different categories is resolved by the researchers [4, 6, 9] by proposing a new CNN architecture.

CHAPTER 12

Hybrid Deep Learning Model for Sleep Disorders Detection

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Abstract: The polysomnography test (sleep study) is used to diagnose several sleeping disorders. Sleep study is used to detect sleep disorders such as Insomnia, REM Sleep Behavior, Insomnia, Restless Leg Movement Syndrome, and Sleep Apnea. It measures different parameters such as heart rate, level of oxygen in your blood, body position, brain waves (EEG), breathing rate, eye movement, and electrical activities of muscles. In the world, 700 million people suffer from sleeping disorders. A wide range of sensors was attached to the body of the patient to measure the value of different parameters. However, in 2020, due to the exponential spread of COVID-19 coronavirus disease, the sleep study centers were closed, and it was very difficult to perform sleep studies on patients. Therefore, we developed a hybrid model based on deep learning techniques like Convolutional Neural Network (CNN) and Deep Belief Network (DBN) architectures. Numerous cameras were mounted in rooms at certain angles, which provide live surveillance data and record a patient's movements after a short periodic interval of time. This research paper concludes that non-contact-based hybrid models are highly accurate in detecting sleep disorders based on polysomnography tests.

Keywords: Brain Waves, Convolutional Neural Network (CNN), Covid-19, Deep Belief Network, Physiological electrical signals, Sleep disorders.

INTRODUCTION

Sleep disorders are one of the most common problems in modern civilization, and one-third of the people in the entire world will be suffering from at least one sleep disorder in 2028.

There are several sleeping disorders that depend on various physiological factors. Insomnia, Rapid Eye Movement Disorder (REM), Sleep Apnea, and Restless Leg Syndrome are common sleep disorders that lead to disturbance in sleep. Sleep.

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Apnea is a chronic disorder in which irregularity in the process of breathing is observed, and the pattern is very uncommon [1]. The three types of sleep apnea are Obstructive Sleep Apnea (OSA), Central Sleep Apnea (CSA), and Complex Sleep Apnea Syndrome (CSAS). Obstructive Sleep Apnea (OSA) occurs usually [2].

When the patient's throat muscles contract and expand irregularly, it reduces the flow of air during the inhaling and exhaling process [3]. Sleep Apnea also leads to other severe diseases such as cancer and type 2 diabetes. Similarly, Restless Leg Syndrome (RLS) is the involuntary movement of leg muscles when a person is lying down [4]. This disorder causes unnecessary movement in patients' legs, due to which it is very difficult for the patient to sleep. Insomnia is the most common sleep disorder, which decreases the tendency of the person to sleep [5]. Insomnia is related to many diseases such as severe depression, and anxiety, and is caused due to poor sleeping behavior.

Rapid Eye Movement (REM) disorder occurs when the patient is asleep and physically acts intensely and correspondingly moves limbs violently [6]. Thus, sleep orders play a vital role in the lack of sleep and increase the chances of chronic diseases.

The detection of sleep orders occurs through a polysomnography test (Sleep study), which generally occurs in Sleep Clinics. These clinics are very famous in Western countries and are gradually increasing in Asian countries [7]. The polysomnography test involves many parameters like heart rate (HR), oxygen saturation (SaO_2), breathing rate (BR), eye movement, movement of brain waves (EEG), electrical activities of muscles, and body position. After the assessment of the above-mentioned parameters, the experts diagnose whether a person is suffering from a sleeping disorder or not [8]. In the polysomnography test, sleep disorders can be detected when abrupt changes are certainly observed in the reading of this parameter. A large number of biosensors and actuators were used to record impulsive movements in sleep studies [9].

Deep learning techniques are capable of detecting sleep disorders because many of them contain several types of abnormal physiological movements [10]. In sleep apnea, the irregular movement of the thoracic muscles leads to disturbance of air flow in the breathing process. Moreover, the Restless Leg syndrome is when the spontaneous movement of leg muscles occurs. Additionally, 7REM disease occurs due to spontaneous movement of the eyeballs. Therefore, using the feature as an abnormal physiological movement, we developed a fusion model based on the Convolutional Neural Network (CNN) and Deep Belief Network (DBN), which is capable of detecting sleep order.

We divided the entire research paper into three categories- Section 1, and Section 2. Section 1 contains Introduction and Related Work. This section contains a comparison of work done by previous research studies done to detect various sleep disorders. In Section 2, we have described the proposed work and the description of deep learning architectures. Section 3 contains the result analysis, conclusion, future work, and references.

RELATED WORK

Dey D. *et al.* [11], developed a deep learning-based Convolutional Neural Network (CNN), which is used to detect sleep apnea disease. Machine Learning models were also used to detect sleep apnea, in which features were used as pulse oximetry and airflow. These models are also used to test the patients at home itself. The main aim of this research paper is to detect sleep apnea with a minimum number of parameters [12]. Yulita, I. N. *et al.* [13], developed a sophisticated system for detecting a disturbance in airflow using the Deep Belief Network. NREM-based classifier was used to detect insomnia based on 57 features extracted from the 2 channel EEG mode (Sachin M *et al.*, 2017). It obtained an overall accuracy of 92%. Cooray, N. *et al.* [14], proposed a system based on the study of 53 REM patients in which REM is detected with the help of a deep learning model. Furthermore, the Restless Leg Syndrome can be diagnosed with the help of the hybrid model of deep belief networks [15, 16]. Deep learning models are very highly accurate in detecting several sleep disorders. However, these models detect only one type of disorder. They are not useful in sleep studies because of their tendency to work for just one type of syndrome. The research gap can be trounced by developing a fusion deep learning model for detecting a large number of sleeping disorders based on the spontaneous readings provided by the sensors. Table **1** shows the comparative study.

Table 1. Comparative study of the different deep learning methods used for the detection of sleep disorders.

S.No.	Study	Year	No. of studies	Sleep Disorder	Feature Selection	Deep Learning Technique
1.	Cen, L. *et al.* [17].	2018	3	Sleep Apnea	ECG Signals	Convolutional Neural Network
2.	Prasad B. *et al.* [18].	2020	0	Sleep Apnea	Blood Pressure Measurement	Convolutional Neural Network
3.	Jarchi, D. *et al.* [19].	2020	0	Sleep Apnea	Biological Signals (ECG, EEG)	Deep Neural Network
4.	Korkalainen H. *et al.* [20].	2019	1	Obstructive Sleep Apnea	ECG Signals	Deep Neural Network

CHAPTER 13

Identification of Covid-19 Positive Cases Using Deep Learning Model and CT Scan Images

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Abstract: Today, the coronavirus has widely affected the entire world. In late 2019, a virus with the pandemic potential was reported in the city of Wuhan, situated on the mainland of China. In no time, the virus had spread all over the world, multiplying from person to person. Undoubtedly, COVID-19 has become an important research topic, and many research works are coming forward daily. Thus, COVID-19 patient's detection has become the most personified research for the researchers. CT scanning has been an important and widely used approach for detecting COVID-19 patients. In this work, the identification of COVID-19 patients is performed using two different deep neural network methods. For the image accession, the dataset having 746 samples was used. The entire dataset has been bifurcated into two different classes, *i.e.*, COVID-19 and non-COVID-19. COVID-19 class contains samples of the COVID-19 positive cases, whereas the non-COVID-19 class contains the sample of COVID-19 negative cases. In total, 506 images are used for training purposes, whereas 240 images are used for validation. The identification is performed using MobileNet-V2 and Modified LeNet5 convolutional neural network (CNN) models having a fixed number of convolutional and fully connected layers. The term modified is added before the LeNet architecture because an extra convolutional layer was created for the experiment. As per the details and requirements, the architecture for Modified LeNet was designed, whereas, for the MobileNet-V2, it is imported from predefined libraries and is used further as per the author's need. After the successful completion of the experiment, it has been found that the accuracy of MobileNet-V2 and Modified LeNet5 came out to 85.86%, and 84.38%, respectively.

Keywords: COVID 19, CT Screening, Deep learning models, LeNet5, MobileNet-V2.

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INTRODUCTION

In 2019, a virus named Corona with pandemic potential was reported in the Wuhan city of China during the tail end of the year 2019 [1] and was given the name “The Novel COVID-19”. This virus rapidly spread in all countries in no time [2 - 5], and no one could have even imagined that a virus named Corona would affect millions of people. One of the most important factors that turned out to be a barrier to getting the pandemic under control is a smaller number of medical resources and a shortage in the number of tests [6]. When observed under an electronic microscope, it was found that the virus inhabited the solar corona characteristics, which is how coronavirus's nomenclature occurred [7]. The World Health Organization (WHO), on February 11, 2020, came forward stating this virus was a pandemic outbreak, naming it COVID-19 [8], and further stating that the virus had first occurred in China, making its way to different countries. USA, Brazil, and India have been the most affected countries where the number of cases of this pandemic COVID-19 multiplied rapidly daily. Screening of large numbers, availability of quarantine centers, and better treatment are essential factors to control the spread of this pandemic disease [9].

Today, the entire world is trying its level best to win over this pandemic outbreak completely by putting in all possible efforts day and night. Although for the diagnosis, RT-PCR is the standard method that is taken into consideration. However, it is still found to be more time-consuming to confirm the COVID-19 patients as a high number of false negative reports are resulting [10]. The most familiar symptoms of COVID-19 are fever, cough, breathing or respiratory problems, mild symptoms of pneumonia, etc [11]. To overcome the issue of a high number of negative false reports, CT scans are an effective methodology to detect the disease [12]. Thus, for the confirmation of the COVID-19 patient, especially in the case of children and women, CT scan is the highly suggested and preferred approach [13]. Although CT imaging is an effective approach, there are still a few disadvantages that need to be kept in mind. High dose for the patient and high scanning costs are the major disadvantages of CT imaging [14]. Through this research, the authors mainly focus on detecting COVID-19 patients using the CT scanning method and further comparing with different deep learning models.

Some related works that have been bought forward for this problem are discussed in studies [15 - 19]. The study [15] brought forward a different approach for screening coronavirus disease. The observation or screening of COVID-19 patients was done using the CT screening concept in this work. First, they studied the comparison of different multiple CNN models to classify CT samples into different classes that consisted of COVID-19 patients, influenza, pneumonia, or with no infection. The further comparative study was on 2D and 3D deep learning

models that were already developed before achieving an accuracy of 95% for the reference of COVID and Non-COVID-19 patients. Another work related to this problem has been accomplished in "Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2" [16] with the help of different deep learning techniques. They created a model that helped them differentiate the COVID-19 patients from healthy cases and IAVP using CT scanning at the early stage. Sums of total 618 CT samples were taken for the work. With the help of 3D deep learning techniques, the segmentation of a particular infectious region from the CT scan image of a particular candidate was done. Later, these separated images were categorized into three different categories to understand the type of infection. Using the Noisy function, the type of infection along with the positive score is measured for the CT scan cases individually, producing almost 87% (86.7%) accuracy when taking all CT scan cases together.

A similar type of problem has been carried out in a study [17]. In this work, different deep learning models like ResNet50, ResNetV2, and InceptionV3 were used for the screening of COVID 19 patients and the methodology used was radiographs related to Chest X-rays. For these different models that were used, the ROC Analysis, and indecision matrices were given, and with the help of 5 fold-cross-validation, it was analyzed. To automatically recognize the coronavirus using CT imaging concept, an approach was developed in the study [18]. In this study, a new model was proposed by them in which they used Chest X-ray images for the observation of COVID 19 automatically. They had created 17 different convolutional layers and each layer was instigated with different means of filtering. DarkNet miniature was used in the detection system of a synchronal object as a classifier. The accuracy achieved by the model was 98.08%, which shows how well the model worked. Considering the CT imaging technique, to achieve coronavirus diseases detection, an approach was developed by A Jaiswal *et al*. [19]. In this approach, they used different models like DenseNet201, VGG-16, ResNet152V2, *etc*., that were already trained to recognize the COVID-19 patients. Based on DTL, DenseNet201 model was proposed to determine if a person is suspected to be found as a COVID-19 patient or not. The proposed model was used so that it could extract the features on its own when performed on the ImageNet dataset. A CNN structure was also used.

Although COVID-19 has extensively affected the entire world and is currently the most discussed topic among people throughout the world. However, after studying previously published works, it has been induced that the detection of coronavirus is an interesting and trending topic. Moreover, it has been noticed that most of the studies were based on CT imaging techniques as it results in the most minimal false reports with better accuracy. Therefore, the authors are trying to propose the COVID-19 identification using a deep neural network method that is

CHAPTER 14

Application of Nature Inspired Algorithms to Test Data Generation/Selection/Minimization using Mutation Testing

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Abstract: This chapter builds the foundation of software testing techniques by classifying the various testing approaches and testing coverage criteria. It gradually advances in the concepts and process of Mutation Testing and its application areas. Mutation testing has been applied at both the source code level and specification level of the software under test. Mutation testing, when applied to the source code, is named as Program Mutation. Similarly, when applied to the specifications, it is named as Specification Mutation. The relevant Mutation Testing tools available for different programming languages for both program and Specification Mutations are hereby listed. Owing to the high cost incurred in applying Mutation Testing to industrial needs, the on-going endeavors of the researchers in the area are elaborated here. Applying nature-inspired algorithms along with Mutation Testing for data generation/selection/minimization is an upcoming area of research. Search based Mutation Testing (SBMT) applies evolutionary techniques like Genetic Algorithms or other metaheuristic approaches for automating the tasks associated with mutation testing, which otherwise requires a lot of human effort, thus, making it a practical approach. This chapter concludes by giving the seminal recent advancements in the area.

Keywords: Generation/Selection/Minimization of test data, Metaheuristics, Mutation Testing, Nature–Inspired Algorithms.

INTRODUCTION

"To err is human" [1]. Software codes are written by humans, and humans make mistakes. Therefore, a system that is built must be validated and tested. Software testing is an activity that verifies and validates the functioning of the software. It entails 50% of the total software development effort, time, and cost [2]. Inade-

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quate testing leads to the wastage of millions of dollars wastage, especially in large projects [3]. The following subsections explain the basics of software testing:

Basics of Software Testing

Testing software requires a methodical procedure of executing software using different inputs, intending to authenticate its functioning and reveal faults wherever encountered. These faults are also known as bugs or defects. These faults may lead to system failure. A fault can occur due to a requirement misinterpreted or due to logical errors or coding errors. Test data is a collection of input values that reveals some behavior of the software being tested. A program "input" is a means of communication with it. In the case of a function, the parameters act as an input. In the case of an Android application, the inputs correspond to the events on the UI (user interface). To test a network protocol, the network packets are treated as inputs. To test a daily user application like the word processor, the input is either by UI (User Interface) or XML (eXtended Markup Language) documents. For validating the observed behavior of the software to be tested, a test case is formed using the input values and a test oracle, which requires an output value. This may be the expected value returned by a function or an output file, or a network packet, as the case may be. A test suite or a test set comprises the selected test cases.

To test the software, a series of tasks are performed by a test engineer. The process of testing requires the following steps:

- Identify an objective for testing.
- Selection of Inputs.
- Compute the expected outputs corresponding to the inputs selected.
- Set up the correct environment for testing.
- Execute the software system with the selected inputs.
- Analyze the results of execution and generate a test report.

Software testing can be done manually, but it is largely being anticipated to automate it. The advantages of automation include the ability to test the execution many times as desired. It reduces the human error of repeated execution while saving a lot of time. To automate the testing process, test cases are executed using a test driver, considering the system under test (SUT) under certain conditions. It applies to the input and verifies the output using the test oracle [4].

Testing is needed at different levels involving system parts or system software as a whole. The levels of software testing based on software activity [5] are as follows:

- Acceptance Testing – validating the SUT with respect to the requirements.
- System Testing – verifying the SUT with respect to its architectural design.
- Integration Testing – evaluating the SUT with respect to the subsystem design.
- Module Testing – checking and testing the detailed design of the SUT.
- Unit Testing – assessing the SUT with respect to its implementation.

Testing the software completely is an impossible task. The testing principle looks simple, but effective testing is a tedious task [6].

Testing rules are, thus, needed to define a criterion that the test data must satisfy, helping the tester in the selection of appropriate test inputs and helps in determining when to stop testing [5]. The next subsection details the various categories of coverage criteria for testing.

TEST COVERAGE AND ADEQUACY PRELIMINARIES

The software cannot be tested with every possible input, so test coverage criteria can be helpful for deciding which test inputs should be selected. The research on software testing largely reflects that the effective usage of the coverage criteria makes it more probable that the testers will locate faults in the SUT and increase the reliability and assurance of the correct functioning of the software.

Goodenough and Gerhart [7] brought up two key questions in software testing:

a. “What are the testing criteria?” or “what constitutes an adequate test suite?”, and.
b. “How to generate a finite test suite that satisfies the adequacy criteria?”.

Structural Testing

Structural testing techniques (well-known as White-box testing techniques) require knowledge of the structure of the SUT or its internal implementation. It is also known as clear box testing, glass box testing, path driven testing, open box testing, or logic driven testing. The coverage criteria here are mainly covered under the following categorization:

- Program based testing.
- Specification based testing.

CHAPTER 15

Multimodal Genetic Optimized Feature Selection for Online Sequential Extreme Learning Machine

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Abstract: Extreme learning machine (ELM) is a rapid classifier evolved for batch learning mode unsuitable for sequential input. Retrieving data from the new inventory leads to a time-extended process. Therefore, online sequential extreme learning machine (OSELM) algorithms were proposed by Liang *et al.*. The OSELM is able to handle the sequential input by reading data 1 by 1 or chunk by chunk mode. The overall system generalization performance may devalue because of the amalgamation of the random initialization of OS-ELM and the presence of redundant and irrelevant features. To resolve the said problem, this paper proposes a correspondence multimodal genetic optimized feature selection paradigm for sequential input (MG-OSELM) for radial basis function by using clinical datasets. For performance comparison, the proposed paradigm is implemented and evaluated for ELM, multimodal genetic optimized for ELM classifier (MG-ELM), OS-ELM, MG-OSELM. Experimental results are calculated and analysed accordingly. The comparative results analysis illustrates that MG-ELM provides 10.94% improved accuracy with 43.25% features compared to ELM.

Keywords: Classification Problem, Feature Selection problem, Genetic Algorithm, Online sequential Extreme Learning Machine.

INTRODUCTION

Nowadays, artificial intelligence is a growing and critical area [1]. Feature subset selection (FSS) is an intricate procedure in the fields of artificial intelligence and machine learning. The prime objective of feature selection is to adopt the optimal features for further evaluation. The features which are relevant and non-redundant are called optimal features. It is entangled to decide the significance of features.

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[2]. To enhance the system generalization performance, it is necessary to search and finalize only the optimal features.

Various FSS algorithms like Half selection, Neural Network for threshold, Mean Selection, *etc.*, are used for FSS. These are random searched optimization techniques useful for selecting the optimal feature subsets [3]. The big search space is handled by GA very effectively [4] and has the maximum chance of a globally optimal solution.

Extreme Learning Machines are rapid classifiers with various advantages like good generalization performance, high speed, less training time, *etc.* ELM is primarily designed for batch mode, in which all data is available before training. However, it is not suitable for sequential input [5]. Therefore, OS-ELM is designed by Liang *et al.* for sequential input. Zhu *et al.* developed Evolutionary ELM [6] and Han *et al.* developed the particle swarm optimization-based Evolutionary ELM [7]. In many papers, for ELM sig activation function is used [8, 9]. Huang *et al.* designed Incremental – ELM [10]. ELM is also used to solve real-time applications like medical data classification [11], universal approximation [12], and big data [13].

The original Extreme learning machine (ELM) is primarily designed for batch mode. Nan-Ying *et al.* [5] emerged online sequential – ELM (OS-ELM) for linear, incremental, or sequential input. ELM and OS-ELM calculate the input to hidden layer neurons by randomly assigning the specified input weights and biases. The target output is calculated [14, 15] by analytically evaluating the weights between the hidden layers resulting in the layer as shown in Fig. (**1**). Therefore, the generalization performance of the system may deteriorate due to the random initialization. One of the most significant steps is required, *i.e.*, optimal feature subset selection.

The key intent of the paper is the innovative use of a genetic algorithm with a multimodal optimization approach for OS-ELM (MG-OSELM) for clinical datasets. In various papers, authors evaluated OSELM only by changing hidden nodes, but extensive literature breaks down to recognize the changes in the inceptive training data (block) according to the quantity of hidden nodes.

The structure of the paper is organised as follows: The detailed structure of the proposed methodology of MG-OSELM with the aid of the paradigm is detailed in Section 2. Innovative results and a comparison of results are mentioned in Section 3. The future work, in combination with the conclusion, is described in Section 4.

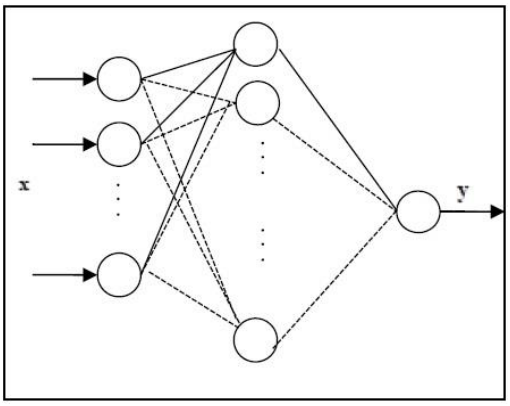

Fig. (1). Basic ELM Architecture

PROPOSED MG-OSELM APPROACH

The paradigm of the proposed MG-OSELM approach is as shown in Fig. (**2**), which is categorized into threefold subsystems – a. Pre-processing subsystem, b. FSS subsystem 3. Classification Subsystem.

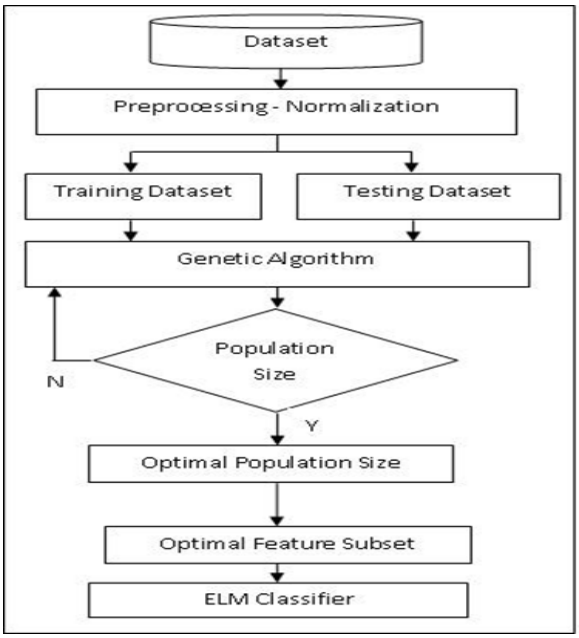

Fig. (2). Proposed MG-OSELM Paradigm.

Datasets

The various datasets like Pima, Indian Diabetes (PID), Stat, log heart disease (SHD), Breast Cancer (BC), and Australian (AS) [16, 17] are used. The

CHAPTER 16

A New Non-Stigmergic-Ant Algorithm to Make Load Balancing Resilient in Big Data Processing for Enterprises

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Abstract: Due to the continuous evolution of the Big Data phenomenon, data processing in Business Big Data Analytics (BBDA) needs new advanced load balancing techniques. This chapter proposes a new algorithm based on a non-stigmergic approach to address these concerns. The algorithm imitates a specific species of ants that communicate by the acoustics in situations of threats. Besides, the research methodology in this study presents a methodic filtration of the relevant metrics before carrying out the benchmarking trials of several ant-colony algorithms (*i.e.*, makespan, response time, throughput, memory and CPU utilization, *etc.*). The experimentations' outcomes show the effectiveness of the proposed approach that might empower the research efforts in big data analytics, business intelligence, and intelligent autonomous software agents. The main objective of this research is to contribute to reinforcing the resilience of the Big Data processing environment for enterprises.

Keywords: Big Data processing, Business Big Data Analytics, Load balancing, Swarm intelligence, Workload Management.

INTRODUCTION

With the advent of Big Data, enterprises continuously need to extract more and more value from accumulated data in their Information Systems (IS). Companies then adopt high-frequency parallel data processing as a new compulsory economic model [1]. In such complex platforms, workload management and load balancing become essential in maintaining resilient business activity [2].

In the new research community, the paradigm “Big Valuable Data” is an emerging topic that triggers several challenges, including load balancing

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management in high-frequency parallel environments [3]. Such large-scale computation systems include dedicated distributed Big Data processing using MapReduce® programming models such as Hadoop® [4], and distributed databases in clusters such as Cassandra® [4]. Such technologies can handle a massive amount of data, along with some difficulties and challenges. Hadoop®, for instance, is designed to parallelize large-scale computations; however, these computations often attain peaks of high latency because of workload issues [5].

With the incessant urge to extract valuable patterns from volatile data, workload management has stepped to the head of research concerns in business and management engineering [6]. One of the most challenging topics is the resilient management of wide-ranged workload types in real-time and with very complex inter-dependencies systems [7]. Resilient management includes a robust load balancing system, which means a pilot process that supports assigning tasks to avoid unavailability and unexpected cuts of services [8]. The main role of load balancing policies is to accelerate software execution by using limited resources where workload fluctuates irregularly [9].

Accordingly, providing an effective load balancing algorithm is vital to perform well in such a challenging environment. Several algorithms and heuristics have been proposed in the academic literature, particularly after the advent of the Big Data and Cloud computing paradigms. Authors [10 - 12] classified these algorithms into static and dynamic approaches. Static algorithms are widely used in the standard Cloud and Grid Computing environments, such as Round Robin Algorithm [13], Min-Min Algorithm [14], Max-Min Algorithms [15], and Throttled Algorithm (TA) [16]. These algorithms are based on two main characteristics: procedural, following immovable rules, and completing preliminary information about the system without the flexibility to change [10]. Dynamic algorithms, on the contrary, are characterized by their ability to decide based on the changing state with the capacity of flexibility [12]. They cover different sub-categories, including agent-based algorithms [17], application-based algorithms [18], workflow-based algorithms [19], and nature-based algorithms [20].

The last sub-category (nature-based) is one of the most prolific due to the abilities of the algorithms to solve complex problems compared to three other sub-categories [11]. These techniques have the particularity of miming the natural phenomena and behaviors and are also clustered into three classes: the Bio-Inspired Algorithms (BIA), and the Physics-Chemistry-inspired Algorithms (PCA), and others.

In the class of physics-chemistry-inspired heuristics, the natural chemical and physical transformations and interactions form the foundation of inspiration, such as some specific mechanical laws and organic movements [21]. For instance, the well-known Osmotic Load Balancing Algorithm (OLBA) imitates the osmosis self-regulatory phenomenon where liquids interchange through semi-permeable membranes [22].

The other class of bio-inspired algorithms forms the branch of Swarm Intelligence (SI), where the miming behavior can be extracted through five ways to assist in load balancing:

a. Swarming behavior is inspired by insects, particles, birds, bacteriological organisms, and vegetation [23]. These techniques are predominantly used in load balancing for optimization purposes and resource migrations strategies. Examples are Particle Swarm Optimization (PSO) [24], Bat-Inspired Algorithm (BIA) [25], and Artificial Bee Colony (ABC) [26].
b. Foraging behavior is replicated in some species of insects and animals like ants and bees. These algorithms are mainly applied to searching for available resources and allocation optimization in load balancing. Examples are the Ant Colony Optimization (ACO) [27] by imitating the trailed pheromone in searching for food, and the Honey Bee Foraging (HBF) algorithm [28] by reproducing the hunting process of bees in computing the distance between the hive and food sources.
c. Evolution behavior is based on Darwin's theory of natural organisms' survivorship, where critters can be preserved via three processes (reproduction, mutations, and cross-over [29]. These algorithms constitute the sub-class of Evolutionary Computation Algorithms (ECA). They are mainly applied in load balancing for workflow and node management. Well-known Genetic Algorithms (GE) are employed to ease operative resource exploitation and attain improved performances in nodes [30].
d. Breeding behavior mimicked some animals like birds and body cells [31]. The breeding-inspired algorithms are primarily applied to resource scheduling and optimal node selection in load balancing. Examples are the Cuckoo Optimization Algorithm (COA) [32].
e. Self-learning behavior is emulated from the learning ability of the human brain [33]. Artificial Neural Networks (ANN) are the most commonly known in this sub-category. They are helpful in load balancing for inferring optimal configurations and forecasting purposes due to their robustness in heterogeneous and large-scale infrastructures [34, 35].

CHAPTER 17

Computational Algorithms and Study of Elastic Artery and their Applications

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Abstract: The concept of computational algorithmic and sustainable elastic artery evaluation and its impact on different variables such as structural and morphological variations and its applications are explored in this chapter. The Crank-Nicolson approach has solved the mathematical goal of the equation. The result is explained in the case of blood supply in elastic vessels while the electromagnetic effect is established. In this computational analysis, the discrepancy between the arteries and veins attached to the elastic arteries in the blood vessel is easier than determining the presence or absence of the elastic layer within the vessel. The obtained results in the analysis are in relatively accurate compliance with the computational findings in this chapter. The findings may be applicable to cases of pulmonary edema, *etc.*

Keywords: Blood flow, Computational algorithm, Crank- Nicolson scheme, Elastic artery, Shear rate, Vessels.

INTRODUCTION

The renal cortex of an elastic artery (conducting artery or conduit artery) includes numerous collagen and elastin filaments, enabling it to stretch in response to each pulse. The Windkessel effect results from this elasticity, which effectively prevents the pressure in the arteries from being relatively constant despite the pulsating nature of the blood flow. The largest arteries in the body, those proximal to the heart, are elastic arteries. They give rise to distributing arteries that are medium-sized vessels (or muscular arteries). The body's elastic artery system consists of the pulmonary arteries, the aorta, and branches. In recent years, researchers have investigated the physiology of laminated composite materials from the context of continuous bio-mechanics. Elastic arteries are already adapted to receive blood throughout the outflow region of the heart at relatively high pressure. For example, for the measurement of friction and flow waves along with

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an artery, the magnificent area of the aorta, pulmonary artery, and aorta is validated. Over the past few decades, the significance of arterial flow phenomena such as secondary flow, recirculation and instability, flow separation movement, low and oscillatory wall shear intensity, and long particle residence duration for the development of atherosclerosis has become glaringly evident.

Some scientific research papers have discussed algorithmic and sustainable blood assessment through elastic arteries. Thurston [1] profounded the thermal behaviour of blood using non-Newtonian, poroelastic, and rheology models and their applications. Liepsch and Moravec [2] examined the simulated fluid flow and discovered the change in pressure velocity to the measured velocity of a Newtonian fluid with the simulated fluid's high shear rate viscosity. Both experimental and numerical, the two-dimensional steady state and pulsatile flow developed by Rindt *et al.* [3] were considered.

Nazemi *et al.* [4] made a major contribution to the discovery of atherosclerosis. Rodkiewicz *et al.* [5] reported two significant non-Newtonian blood designs in predicting the heart rate, including the heart rate, including the aorta. They found that blood yield stress has no effect on the allocation of velocity or wall shear tension. Chaturani and Palanisamy [6] examined the pulsatile flow of blood into a rigid artery under the influence of tissue displacement of a Newtonian fluid.

In straight and curved rigid arterial models under established oscillating flow conditions, a study [7] used renal blood to examine the relationships between haematocrit concentrations and wall shear rate patterns.

The results revealed that the improved viscosity of the aqueous glycerol solution created the wall cut-rate waveform. Initial blood enhanced by haematocrit has the same size and shape. It is concluded that the change in shear stress is mainly due to a viscosity improvement rather than a blood elasticity change. The blood flow was described by Perktold *et al.* [8] in a stenosis vessel as an inviscid laminar flow in a flexible tube. Sharma and Kapoor [9] used the finite element process to scientifically analyse the blood circulation through the artery and their applications.

Dutta and Tarbell [10] explored two hemorheological models that demonstrate the effects of shear-thinning viscosity and oscillating flow viscoelasticity [11] and found their structural and physical adaptation models of arteries. Based on the principle of the layer boundary layer, two methods were used by Botnar *et al.* [12] to explore the specifics of the influence of different flow patterns on the initiation and amplification of atherosclerotic plaque deposition based on the correspondence between estimations of Ultrasound speed and theoretical predictions. Sharma *et al.* [17] used the finite element Galerkin method to analyse

the mathematical flow of blood through the artery. Kumar *et al.* [18] developed the design and analysis of elastic arterial supply. These models are used in accordance with the Newtonian model to study the sine-wave movement of rigid and elastic straight arteries. Bazilevs *et al.* [13] founded a computer model for the modelling of cerebellar embolism implementations precise to physicians and also explained a novel paradigm for blood algorithm prestress of the vessel tissue. Yang and Murfee [14] discovered that the angular shape modifications are much more complicated than just channel depletion in adult rat herniation frameworks obtained from spontaneous hypertensives. High blood pressure networks contained an excessive level of blood vessel interactions compared with cerebral perfusion systems, which would diminish channel sensitivity via limited pathways from either low or high closer to zero sides of the system.

Bianchi *et al.* [15] have concentrated on certain experimental mechanical studies in order to challenge the model. The results obtained by computation using finite element simulation have been correlated. Impact of viscous dissipation on magneto-hydro-dynamics unsteady motion across longitudinal transparent media through persistent suction [11]. Kumar [19] has analytical results for a porous consequence on oscillatory blood flow that acts as a Newtonian flow to fully appreciate the irregular flow conditions of blood in a locally constricted blood vessel. Kumar [20] investigated a Mathematical and Mechanical Analysis of Arterial Blood Flow with Porous Effects. Kumar and Agarwal [21] have two different non-Newtonian models for blood flow. One displays only shear-thinning viscosity while the other displays both shear-thinning viscosity and oscillating flow viscous-elasticity.

In recent research, we are interested in understanding blood flow in an elastic artery in the electromagnetic effects. We use the appropriate finite difference approach to measure the effects of shear-thinning viscous-elasticity of blood on the flow phenomenon in the electromagnetic effects in large elastic arteries to extend the local flow estimation to include non-Newtonian for hemorheology.

DYNAMICAL STUDY OF PULSATILE FLOW

In a rigid artery, circulatory flow builds, and the fluid fluctuates in volume. r is, a uniform increase and decrease in the velocity flow pattern for multiple places along the vessel appear with each heartbeat introduced to the fluid. As discussed before, to regulate heart production, the distance across an artery is regulated. In this way, it has been described that the concern of exhibiting artery flow has been limited to the region of the blood vessel where there is no significant stable shrinkage and no fanning or existence of vasodilatation.

CHAPTER 18

Performance Analysis of CCS on Inclined Plane using Fuzzy-PID Controller

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Abstract: Nowadays, in the automation industries, the Cruise Control System (CCS) is one of the essential aspects, and it is necessary to have a well-designed controller that can suit a new improvement in innovation. The CCS is a very famous and important model in control system engineering. The fundamental objective of CCS is to regulate vehicle speed depending upon the chosen speed. The CCS is an example of a close loop control system. Speedometer is utilized in the feedback path for measurement of the speed. This is a simple model used to solve the many problems of drivers like road accidents, weariness, *etc.* In this paper, we analyze the performance of different controllers such as Proportional-Integral-Derivative (PID) controller, the fuzzy logic controller (FLC) and the fuzzy-PID (F-PID) controller in the different situations on the road, such as friction, road grad, or angle of inclination to attain the chosen speed of the vehicles. The tuning of PID parameters is done using the method of Ziegler-Nichols, and FLC uses the gaussian Membership Function (MF) in this paper. The MF is a graph that lies between zero and one. It indicates the mapping of every point in the input state and the values of MF. The mathematical model of this system is considers the road grad and the friction. Finally, in this paper, we see the response of models with and without a controller in different situations on the road.

Keywords: CCS, Fuzzy, Fuzzy-PID controller, PID controller.

INTRODUCTION

In many countries, CCS is also known as Tempomat Control System (TCS) or Speed Control System (SCS), which automatically controls the speed of any vehicle. The main objective of this system is to regulate the speed of the vehicle that depends upon the desired speed. The speed can be measured with the help of a speed sensor like a speedometer. The CCS uses a servomechanism (the close loop system and converts the mechanical motion into power) that uses a choke into the motor to provide a fixed speed as set by the drivers. These types of

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systems are used to solve the huge problems that are faced by the drivers, such as tiredness and road problems, *etc.,* [1 - 3]. The basic operation of this system has many steps. First, the sensors sense the vehicle's speed and then speed is measured. Now, the error detectors compared this speed with the standard speed that is provided by the drivers. After that, it is decided whether the car will be accelerated or deaccelerated, depending on the error value.

The speed measurement sensor is connected to the feedback path, and this sensor is known as the speed sensor or speedometer. Due to the feedback path, it is a closed-loop system. The CCS can be performed only with velocity control [4]. The performance of the normal CCS for passenger cars is not good due to the traffic density, road condition, *etc.* At present, this type of system minimizes the working of the drivers as stabling gear-pedal and the continuity seeing the needle of the speedometer. This system is not suitable when the speed suddenly changes, and it is the major disadvantage of CCS [3 - 5].

In the SCS, the decision of many controls can be improved by considering the differences as the mass of the vehicle, friction coefficient, drag coefficient, and the road grade can be estimated. The friction coefficient and the angle of inclination are the main sources of peripheral loading [5]. The internal parameters such as the mass, road grade, and drag coefficient can affect the performance, energy efficiency, ride quality, and handling. The two parameters, road grade and the vehicle's mass, are directly associated with the load that can be estimated accurately and reliably. The mass of Vehicle can be directly related to all normal forces that can affect the lateral forces and the longitudinal forces [6].

The CCS has become a very popular option in many states, where the highways are long, flat, open, have good road conditions, *etc.* There are three main advantages of this system as follows:

1: It maintains a constant speed limit throughout the journey,

2: It increases the driver's comfort for the long-distance trip,

3: It improves fuel efficiency [7].

In 1900, this system was utilized in the autos by the scientist Wilson-Pilcher and followed long term during the 1910s by the scientist Peerless. The scientist James Watt and Matthew Boulton used this model to control the steam engine in 1788 [8]. Ralph Teetor developed the advanced version of CCS, known as the Modern speed control, in 1948 [9]. The M-Sgt Frank J. Riley, the patent for the specific speed, was filed in 1950 [10, 11]. American Motors presented a less-valued programmed auto control framework for the enormous -measured vehicles or

engines with the auto transmission in 1965 [12]. In 2009, the advancements of this system forced the drivers for maintaining a significant distance on the roadway. CCS can play the role in speed control [13, 14].

One of the most well-known regards the automation of vehicles is the Automated Highway System (AHS). The advancement of the transmission and highway program has been one of the effective examinations done on the AHS with the help of California Partners. The task was balanced on expressways driving a particular prepared vehicle in a different path from another physically determined vehicle. Many projects are done on the longitudinal and horizontal control of the speed control with the many types of research. In 1997, the highway AHS was effectively shown in tests which are done by San Diego in California [15]. The advanced version of conventional CCS is the ACC system. The conventional CCS keeps up the ideal speed of the vehicle which is given by the driver and the ACC framework additionally keeps up a suitable relative separation to the lead vehicle. If the forward vehicles are recognized to be driven at a slower speed than the ideal speed, the system delays the swarm vehicles and keeps up a suitable relative separation, which relies upon the conditions of the swarm vehicles and nature. The extension version of ACC is the Cooperative ACC (CACC) system. The Stop and go system is excellent in urban driving condition where the ACC can't be effortlessly used [16]. Likewise, in urban areas driving, the conditions are more mind-boggling, and necessities for the stricter sensor data [17]. Since it is relied upon to be functional at low speed in urban driving circumstances, an option for responding to visits is available for removing in and leading vehicles for stopping and going system. The CACC is another upgraded variant of the ACC. Now, the CACC uses correspondence among the vehicles or potentially between vehicles and street structures. This correspondence permits the system on a solitary vehicle to get data about an unfamiliar vehicle in the units. Many research projects are done on the CACC near traffic lights and the communication that shows the CACC can improve the traffic stream [18] and the string constancy [19]. When the spacing error increases, the string stabilities show the major role. An unexpected acceleration or de-acceleration of the primary vehicle of the sub-division unit incorporated a mistake for the following vehicles. The magnitude of the error is increased for a later vehicle if the sub-system is unstable.

The main objective of CACCS is to have vehicle drive in the method platoon-wise, within a small room that lie between the individual vehicles; such a methodology may cause circumstances where combining vehicles won't have the option to discover a hole to converge. Our assumption is that the system is working in an environment where the non-automated and automated vehicles are combined. Our framework should have the option to adapt to non-automation vehicles. After a very long time, many researchers added more functions to this

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