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EFFECTS OF CLEM (CLOUD-BASED E-LEARNING MANAGEMENT SYSTEM FOR TEACHING AND LEARNING PROCESS IN MECHATRONICS)

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Doctor of Philosophy

Supervisor

Asst. Prof. Dr. Abdullahi Abdu IBRAHIM

İstanbul, 2022

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The dissertation titled EFFECTS OF CLEM CLOUD BASED E-LEARNING MANAGEMENT SYSTEM FOR TEACHING AND LEARNING PROCESS IN MECHATRONICS prepared by SAEED AHMED RAHEEM ALSUDANY and submitted on 16/12/2022 has been **accepted unanimously** for the degree of PhD in Electrical and Computer Engineering.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Saeed Ahmed Raheem ALSUDANY

Signature

DEDICATION

To the memory of the soul of my dear son, (Mustafa) whom I could not forget him for a moment, and to my dear wife who stood with me and encouraged me and was the best help to my dear children, and to me to my mother and father who believed in me as well as to my dear brothers the witness to the heart and its intention. Praise and thanks to Allah, who reconciles me to complete this study; I would like expression my thanks and regards to my supervisor, thanks to Asst. Prof. Dr. Abdullahi Abdu IBRAHIM**,** my supervisor to follow my work and give me his advice during all stages of this work.

Finally, I wish to expression my cordial thanks and deepest gratitude to my university

For all the staff (teachers, employees).

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.

ABSTRACT

EFFECTS OF CLEM (CLOUD-BASED E-LEARNING MANAGEMENT SYSTEM FOR TEACHING AND LEARNING PROCESS IN MECHATRONICS)

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Because of the increased modern learning requirements, the cloud-based mechatronic learning effects are studied analytically, which have obtained the high usage of the Internet. Additionally, due to the chance and ease of accessing the Internet through different technology gadgets, for example, iPad, and phones with tabs, the utilize of cloud computing has become well known. and pervasive." E-learning is a significant point as it reduces the expense and period of real learning for mechatronics (that is, a specialty of computers, mechanics, and devices). Applying cloud e-learning will compose it further clear for teachers, students, and clients to enhance their vision in mechatronics. Moreover, they might create courses that strengthen it, however, considering exchanging reliable and simple access. Virtual homerooms have been simulated to prepare different arrangement calculations to represent the mechanism of distance e-learning by getting the variables of student preparation, lesson type, and class time. Order tests were performed utilizing SVM, Decision Tree, and KNN on a data set representing tables of the Mechatronics Labs system. The server system and the correspondence network were simulated utilizing the Matlab2020b program to implement the idea of distance education. At last, the results were compared with the savvy neural network calculation as an excellent trainer, and the best performance was reached with a high efficiency of 94% and a small error rate of 2%.

Keywords: E-learning, Mechatronics, Remote E-laboratories, and Virtual Laboratories

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ABBREVIATIONS

VLE: Virtual Learning Environment

LMS: Learning Management System

MSP: Managed Service Providers

IAAS: Infrastructure as a service

PAAS: Platform as a service

SAAS: Software as a service

SOA: Service–Oriented Architecture

SRS: Software Requirements Specification

CSC: Computer Support Collaborative Learning

GAE: Google Application For Education

VET: Vocational Education and Testing

HDFS: Hadoop Distribution File System

GUI: Graphical User Interface

ANN: Artificial Neural Network

TPE: Tree Structure Parzen Estimator

RNN: Recurrent Neural Network

KNN: K Nearest Neighbours (KNN) Algorithm

SVM: Support Vector Machine

CNN: Convolutional Neural Network

MSE: Mean Square Error

LM: Levenberg Marquardt

1. INTRODUCTION

1.1 PREFACE

Because of the variations in techniques with association also engineering demands, it is necessary thought to provide actual statistics for learners with students to examine and evaluate troubles. For such reason, analyzing the electronic-learning structure will enable the educational operation as well as the student's experience beyond either time or place constraints. Additionally, constructing broad libraries or actual laboratories might catch attempts with expense, thus, utilizing an e-learning model will compose it simpler. A conventional e-learning management structure should contain abilities to distribute and save data from being appropriate against the learning and teaching convention of such days. Cloud-based electronic- training models might expand the abilities of conventional training management models by integrating along the architecture of cloud computing techniques. Such techniques should be guarded along unofficially clients with destruction. Next, it might minimize the cost of hardware and software possession since they should possess just one info source [1]. Cloud computer e-learning should have a custom floor for every learner as well as officers. The model must be soft and might contain broad students sum additional to common assets similar to hardware (servo, CNC machines, motors, and 3D printers), programs with software which adjust the study operation such as animated slides with video clips. [2]

In this proposition, the cloud computing course guidelines demonstration presents how the teachers, trainers, and students could cooperate and also improve the mechatronics field training techniques not just on their abilities yet further to enhance the eventual procedures.

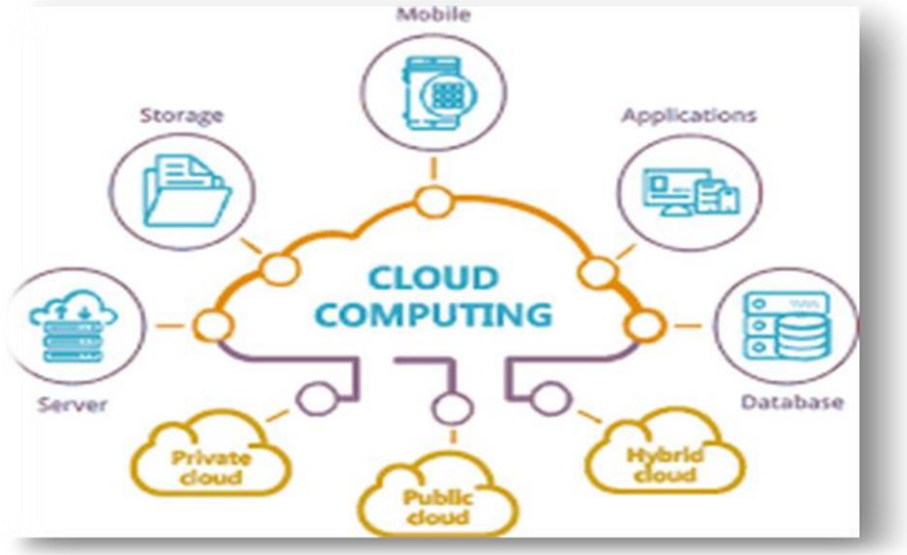

Figure 1.1: Cloud Computing.

1.1.1 E-learning

Various electronic-learning abbreviations have available such as; virtual learning environment (VLE), learning management system (LMS), and electronic learning; because of the advancing of online courses, broadband width, with the demands of obtaining such procedures accessible, such ascended having courses online by the pupils. Various e-learning schemes were accomplished. The utmost necessary structure is the hybrid educational system that blends e-learning structure against conventional learning scheme. [3]

1.1.2 Mechatronics

This is described as the harmonious between control systems, mechanical engineering, and electronics in construction operations with product analysis. It is linked to the analysis of structures, products, and instruments objected to accomplishing an optimum balance amidst a basic mechanical model with its final control. [4]

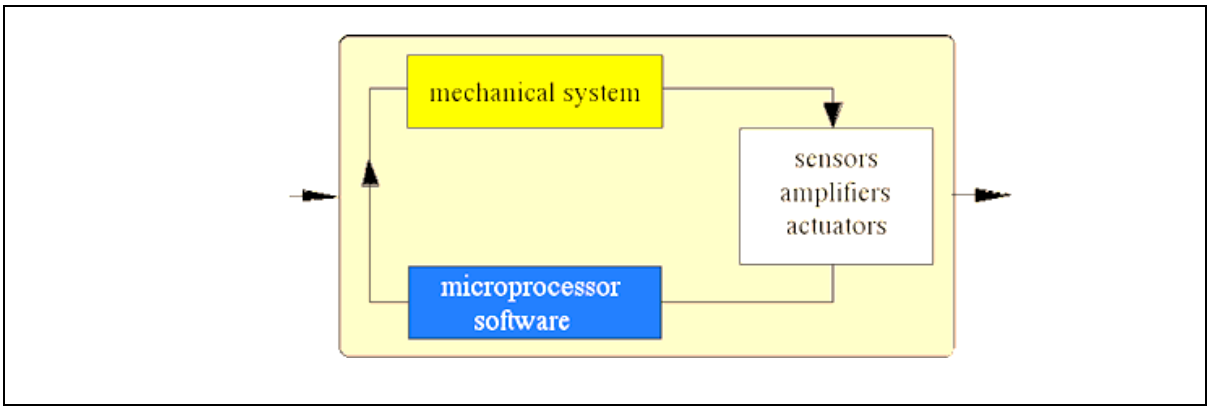

Figure 1.2: Mechatronic system basic components.

1.1.3 The Cloud Computing

It is an approach to maintaining businesses along the Internet such that the supplies are scalable also dynamic. A cloud might become regarded as a set of networks or far clients attached to one another. The path might be being done through several implementations as well platform such as mobile phones, desktop, Tabs, and iPod. [5]

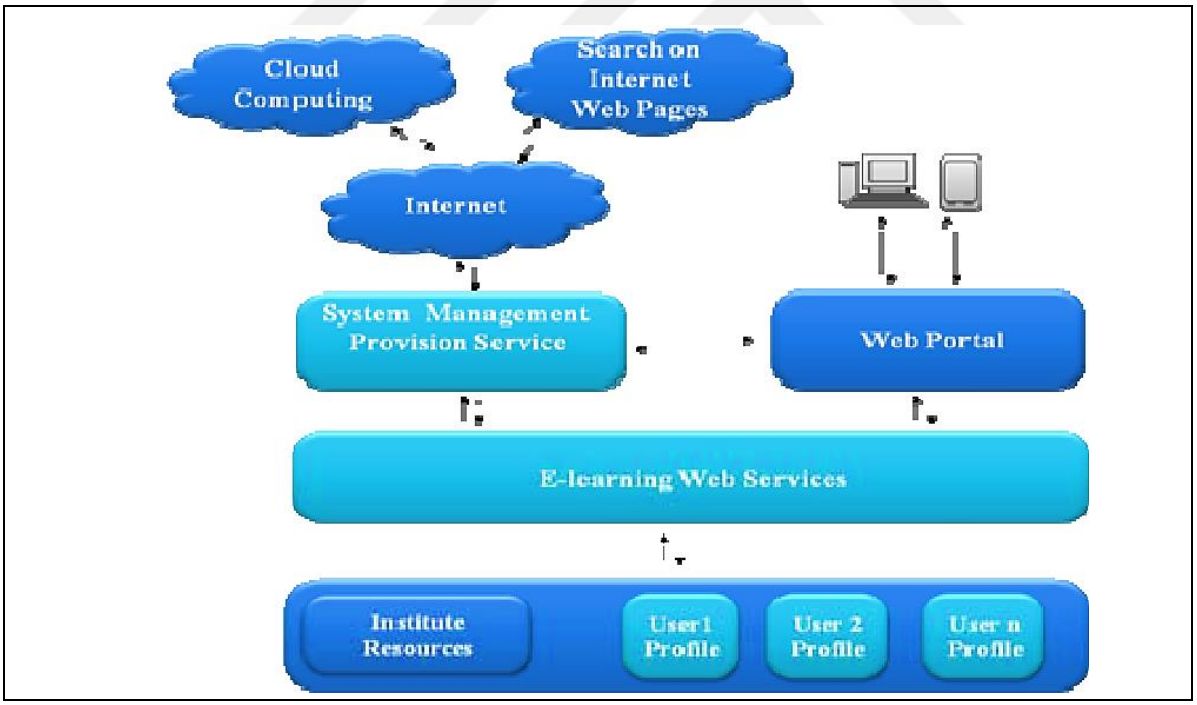

Figure 1.3: General Cloud Computing Layers.

1.2 LITERATURE REVIEW

Several articles have recently investigated the examination of big data and its use in e-learning technologies by cloud computing networks and various online entertainment organizations, with a wide range of strategies. According to the main categories of these procedures, numerous studies and scientific papers have been presented. Each method has some benefits and problems or limitations. Many studies and research concerned with the big data issue and the techniques of managing and dealing with it via the Internet and cloud computing networks have been presented. The most important and latest studies might be summarized through the following review:

Rotsnarani Sethy et al. [2015] introduces the broad infrastructure of excessive information as well next, at that point, centering on the Hadoop layer by employing evaluations of map lessen that provide the conditions to implement the application in expanded conditions that might be fitting for administrating node failure.

Rama Satish K. V. et al. [2016] located a preparatory project on Trend researching cases of big data with its excellent achadual using Hadoop environmental system, using the structure of parallel supervision to treat against excessive data gathering using programming of Apache Hive with Map Reduce for data warehouse structure that depends on the upper side of Hadoop to provide an examination, data outline, and questioning.

Shahriar Akter et al. [2016] presented an analytical model that investigates the kinds of business that deserves definitional views as well distinct aspects in the landscape of online business. The article along it goes off extra expanded discussions against concerns to eventual research threats and valued open doors in concept against tradition. In general, the inventions of the diverse literature mix BDA thoughts (e.g., huge data meaning, types, structure, business respect, and necessary hypothesis) that produce extra knowledge bits over the cross-cutting research implementations in business online.

Kshitij Jaju et al. [2016] produce unbelievable assistance to the systems to more advancing their developing techniques as well as increase contracts. In such a method, the business data item promotion searching plan also provides accessible data experiments using Map Reduce methodology to investigate as well operate on their contracts by pointing the massive data lock up is the aim we expect to obtain.

Allae Erraissi et al. [2017] made an impression of the models as well peripherals of the Big Data Hadoop five distributions answers. Next, we will present our related requirements such

that we will apply 34 possible conditions to represent the attributes as well as deficiencies of the essential Hadoop credit materials.

Prof A S Devare et al. [2017] introduced a portal network research machine such that each commercial center's notice with updates will be reachable to increase their content. It will similarly provide the info attached against availability with trivial evaluation by considering the contents in different economic places. Also, such a report would help us to relocate the content reachable depending on the customer along affording. It is similarly scanning the content reviews and ratings.

Moorthi K et al. [2017] discussed various methods and approaches extended to online careers for intelligence work. A similar reason is a little modern structure for extra advancing the internet career intelligence according to the business area using big data experiments.

Pooja Jain et al. [2017] introduce Apache hive and Apache pig, big data analytic equipment on the Hadoop analyzing proper cases' largest distance. Utmost intensive problems installed for precise systems and so on. In addition, the hive and pig experiment is finished on certain surroundings through research, which illustrates the hive's superior response related to the pig.

Anisha P. Rodrigues and Niranjan N. Chiplunkar [2018] discussing Twitter flowed gradually. Apache Flume has been applied for extended tweet achievement. As a researching, we have suggested a technique for following down tweets' delayed patterns and also obtained sensing experiments on steady tweets. The experiments are completed using Hadoop environmental tools, e.g., Apache Hive and Apache Pig. Implementation in terms of execution time is planned for research of ongoing tweets using Hive and Pig. Based on the results of the tests, it is possible to conclude that Pig is more qualified than Hive because Pig groups away more edges for running than Hive.

Eleni Zampou et al. [2018] suggested a bunch of career requirements which represent the demands of the web career combining parameters. Next, the importance was transformed towards a group of reason issue positions to illustrate the method that might be supported by big data researching. We near by suggesting an employed engineering of a big info experiment oldie anomaly which might cover the internet career united parameters importances.

Sohini Chatterjee [2019] researched how such personalization is applied along client formulation, designated commercials, predictive experiments, expense personalization as well

more developing client experience. Moreover, it behaves at moving against hardships approaching each inner with outer the company, as induction of career intelligence, information restraining infrastructures, as well data security with protection. The survey presents that since there is exciting cause for good truth concerning the future truth of the massive info and web career merger, it is, in addition, helpful to be aware of the restraints of big data with uncertainties about info security with protection.

Manoj Muniswamaiah et al. [2019] introduces the review, advantages, and hardships of altering big info application in cloud computing projects.

Zhang Yi-Wen [2020] collects the cross-line E-trade stage sender credit estimation proposals based on massive data to provide a source to make cross-line E-business stage sender credit estimation corresponding to the big data point view, trusting that such review might help along improving the cross-line E-trade stage enhancement with cross-line E-trade production improvement.

Sarah S. Alrumaiah and Mohammed Hadwan [2021] focused on the benefits of utilizing BDA in network recruitment to both purchasers with marketers. There are 15 articles selected for testing the properties of processing big info in a web career. BDA has been utilized by Electronics sellers (E-merchants) for general objectives they required to explain client’s attitudes against advanced their salaries along with client expansion constancy. Furthermore, proposition structures import over BDA notifies the investigation with the e-commerce exercise of the clients. However, there are various bad outcomes were achieved along the BDA resignation in network recruitment, such as buying customs. Furthermore, e-traders need to organize expensive BDA tools with advisors. Finally, regardless of the truth that BDA updates sellers' as well buyers' with electronic buying practices, the fast improvement of info is as until now examining.

Weiqing Zhuang et al. [2021] investigate the global theoretical exploration of BDA influence in web sights careers to create sensing of the separations amidst the U.S. as well China standards by considering an accurate experimental technique relied on drills collected along dual essential databases writing. The U.S. and China have been focused on by the Web of Science and CNKI. The consequences of such a survey help along with questions answering with respect to China's web-based career improvement, which exceeds that of the U.S. today, considering the theoretical comparisons of BDA in web-based careers amidst them.

In 2020, Intisar Salem Hamed Al-Mandhari [16], the principal reasons behind the saved

dull appearance regarding a few exceptional classifiers, particularly in getting along to arrange slight classes/attacks, were determined by the researchers after they expanded on a certain assessment. Due to the natural concept of association interference space, the assessments made with this notion indicate that the KDD Cup '99 information set is overloaded, but some attacks are both common and exceptional. As a result, there is an unsettling mismatch between the number of information schemes in the different attack classes of such information. Given the number of categories in the case, the ungainliness information case may be a multi-class or two-type issue. The majority of researchers focus on matched-type misclassification cases when working on hard copies since spotting the multi-class gathering case is a tricky problem that calls for clear solutions.

One of the most common jobs of PA frameworks involves automating the water system plan. It is commonly accomplished through the use of agro barometer data and meteorological terminals that may be placed far away from areas. After using RDI techniques in conjunction with a programmed water model framework, sustainable in-crop construction was achieved. The results of using DDRMPC showed a 40% decrease in water consumption. In order to obtain the best results versus the method followed by intelligent neural structures, machine learning (ML) has also been used to predict crop evapotranspiration (ETo) based on data from soil moisture sensor units [17]. Finally, it is important to do climate prediction [18] in order to foresee a product's requirements.

When implementing IoT frameworks for farming, one of the biggest problems to take into consideration is the necessity for power sources. In fact, power sources are scarce in many rural regions. Therefore, most of the sun, batteries, and solar-powered boards are used to manage the IoT devices sent to the work area. As a result, both data gathering and actuator management often involve compact IoT nodes with strong batteries and low-level power consumption. In order to reduce power usage as much as possible, less-energy procedures may also be used [19,20].

Because of the aforementioned reasons, it is challenging to actualize workable and appropriate plans for intelligent cultivation [21]. The size of the information gathered could not be one of them. For intelligent cultivation WSN, the size of sent data is often small because the considered boundaries change gradually. Whatever the case, accurate information communication is crucial. Additionally, the sum of IoT devices deployed in the area should be minimized in order to lower the overall charge while maintaining the functionality of the structure. Placing IoT hubs at the greatest distance at which communication can be ensured is

one of the IoT minimizing sum techniques. The type of nodes seeded in the observed area, however, could affect the largest distance between IoT nodes.

The natural environment, the chosen communication standard, the location where IoT nodes are deployed, and additional signal propagation factors such as the multipath effect, absorptions, reflections, dispersion, potential interferences, or distance attenuation all affect the communication range regarding IoT nodes. As a result, the communication distance covered by IoT nodes installed at plants may be significantly reduced. Therefore, in the case when implementing a culture arrangement, it is crucial to be aware of the limitations of the communication range of the IoT devices in order to plan the structure in accordance with the environment qualities. The RSSI enables gaining some degree of wireless waveform characteristics and may be used to locate IoT nodes [22]. Although there are many metrics for evaluating connection quality, RSSI may be effective for determining the quality of a distant connection to determine whether or not the current deployment is adequate to ensure the connection between IoT nodes. The edge that was created for planted areas to show a poor aspect was no more than 90 dBm.

As there are discrepancies between the two criteria in the earlier investigations, the authors of the same reference [23] came to the conclusion that no completion had been reached that RSSI or LQI (interface aspect pointer) is significantly superior to another. According to the authors, LQI and RSSI can both provide information on some metrics that are linked to the link aspect. However, other than a recently suggested measure with a significant overload, there is no commonly used measure that can provide data on all of the viewpoints that are now available with regard to the interface aspect. Therefore, RSSI may be considered a great enough measure for the purpose of computing scope analysis. With regard to soil monitoring, which intends to deliver irrigation water, it is vital to try to determine the fundamental parameters which might impact such distributions since there is no independent research on the distribution of IoT nodes regarding each crop type. The purpose of the presented work was to monitor citrus with varying densities along with grass fields as well as other types of crops in order to determine the impact of various agricultural environments on the spread of wireless signals. This was done by examining the various distribution processes regarding IoT nodes. The irrigation organizing model's overall structure is also described in this document, along with descriptions of the soil-controlling IoT hubs. These descriptions state that an algorithm should be run to identify the proper irrigation times by utilizing the data that is now accessible. The tests that were considered involved the distribution of IoT

nodes on the ground, close to the ground, and at various heights along the ground. Additionally, simulations were run to investigate more complicated circumstances. The maximum distance that IoT hubs can correspond with one another while maintaining high signal quality was calculated by examining the data. The acquired data were also evaluated to assess the degree to which the type of crops affected the quality of wireless signal transmission and the distance of the Internet of Things (IoT) nodes' coverage.

In order to enable communication between the many elements of these monitoring schemes, Wi-Fi is utilized in many monitoring schemes, including agricultural monitoring. As a result, it is one of the most widely used communication technologies. The authors offer a system for monitoring agricultural fields' properties, including temperature, humidity, light, and soil moisture [19]. This system is based on sensors. Along the field, sensors (or Internet of Things nodes) gather data and send it to a server where it can later be viewed. Among the most important concerns which have been tackled was the one regarding the study of the contract's coverage for the IoT.

The problem of locating Internet of Things sensors or nodes was investigated in [24] with the use of the received signal strength method due to the fact that the experiments were conducted using various frequencies in 2.4 and 5.5 GHz bands in ad hoc networks, the effect of the variation in vegetation cover on the spread of the wireless signal in various surroundings were also explored. According to studies, grasslands, followed by woods and wild areas, had the greatest wireless signal spread. The worth therefore demonstrated the significance of researching the impact of vegetation cover density on the spread of signals between IoT nodes. [25] evaluated the signal attenuation in a tropical forest environment and examined the impact of the environment's trees on the signal. Both the frequency ranges of 2 to 18 GHz and the frequency range of 26.5 to 40 GHz were the ranges that were worked on. Analysis of the results revealed that attenuation is proportional to frequency over frequency, with attenuation readings of around 11 dB at 15 GHz and approximately 25 dB at 9 GHz.

The work described in [23] examines environmental interference brought on by the impact of grasses and other impediments on remote WSNs with the aim of lowering waveform power in areas where analysis is not necessary. Various brushes of different extensions were taken into consideration. The results showed that the attenuation for 2.4 GHz and 5.8 GHz is up to 10 dB and 21 dB, respectively. In order to study radio wave propagation in the 2.4 GHz band in several climates with varied and diverse vegetation cover, the authors of [26] set up a laboratory. Along with natural and structural barriers, vegetated settings with trees, grass, and

bushes were utilized with technologies like ZigBee and Bluetooth. ZigBee knots were fastened on tree trunks to take measurements. The outcomes demonstrated that the suggested algorithm was effective for creating a communication plan amongst nodes placed in various contexts. For radio wave propagation in the 1 to 60 GHz range along foliage environments for different tree types, as well as for varied tree types and positions, another model was given in [25]. The computed RMS glitches were roughly 9 dB, which is less than the 12 dB of the ITU-R structure, according to the conclusions.

On frequency, to investigate the impact of vegetation quality on radio waves in WSNs operating at frequencies between 1 and 3 GHz, with lengths between 15 and 25 m and altitudes ranging from 0 to 3.5 meters, a simulation was carried out [27]. The free space path loss model and several tree kinds were utilized to model the wireless signal's attenuation process. The influence of grass cover on wireless signal attenuation was examined in the frequency ranges of 1.3, 2, and 11.6 GHz in another research that was described in [28]. Different models, including non-zero gradient (NZG), maximum attenuation (MA), and modified exponential decay (MED), were used to simulate the vegetation-induced attenuation. The data gathered indicated that the primary elements that cause signal attenuation are the shape, quality, and condition of plants. A wide-range antenna was utilized to measure the signal intensity at various heights along 2 to 8 meters. The results showed that the main causes of attenuation are gauge algebra, grass thickness, and leaf condition. 11.6 GHz was the frequency that was most significantly attenuated by the leaves. The authors of [29] looked into the transmission of low-frequency waves over grasslands, notably those at 433 MHz. The data obtained demonstrated that effective communication was possible at a distance of 80 meters when the crop plants were close to the ground, yet that the communication distance decreased to no more than 25 meters in the case when the crop began to grow, and then decreased to no more than 10 meters in the case when the crop bore frearsuit. The RSSI indicator served as the basis for the signal measurement.

1.3 PROBLEM STATEMENT

The initial steps of our current research are planning the research problem and as indicated in the work steps. Where each research starts by defining the problem and arranging the steps to address this problem using an organized methodology to reach the appropriate solutions to form the conclusion or results of the research. Detailing a general point in a particular research problem is the essential step in any methodological and scientific inquiry. Two steps available in any research problem are to discover the problem, understand it carefully, and

reformulate and analyze it towards worthwhile expressions according to an analytic context. The ideal strategy for understanding the problem is to examine it with researchers who have little experience in the field. With regard to public schools, it is usually the presentation of the problem through the supervisory companies along that we might explain how the problem basically occurred and also what proposals were included in providing potential solutions. Later rearranging the problem through analytic expressions, i.e., defining the issue in certain expressions as expected. Such procedure in reviewing the complication is considered frequency is of great importance in the research operation once and for all. You must specify the problem to be explored in order to support the applicable information that is drawn from the irrelevant information. In fact, an investigation issue plan usually pursues a basic step-by-step investigation model so that different details are organized, each definition further specific and different from the previous definition, as each one is explored with further numerical expressions with thought, every much functional with respect of data against visual reserves. In such a study, the essential problems with drawbacks might be condensed in the following conditions:

a. The problem of the limited online feedback to the students.

b. The social isolation which might be produced by e_learning operation.

c. The need for strong and efficient devices and servers, which do not always exist.

d. E-learning requires powerful students' self-learning skills and precise administration management abilities.

e. Difficulties with cheating prevention and limited observation abilities.

1.4 THESIS AIMS AND PURPOSES

To understand the implementation plan, it is important to consider the necessities from standard requirements along with thesis prerequisites to perceive images by OCR. The prerequisites are:

a. To compute the Cloud Based E-learning Management System effectiveness in Mechatronics.

b. Critical factors computations that disturb the Cloud Based E-learning Management System in Mechatronics.

c. To suggest an application structure for Cloud Based E-learning Management System for Teaching and Learning Processes in Mechatronics.

d. Suggesting a regression formula for an efficient forecaster amidst the independent variables that have a direct affiliation to the e-learning system response enhancement.

e. Suggest appropriate recommendations to develop the work performance of the cloud-based e-learning management model for mechatronics learning and teaching operations.

1.5 SUGGESTED SYSTEM

The suggested architecture is a cloud-based mechatronics core e-learning model. Such a proposal depicts the outlines of the CLEM project, Cloud e-Learning for Mechatronics. A CLEM might be defined as an explicit region cloud luminance that is specifically tailored to the Vocational Education and Training (VET) trainer's requirements. The most amazing improvement is by configuring the cloud wireless investigation apparatus, where juniors might simulate connections to most virtual lab facilities to help them learn remotely and virtually without having to set up labs in their own institutions. The cloud structure enables various investigation places to essentially converge to provide convenient surroundings for teachers and juniors. Through this structure, supervisors might choose as well mix abstracts to create appropriate sessions for their students as well enable them to accomplish different types of instruments and laboratory equipment along the cloud network. This study presents an integrated blueprint for this state-of-the-art cloud-based e-learning technology and also illustrates the outcomes. This study analyses how distributed computing is implemented and supported in other technologies, in addition to showing how to aggregate the overall e-learning experience along with the use of static and dynamic branch graphics Intuitive for development and collaboration.

The CLEM important stage of engineering contains an employer that holds static training resources, e.g., automated textbooks and energy mark slices with talking remarks. The employer besides has Moodle, which provides the Integrated Learning Environment along that the static substantial might be required to. The employer, besides wiring to different far-off investigation attachments and includes a reservation with an entry scheme against the aim that the laboratories might be booked up and obtained by students or instructors. Moreover, the employer has a combined collection office named CLEM ROOM with the aim that staff might obtain master guidance with more assistance every another as data as well practice improves. CLEM ROOM, which associates an Expert Channel, makes the analyze and agreement of collecting to produce an improved theoretical description for transaction and transmission sessions among convections sums and relies on our last production, frame professionals are recruited. In the beginning, the technicians are the planners of the structures against the discoverers of the supply statistics.

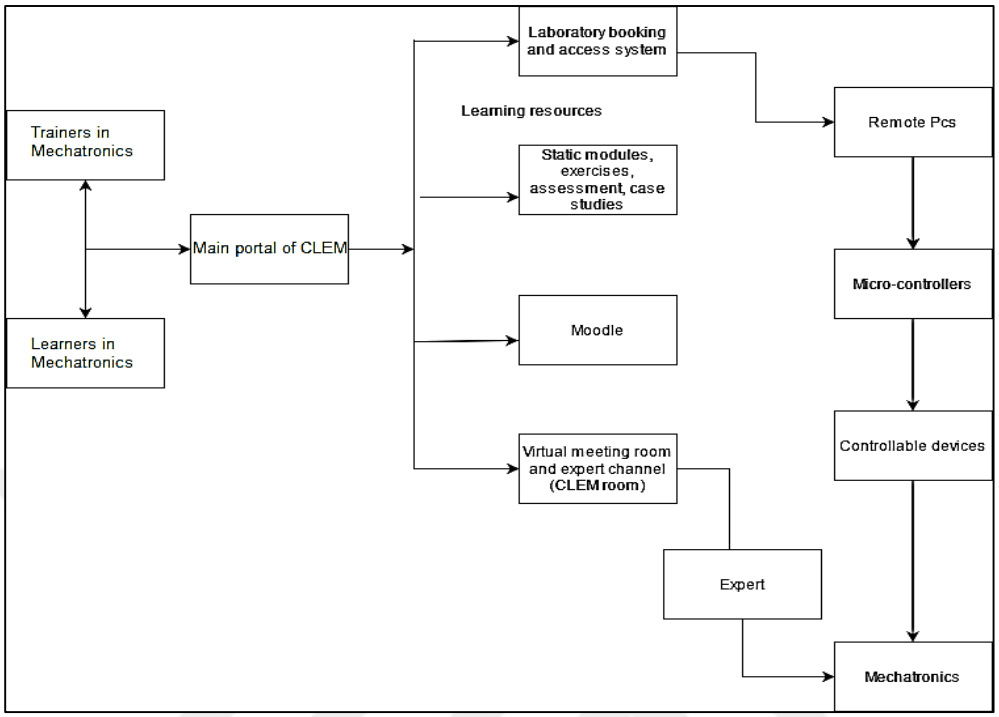

Figure 1.4: Architecture of proposed CLEM system.

1.6 THESIS CONTENTS

Chapter 1: Introduction: Such chapter will display the introduction of the overall investigation along objectives & aims of such investigation.

Chapter 2: Literature Review: This chapter will present study over literature review on different aspects of the study.

Chapter 3: Research Methodology: This chapter will discuss & present the methods used for this research along with data collection.

Chapter 4: Results & Discussion: in this chapter, the performance evaluation results will be presented based on case studies.

Chapter 5: Conclusions & Suggestions: Conclusion & future work will be discussed in this chapter.

2. THEORETICAL CONCEPTS

2.1 MOTIVATION

In this Chapter, we will illustrate the main features and properties of the algorithms and tools utilized in the problem of the project " Effects of CLEM for Teaching and Learning Process in Mechatronics. " As we previously mentioned in the project proposal, the main steps of the project problem can be listed in four essential stages:

a. Data collection and gathering (classifications and clustering).
b. Data temporarily storage (Hadoop Distributed File System (HDFS), also Cloud computing). Helping in charge minimizing, floor developing, rapid clarification also efficiency achieving.
c. Data Analysing (Feature Extraction). Data Analysing as well as introducing valuable instructions for assisting managers, executives as well as further big company terminal customers, apply learned employment judgments.
d. Performance testing (Precision, Accuracy, Recall, F-Measure).
Hence, for each step outlined above, we must specify the best and optimum algorithm or technique that satisfy the project requirement compared with existing ones presented in the literature. One of the most important factors that must be compared to the techniques and algorithms used on the basis of which is: the accuracy, high efficiency, and speed of implementation of the operations and tasks required. In the next section, we will discuss in detail the available and effective algorithms and techniques for each stage of the project.

2.2 PROJECT EFFECTIVE ALGORITHMS & TECHNIQUES

In this section, the most effective and usable algorithms, as well as techniques in literature, will be discussed in order to suggest the optimal ones which might be utilized in the E-Commerce Data Analytics Proposed System. The illustration will consider each stage individually by listing the most efficient techniques reviewed in the literature.

2.2.1 Data Collection & Gathering Stage

As illustrated previously in the project proposal, this stage is responsible for the big data and information collection from the different web sites and servers. The big data gathering work requires what is called the data mining technique, which is an important and essential technique that must be implemented in the E-Commerce Data Analytics Proposed System. The data mining technique [1] introduced 10 top algorithms utilized to perform the classification and clustering tasks important for the performance of this stage [1-3]. We will list these ten algorithms with scientific comparisons among them. The separation of amusing science (non-unimportant, understood, formerly obscure, and possibly effective) is called Data Mining which analytically receives certain figures and tendencies in the info with regulations machinery (relationship among clearly unattached info). Data Mining is an interdisciplinary area that contains approaches with strategies (counting algorithms) along Machine Learning as well Measurements, yet additionally Pattern Recognition, Data Visualization, Databases, and Artificial Intelligence [4],[5]. Data Mining assignments are associated with the principles. The reason for the order mission is to construct schemes able to conclude the modern issues class. Data Mining structures are analytical demonstrations directed at explaining also examining the info. Data Mining undertakings are a group of operations included in creating schemes employed utilizing algorithms (techniques).

The Data Mining program apparatuses collect essential techniques, approaches as well theories; such implementations base their process on innovations that investigate figures of comprehension by consolidating a group of equipment for questioning with the examination of info against apparatuses that permit the decision of outcomes with recording.

2.2.2 Methodology

This project procedure contains three elementary stages: (1) choosing of info mining equipment for examining, (2) choosing of info groups to be also applied (3) choosing of evaluation classification algorithms. The project will examine every possible group of info sets, segmentation patterns, algorithms, and techniques to compute their classification against a scale of precision.

a. Tools

The tools to be tested were selected according to the top 5 data mining instruments [6]. The choice methods at the path of simple of utilize. Only four of them can be used beyond scripting, despite the fact that they all have GUI. Applying JHepWork is necessary to develop programming skills in the Jython language. The only ones that are typically picked for study are: (1) KNIME 2.6.0 [7], (2) Orange 2.6 [8], (3) Rapid Miner 4.6 [9], and (4) Weka 3.6 [10]. Analysts, not programmers, are typically the only ones who can use these tools. We advise using the programming language MatLab2020 for the suggested work.

b. Datasets

The selected datasets have been downloaded along the UCI repository (University of California, Irvine) [10]. Table 2.1 presents their performances: the title by that they are recognized in the review, the variables info kind against formal and total grouped towards categorical, the sum of cases, the value of characteristics, and the sum of available amounts for every target stage.

Table 2.1: Characterization of Datasets [11].

Dataset name	Variable types	#Instances	#Attributes	#Class values
Adult	Categorical, Integer	32561	14	2
Breast-cancer	Categorical	286	9	2
Car Evaluation	Categorical	1728	6	4
Credit-approval	Categorical, Integer, Real	690	15	2
Iris	Real	150	4	3
Lung-cancer	Integer	32	56	3
Wine	Integer, Real	178	13	3
Zoo	Categorical, Integer	101	16	7

c. Classification

Data Classification is the operation of a dual step: (1) the learning (or training) stage, also (2) the exam (or computation) stage such that the real instance class is correlated against the concluded class. When the hit rate is adequate for the investigator, the classifier is approved as it becomes able to classify eventual cases against unfamiliar classes. [1,11].

2.3 CLASSIFICATION TECHNIQUES

Classification is typically accomplished through supervised learning, however it is also possible to accomplish classification through unsupervised learning, for instance, when the stage is not used or is unknown, as in the ensemble technique. We use algorithms that follow the upcoming methodologies for testing and evaluation, including rule extrapolation, DTs, ANN, clustering, SVMs, and Bayesian classifiers. The output of classifiers is frequently computed using a precision metric. This measure is computed by dividing the total number of instances by the sum of the precisely classified model. A correctly classed case is an instance such that the classifier expects the correct class for the exam model [11,12].

Table 2.2: Total Accuracy by Technique [12].

Technique	Average accuracy
Decision Trees	83,10%
Artificial Neural Networks	82,85%
Rules	82,76%
Clustering	82,07%
Bayesian Classifiers	81,76%
SVM	74,72%

Also, by referring to [11, 13, 14] we can find the arrangement of the classification algorithms, which are sorted according to the action quality.

Table 2.3: Total Accuracy by Algorithm [12].

Algorithm	Average accuracy	#Tests
AODEsr	100%	1
NBTree	100%	1
FT	98.26%	1
HNB	94.79%	3
PART	94.59%	1
DTNB	91.66%	4
BFTree	91.00%	2
Jrip	90.30%	2
LWL	88.78%	3
LMT	87.33%	2
BayesNet	87.24%	9
RuleLearner	86.02%	11
DecisionStump	85.51%	2
BasicRuleLearner	85.17%	3
NaiveBayes	85.02%	6
MultilayerPerceptron	84.38%	14
KernelNaiveBayes	83.79%	11
k Nearest Neighbor	83.29%	16
Decision Tree Learner	83.06%	16
SMO	82.40%	16
Naive Bayes	82.05%	16
k Nearest Neighbours	81.43%	16
ADTree	81.34%	2
Classification Tree	81.21%	16
SVM Learner	81.06%	16
NeuralNetImproved	80.93%	16
CN2	80.67%	16
SVM	80.53%	16
NearestNeighbors	80.49%	16
Fuzzy Rule Learner	80.17%	16
Naive Bayes Learner	76.41%	16
VotedPerceptron	75.14%	2
LBR	74.48%	1
MultiCriterionDecisionStump	73.26%	1
BestRuleInduction	73.26%	1
EvoSVM	70.25%	1
OneR	70.00%	1
LibSVMLearner	55.96%	14

Table 2.3 above illustrates the total classifier quality by algorithm; also, we might complete which the best classifiers according to the specific data set rely on the Decision Tree strategy, which reached excellent efficiency [1,15].

In order to implement the proposed model demonstrated in Figure 3.1, several classification algorithms, such as Support Vector Matrix (SVM), K Nearest Neighbours (KNN), and Decision Tree (DT) algorithm, have been applied. In fact, several classification techniques are available for performing the task of data feature identification

as well as classifying these data according to their attributes and characteristics. In this project, the proposed model of the study, only two types of algorithms will be nominated to perform the classification mission, which is; the SVM and the KNN algorithms, which are discussed in the succeeding paragraphs.

2.3.1 K Nearest Neighbours (KNN) Algorithm

The KNN [20-22] strategy is a natural supervised learning technique that is not difficult to carry out. As it were, one can say that it depends on this maxim: "Let me know who your companions are, and I will let you know what your identity is." Implying that a man distinguishes himself from individuals around him. These individuals shaping his network have a pretty much significant effect on his personality. By relationship against that, the KNN technique comprises computing the lengths among the elements vector of a novel perception to be classified with the highlights vectors of the original waves those structure the learning base. The sign to be classified is next doled out to the greater part class amidst the k nearest classes as per the picked length computation. There are various sorts of length computation. However, we have settled on the technique for ascertaining the Euclidean length. Let Xp = (xp1, xp2, …, xpN) be a highlights vector to be classified, N the number of elements in such vector with Y the original foundation.

$$d(X_p, Y) = \sqrt{\sum_{i=1}^{N}(X_{pi} - Y_i)^2} \tag{2.1}$$

In the KNN technique, the still up in the air by utilizing the following equation:

$$\alpha_i = \frac{K_i}{K} \tag{2.2}$$

where ki addresses the quantity of the i nearest neighbours located.

$\sum_{i=1}^{M} \alpha_i = 1$, in which M addresses the quantity of the close-to-home class. The trouble in the KNN algorithm is tracking down the ideal worth of k. The larger k is, the more prominent the gamble of over-learning is, with the limits among the profound classes being less unmistakable. Consequently, it is important to make approval the k worth to track down the worth, which decreases the gamble of over-learning and augments the inclination acknowledgment rate. The KNN's arrangement technique is very natural also easy to carry out. Later the execution of the last option, we created and carried out another strategy

named support vector machine (SVM) that, on the arrangement structures writing, achieves improved compared to the KNN referred to. The following passage presents such a grouping technique. A demonstration diagram has been displayed in Figure 2.1 to illustrate the KNN classification algorithm operation [9,10].

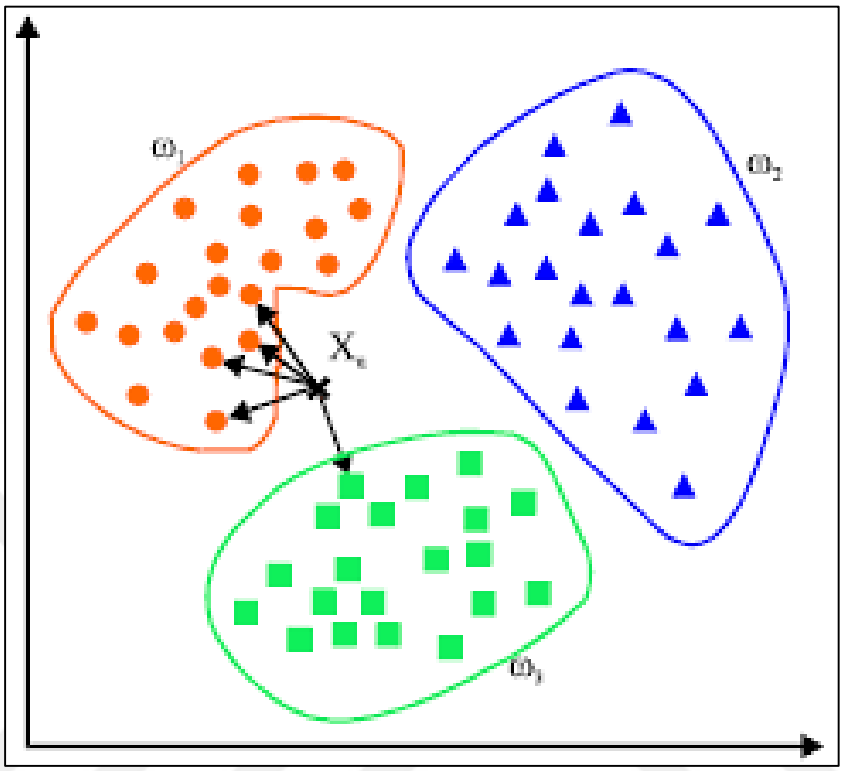

Figure 2.1: A demonstration diagram of the KNN operation [9].

2.3.2 Support Vector Matrix (SVM) Algorithm

SVM [20-23] is a supervised learning strategy for paired grouping. The standard comprises characterizing a hyper plane isolating the 2 classes whereas boosting the edge. The last option is the length among the division limit with the help vectors, which are the nearest exams. For the situation where the information is straightly detachable, an ideal isolating function is characterized (expanding the edge). In either case, the information is projected into a space of bigger aspects in which it tends to be straightly distinguishable.

Let xi, xj be the information of the two stages. The SVM depends on the scalar production of such entered vectors <xi, xj>. For the situation, whereas the information has been projected in a bigger space utilizing the change, $\phi: x \rightarrow \phi(x)$, next, at that point, the scalar

product will be: against K (xi, xj) = < ϕ (xi), ϕ (xj) > with K (xi, xj) as the kernel function. For our situation, we pick the Gaussian as the kernel function.

$$K(x_i, x_j) = \exp \frac{-\|x_i - x_j\|^2}{2\sigma^2} \quad (2.3)$$

The execution of the SVM old-style algorithm doesn't make it conceivable to return to the parameters αi. To keep our vectoral portrayal of feelings, we utilized the MatLab2021b Simulation program to recover the posteriori probabilities, which are the coefficients αi. This study centre's around the multimodal recognition of feelings. Two methodologies exist to pass along the traditional SVM (parallel grouping) to the multi-class SVM. Figure 2.2 presents an illustration chart of the SVM classification technique mechanism [9,10].

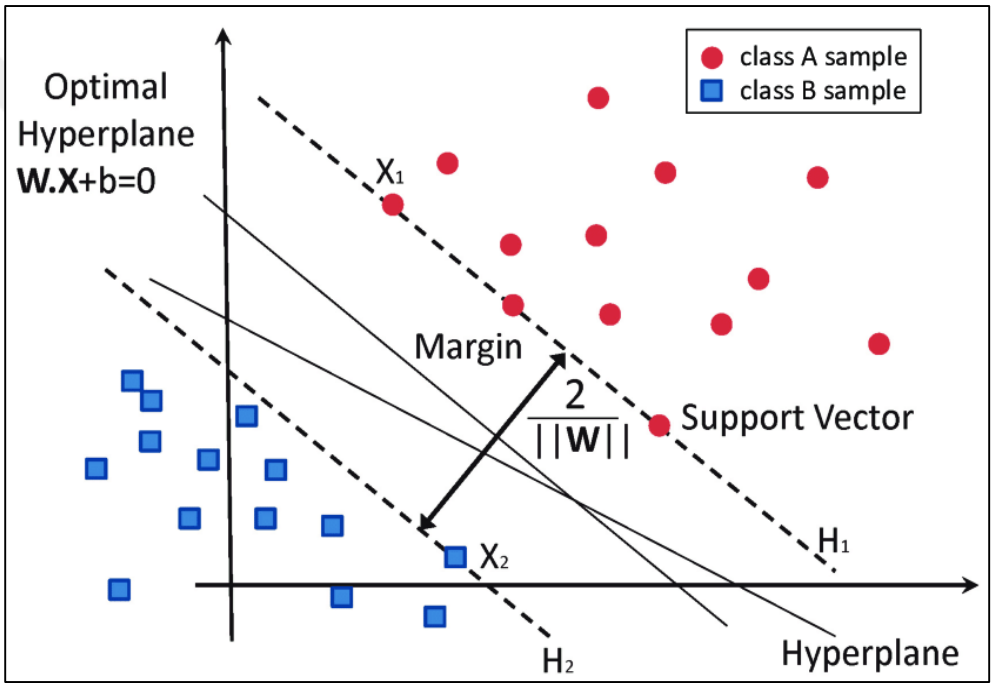

Figure 2.2: An illustration chart of the SVM classification technique mechanism [10].

2.3.3 Decision Tree Algorithms

Decision tree techniques use numerous algorithms to select a portion of a node towards 2 or more sub-nodes. The formation of sub-nodes develops the identity of the sub-node's resultant. Finally, we could conclude that the purity of the hub increments as for the objective variable [19,20]. Presenting Decision Trees are a kind of Supervised ML (in which it is clear that the entered is also against the comparable result in the training info) where the info is continuously divided comparably to a significant constant. A decision

tree is a quite significant sort of likelihood tree that permits us to arrive at a conclusion around a course of several sorts or another. For example, one might pick amidst manufacturing thing an or thing B, or resources mode towards decision 1, decision 2, or decision 3. Trees are a fascinating approach for arranging such sorts of complicated agreements that generally contain different parameters as well as ordinarily containing several stages of asthenia. Despite the fact that they might be drawn manually, the software is often applied as the trees might become complicated speedily [20]. Table 2.4 presents the benefits and drawbacks of DT. Figure 2.3 shows a schematic chart of the decision tree strategy [20].

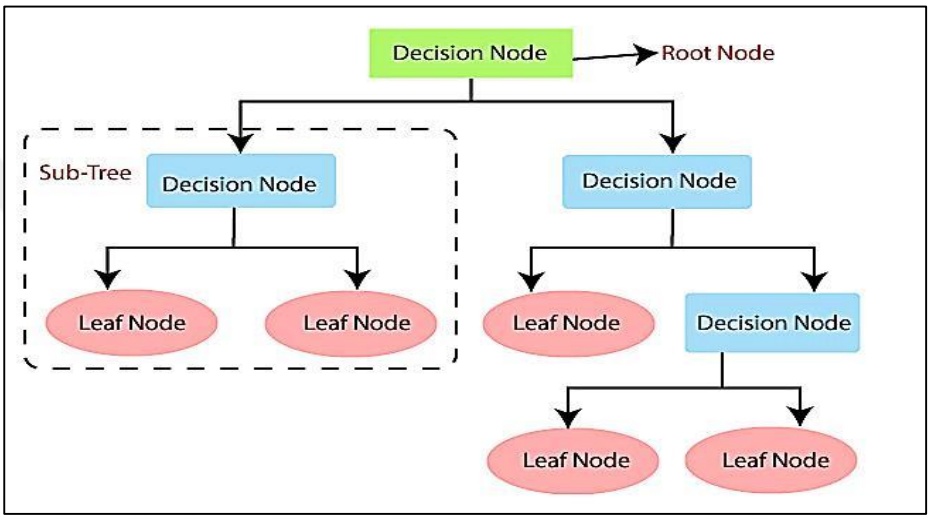

Figure 2.3: A schematic diagram of DT [20].

Table 2.4: Comparison of the advantages and the disadvantages of the decision tree algorithm [20].

No	Benefits	Deficiency
a	A decision tree is straightforward and decipher.	In the event that a decision tree is utilized for categorical factors with various levels, those factors against further levels will have extra data gain.
b	Well-qualified assessment and inclinations can be incorporated, as well as hard data.	Computations might immediately turn out to be exceptionally complex, albeit this is normally just an issue in the event that the tree is being made the hard method.
c	Can be utilized with other decision techniques.	-
d	New situations can undoubtedly be added.	-

2.3.4 CNN Hyperparameter Optimization Algorithms

Convolutional neural networks (CNN) is a functioning engineering of the approach of significant realizing which accepts contributions as sight and sound like pictures, recordings, or different 2D/3D information. It is apparent that age assessment on the premise of facial highlights manages pictures and video information. In this way, different explores done by the analysts and researcher lies on facial age assessment centre's around CNN models. CNN model comprises different piles for every private neuron broadcasted in the numerical articulation of a multi-dimensional lattice. The further picture moves

through secret layers of CNN, measurements of loads, and the network gets redesigned after each convolutional layer. CNN structures are planned by an all-around fixed mix of layers like thin layers, sub-example layers, and full layers. Concentrated layers fill in as building squares to CNN, and it is utilized to play out the fundamental capacity of convolution. Sub-example layers perform significant capacity for controlling over fitting issues by diminishing the boundaries and size by utilizing max activity for greatest pooling. Finally, the completely associated layer of neurons is guided to all actuation capacities of past layers. There exists an extra RELU layer that aides in carrying out the non-immaculateness capacity and amendment in CNNs. The last layer is typically used as a soft-max layer that gives decimal practicality to each yield neuron. Scientists have proposed a few intelligent CNN designs for fundamental neural organization ideas. Predefined CNN models were examined for this examination keeping into account the acknowledgment of age just as the assessment of the age from facial pictures. The utilization of the CNN algorithm as a profound learning strategy has shown better mean square blunder MSE upon the prepared packet test with a better ability to identify the current attack stream through similar statistical estimations implemented all through the standard learning algorithms. The suggested program scheme will show the classification process of the CNN technique. The block graph of the analysed data security scheme utilizing the CNN deep learning strategy has been shown in Figure 2.4 [21-24].

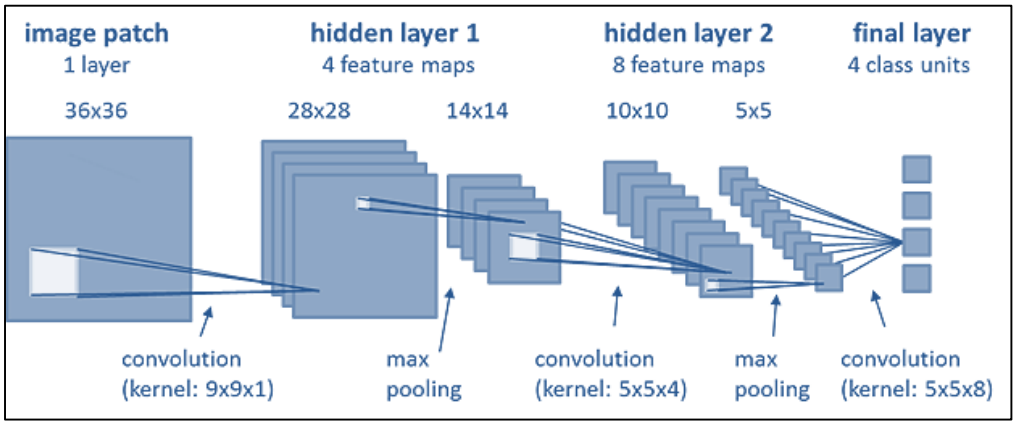

Figure 2.4: block diagram of the examined cloud security model utilizing CNN learning algorithm [21-24].

a. Convolutional Layer

The primary structural component of CNN, which sets it apart from customary ANNs, is the convolutional layer. The use of convolutional procedures on small regions was demonstrated as a means for avoiding the situation of learning billions regarding the parameters (on the off chance that all layers are completely related). The sharing of weights within convolutional layers, which entails applying the same filters to the same element map, is a key advantage of convolutional networks. Weights sharing aids in reducing anticipated compute memory requirements and improving CNN performance on PC vision tasks [17]. The effect of weight sharing on border decreasing is depicted in Fig. 2.5. The over-fitting problem of customary neural networks was, after that, resolved by decreasing the number of trainable parameters [18].

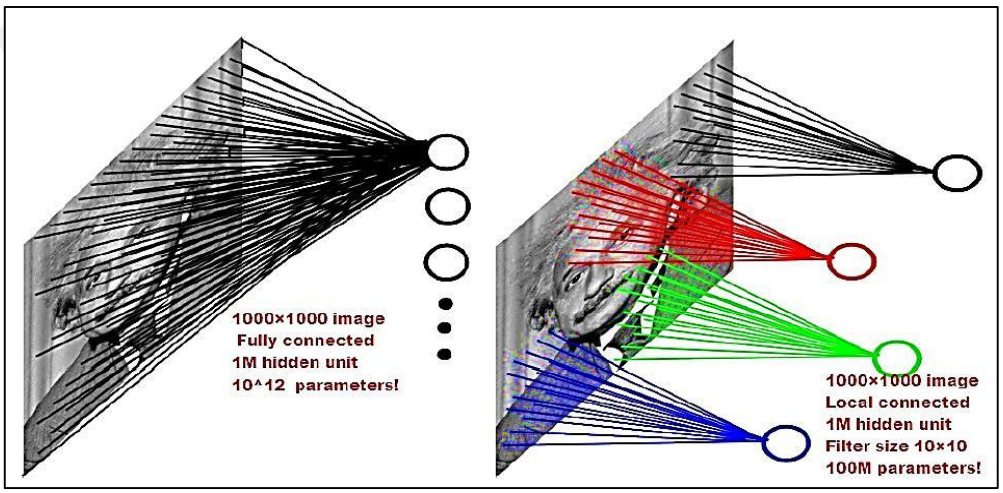

Figure 2.5: Analogy among convolutional layers against weights sharing as well as totally combined [19,20].

A number of spatially sparse learnable filters make up the convolutional layer's borders. Every filter is convolved through the thickness and level of information content through the forward access, resulting in a 2-layered implementation approach for that filter. The system learns filters that will be activated by specific types of features along the contribution at precise points, extracting crucial information along entrances in a manner similar to the convolutional activity in conventional feature-planned algorithms. The entire result volume is after that framed by stacking such activation maps for all filters along the profundity aspect. The number of convolutional learned filters increased with the help of load sharing, enabling the extraction of additional information in addition to the inputted data.

Convolution of the data image against a filter, summarizing a portability expression, produces a feature plan in a convolutional layer by reformulating capacity usage across sub-areas of the entire image. If we mean the k-th entered feature guide of a given convolutional layer as hk, with the corresponding filter set to Wk and predisposition set to bk, then the result feature guide of such convolutional layer hk+1 is obtained as:

$$h_{k+1} = W_k + h_k + b_k \quad (2.4)$$

In which + means the convolutional activity. For a completely associated layer, it is an extraordinary instance of the convolutional layer. A completely associated layer is a convolutional layer that catches every neuron in the past layer as well as attaches them to each individual neuron it has; that is, applying a convolutional layer beyond parameters allocating with every filter of such layer is using size 1*1. The essential operation of the totally linked layer is to minimize the spatial neurons positioned as well as along huge-perception features.

b. Pooling Layer

In a CNN design, the pooling layer is intermittently embedded between convolutional layers. The pooling layer has the ability to lower the objective of feature plans, achieving spatial invariance and easing the over-fitting problem in the process [21]. Every pooled feature plan in a layer that pools features is related to a feature guide in the layer that pools features. The feature map's units are joined using a small n * n patch, as seen in Fig. 2.14, creating position invariance along larger neighbourhoods. In the meantime, it down-examples the contribution along each bearing by an element of n * n [22]. Figure 2.6 shows the maximum pooling approach used for the CNN pooling layer [21].

The maximum pooling layer must satisfy the following formula:

$$a_j = \max(a_i^{n \times n}\, u(n, n)) \quad (2.5)$$

Where u(n,n) is the input data applied window that is utilized to excerpt the ultimate value in the neighboured pixels data.

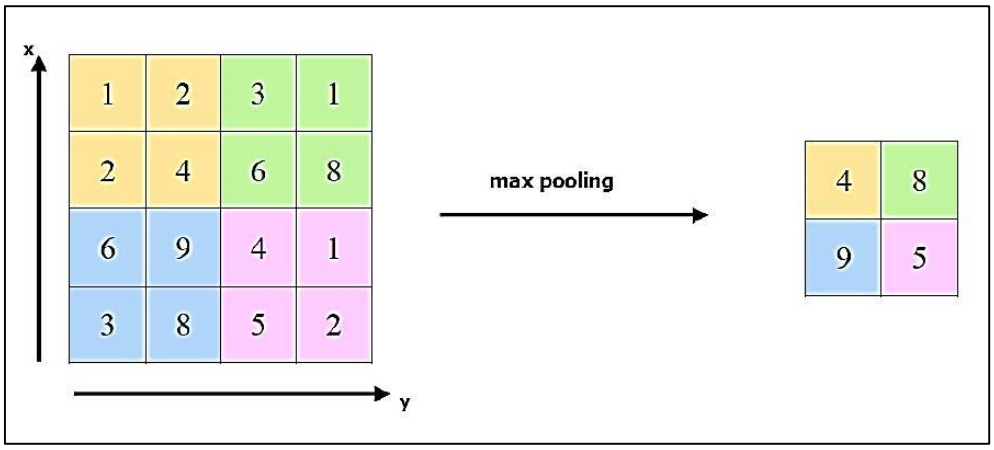

Figure 2.6: Demonstration of the maximum pooling technique utilized in the CNN pooling layer [21].

Despite of mean pooling was regularly utilized in conventional CNN; max pooling showed a superior execution in tests and is broadly utilized in ongoing CNN architecture plans. Scherer et al. [22] led a trial to analyse the execution of maximum pooling and sub-testing on object acknowledgment tasks. The outcome illustrates which maximizing pooling is better than sub-examining for invariance catches in the picture-like information. In addition, maximum pooling empowers a quicker union ratio by picking prevalent invariant features, which further develops execution in speculation, what's more, decreases the number of teachable boundaries, in this manner limiting estimations and processing time, bringing about superior efficiency during preparing [23].

c. The Activation Function

The execution regarding activation functions is one of the most important components in CNN. Activation formulae increment system non-linearity, which leads to high information group comprehension. Despite massive volumes of information, activation relation also offers a feature plan that increases the independence of neurons in the next layer, which in turn increases the security of the whole network. This feature plan is provided in addition to non-linearity. Here, we introduce the three most often used active functions at CNN. All active functions must be differentiable, which ensures the use of the back-propagation approach in the preparatory interaction. This is an important normal affirmation. The so-called sigmoid function, as shown below, can serve as a representation of the activation function.

$$\text{sigm}(x) = \frac{1}{1-e^{-x}} \tag{2.6}$$

The sigmoid function is displayed in Figure 2.7.

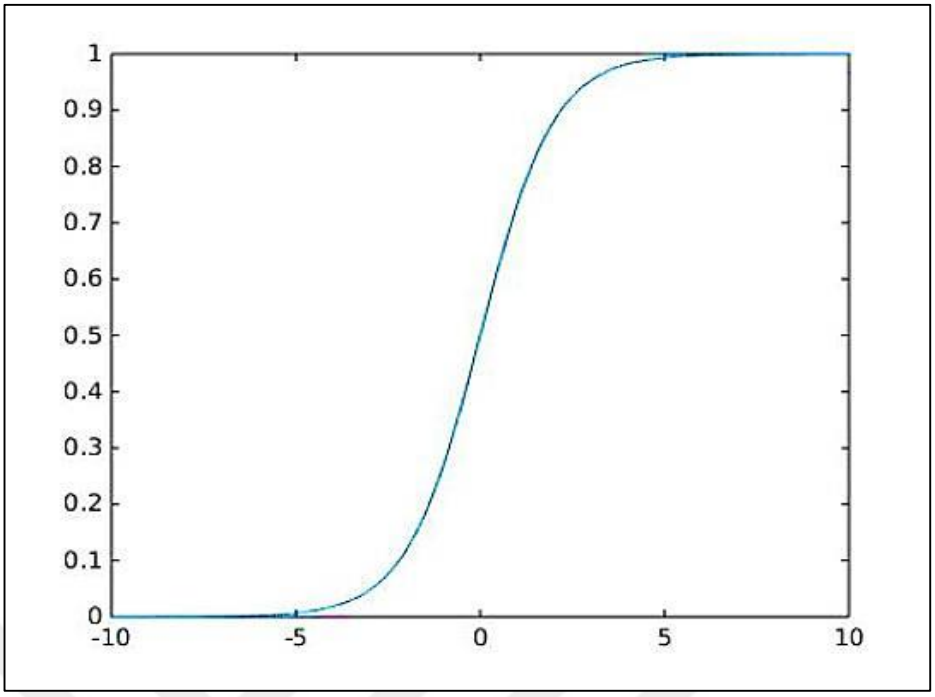

Figure 2.7: Graphical chart of a typical sigmoid activation function [24].

d. Dropout

Multiple non-straight hidden layers in a CNN architecture make CNN an expressive model that may acquire accustomed to dealing with the complicated relationships between the information sources and results. Notwithstanding, under the circumstance where there is restricted preparation information, large sums of such muddled connections will be the consequence of a testing environment that is only available in the preparation sets yet not in test information, regardless of whether the examining information is drawn along similar dissemination [24]. Then, at that point, over fitting would happen during preparing operation. Numerous techniques have been created to diminish such issues, such as halting the preparation whenever execution on an approval set begins to get awful, presenting various weights punishments, and delicate weight-sharing sorts [25]. Dropout [26] is a strong calculation acquainted with taking care of the over fitting issue, which diminishes the speculation mistake of enormous brain systems. Since a single neuron cannot depend on the existence of other neurons in dropout computation, it lessens complex co-transformations of neurons. Dropout thus improves CNN, enabling it to pick up more robust characteristics and reliable construction [27]. The system "dropout" refers to brain

systems' departing units, both apparent and hidden. By "dropping a unit out," we meant to quickly remove it from the structure as well as all of its associations [28]. In Figure 2.8, a typical dropout diagram is shown.

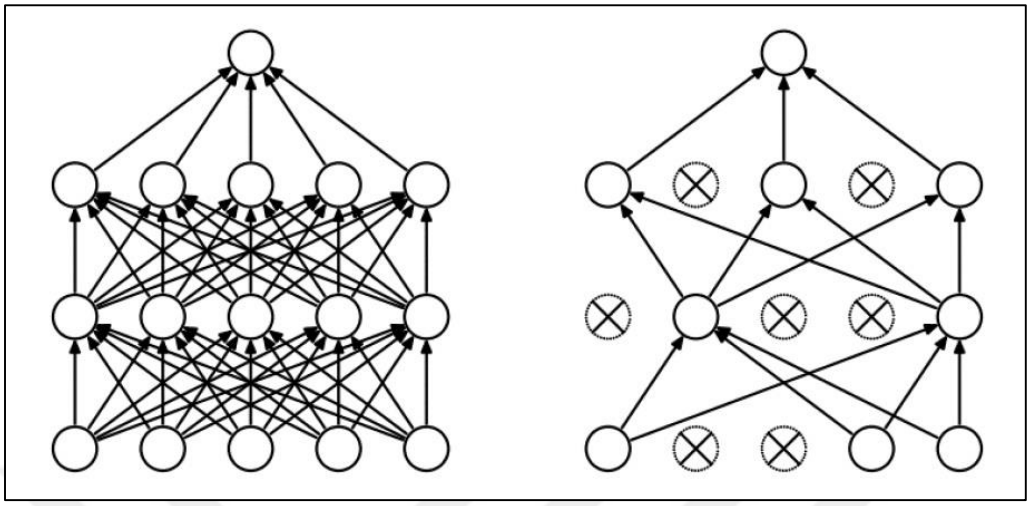

Figure 2.8: Graphical diagram of a typical dropout operation [24].

e. Loss Layer

For CNN application layers, various loss functions have been chosen for various missions. With such a layer, two standard loss functions have been utilized, which are the Softmax loss as well as the Euclidean loss.

2.3.5 Tree-Structured Parzen Estimator

The TPE technique catches various strategies. It does not straight scheme p(yjx), be that as it might, it instead structures p(xjy) and p(y) with customers Bayes' rule to compute p(y/x). In order to design p(x/y) as well as p(y), it utilizes a 'tree parzen estimator' that implements a tree-like strategy like decision trees. Primarily, many points have to be sampled. Also, the next such marks are partitioned in two by selecting a horizon level y* for the y amounts of those marks:

$$P(x|y) = \begin{cases} g(x) & \text{if } f(x) > y^* \\ l(x) & \text{if } f(x) \leq y^* \end{cases} \tag{2.7}$$

l(x) with g(x) are designed in the succeeding approach. To start with, the customer selects an earlier for the hyper-parameters, which characterizes the predictions of what hyper parameters amounts will be well achieved. The elections for hyper parameters are hypothetically boundless. However, in practice, a uniform, Gaussian, or log-uniform

distribution is generally selected [16]. Disregarding the earlier selected, the TPE 'places' Gaussians on every one of the marks that are sampled and fulfil f(x) < y* whenever modelling l(x) or fulfil f(x) ≥ y* whenever modelling g(x). The width of the Gaussians is selected by putting ϭ2 to the excellent of the separations to the neighbour points. We next outlined l(x) or g(x) by considering an equally weighted Gaussian combination with the one selected earlier. A drawback of the TPE technique is that it does such for each hyper-parameter, hence losing the capacity to describe interaction effects among the hyper-parameters. Figure 2.9 visualizes such an operation [25-30].

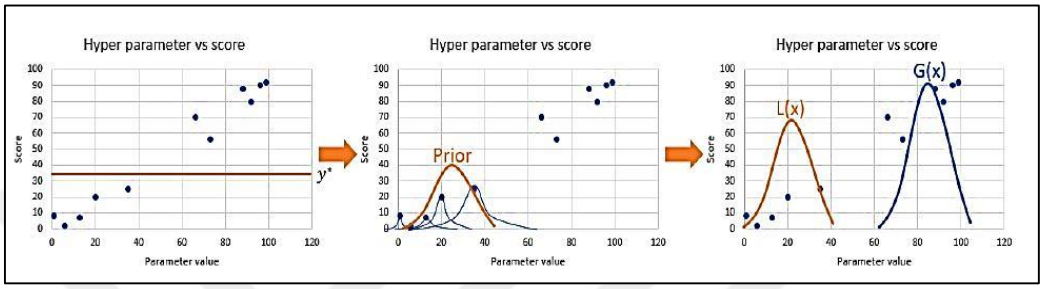

Figure 2.9: Dummy data TPE algorithm examples [10].

Hence, rather than designing the overall interpretation study, TPE repeatedly designs 2 probability distributions such that part is utilized to search for the optimum solution. The procurement work is also the expectation enhancement. [17] demonstrate the way such that, utilizing Bayes' condition and several replacements, it tends to be documented.

$$EI^{y}(x) \propto \left(\gamma + \frac{l(x)}{g(x)}\,(1-\gamma)\right)^{-1} \tag{2.8}$$

In which γ=P(y)y, that represents the observed y function utilized to scheme l(x). The expected formula represents the efforts applied to make the sampled points with a high probability lying below g(x) and those with a lower probability lying below l(x). In other words, the TPE technique is more exploitive than to be employable [31-33].

2.4 DEEP NEURAL NETWORK (DNN) STRUCTURE

The neural network engineering (Figure 2.9) is taken care of against $\mathcal{O}envt$ and $\mathcal{O}selft$ at every edge. The results of the engineering are the Actor with the Critic. Three one-layered convolution layers (out-channel as 32, bit size as 3, and step as 1) are employed for the component extraction reason. The Max Pooling tasks with portion = 2 and ReLU

nonlinearities (Nair and Hinton, 2010) are applied after every convolution layer. The consequence of $\mathcal{O}envt$, in the wake of moving along three stacked one-layered convolution layers, fills in as a contribution to a completely associated layer against 256 regulated cells. Concerning $\mathcal{O}selft$ (a four-aspect vector), we initially fed it into a completely associated layer with 32 regulated cells. Also next, at that point, consolidate with the element removed along $\mathcal{O}envt$. The came about blend is moved to a completely associated layer with 128 rectifier units. The Actor layer comprises two qualities: 1) velocity average ($vmeant$) and 2) bearing ($ameant$). A sigmoid with an exaggerated digression enact work (tanh) is utilized to restrict $vmeant$ to a reach somewhere in the range of 0 and 1 and $ameant$ in a reach between - 1 and 1 [25,26].

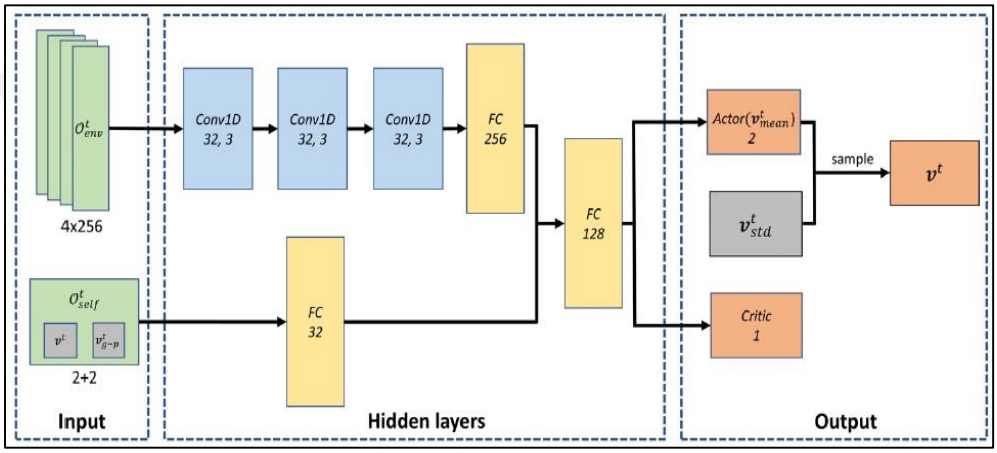

Figure 2.10: Architecture of Deep Neural Network [25].

We further characterize $\boldsymbol{v}meant$= [$vmeant$, $ameant$] and get the last $\boldsymbol{v}t$ along a Gaussian dissemination $\mathcal{N}$ ($vmeant$, $vstdt$), where $vstdt$ is the standard deviation, a consistent hyper-parameter. Along that point forward, we transform the $\boldsymbol{v}t$ to $\boldsymbol{v}pref$ by duplicating the comparing coefficients.

2.4.1 The Deep Neural Network

The neural network is an extremely strong and vigorous arrangement strategy that might be utilized for anticipating the known information, yet in addition to the obscure information. It functions admirably for each straight and non-direct distinct dataset. NN has been utilized in numerous fields, for example, deciphering visual scenes, discourse realization, face realization, unique mark realization, iris realization, and so forth. An ANN is formed out of a system of fake neurons, otherwise named "hubs" or nodes. These hubs are associated with each another. Also, the strength of their associations with each other is

doled out a worth based on their solidarity: hindrance (greatest being - 1.0) or excitation (most extreme being +1.0). In the event that the worth of the association is high, it shows that there is a solid association. Inside every hub's plan, an exchange work is implicit. There are three sorts of neutrons in an ANN, entered hubs, stowed far hubs, and result hubs. A block diagram of the Face Net Structure is illustrated in Figure 2.10 [27,28].

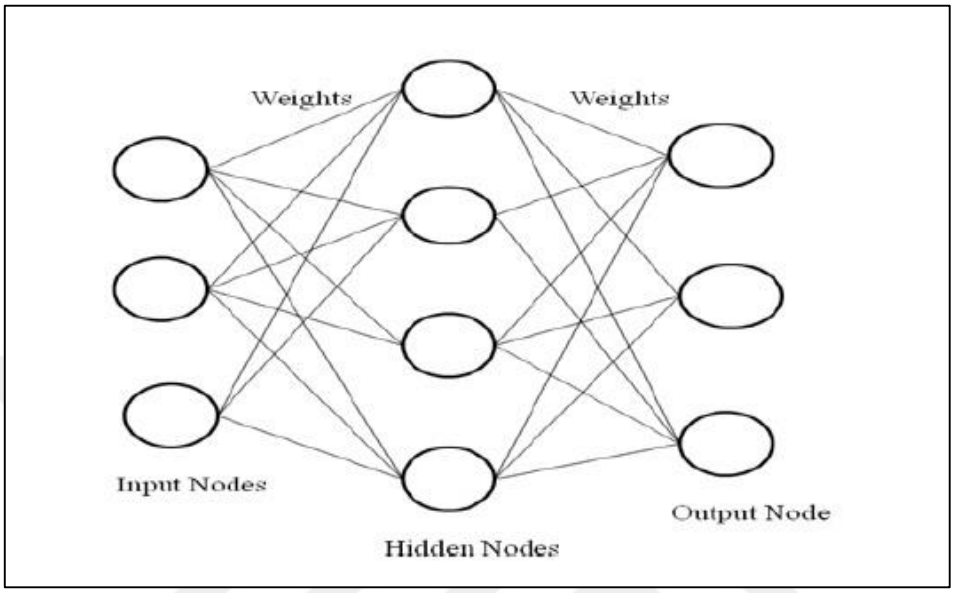

Figure 2.11: Block diagram of Face Net Structure [28].

The info hubs take data as numeric articulation. The data is illustrated as actuation amounts, whereas every hub has provided a sum, the larger the sum, further noteworthy the actuation. Such data is next moved all through the system.

Relying on the association qualities that are loads, hindrance or excitement, and move capacities, the actuation esteem is moved from one hub to another. Every one of the hubs aggregates the enactment amounts it gets; it then alters the worth depending on its exchange study. The initiation moves along the system, over secret layers, until it arrives at the result hubs. The result hubs next, at that point, mirror the significant.

2.4.2 Topologies of Neural Network

Deep neural networks have been categorized into two main topologies, the feed-forward networks and the recurrent (RNN) neural networks, which will be discussed in detail in the incoming sections of this chapter.

a. Feed-Forward Network

A feed-forward network is a non-repetitive network that includes information sources, yields, as well as secret layers; the signs might go in single bearing. Input information is gone to a layer of handling components, which permits computations. Every handling component creates its calculation based on a weighted sum of its bits of feedback. The advanced determined esteems next to become the modern information esteems which feed the following layer. The cycle goes on until it has gone through every part of the layers and also decides the result. A limit move work is here and there used to measure the result of a neuron in the result layer. Feed-forward networks incorporate directly with non-straight, furthermore, Radial Basis Function networks [11]. Figure 2.11 addresses straightforward feed-forward geography, otherwise called a non-cyclic diagram, whereas the info is streamed along contributions to yields in just a unique course, whereas in Figure. 2.12. We really want to create an origin to that for easier comprehension with the mathematical depiction of a fake brain network. We model the gathering of individual neurons in layers. In Figure. 2.10. We might observe enter, stowed away as well yield layer. Whenever we pick with assembling geography of our fake brain network, we only completed a portion of the assignment before we might utilize such a counterfeit brain network to take care of a given issue. The succeeding stage is utilized to become familiar with the legitimate reaction of a fake brain network, and such might be accomplished through directed, unaided, or on the other hand, support learning. The errand of learning is to set the upsides of weight; what's further, inclinations upon the premise of learning information limit the picked cost relation [11].

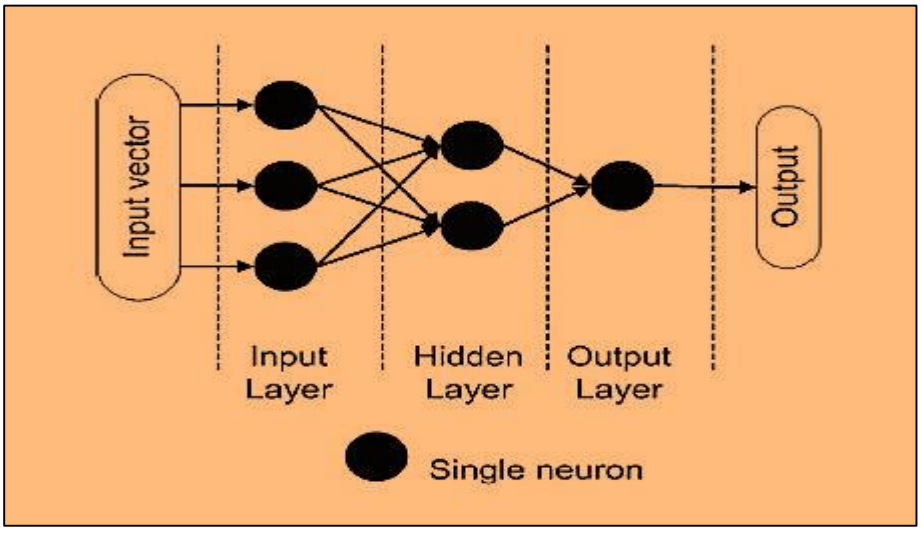

Figure 2.12: Schematic diagram of Feed Forward Neural Networks, FNN [12].

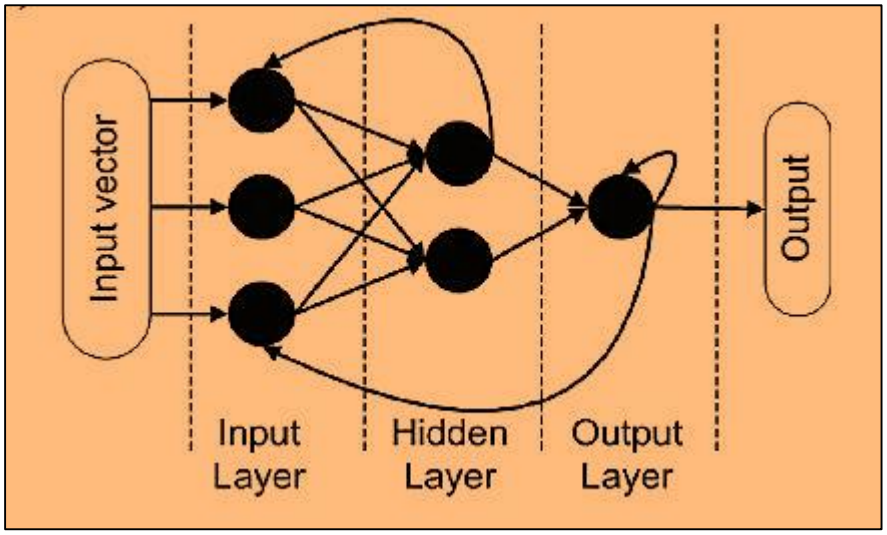

Figure 2.13: Schematic diagram of Recurrence Neural Networks, RNN [12].

b. Recurrent (RNN) Neural Network

In Figure 2.12. Addresses straightforward intermittent geography otherwise named semi-cyclic chart, whereas a portion of the info streams not only in the such frame of mind along a contribution to yield yet additionally in the inverse heading. A fake brain network against intermittent geography is called a repetitive counterfeit brain network. It is like a feed-forward brain network against no constraints in regard to back circles. In these issues, info is not generally sent as it were in a single heading; however, it is additionally sent in reverse. This creates an inside condition of the network which permits it to display the dynamic transient path of behaving. Intermittent fake brain networks might utilize their inward memory to deal against either succession of info origins. The ultimate fundamental geography of intermittent counterfeit brain networks is a totally repetitive fake network, whereas every essential structure block is straightforwardly associated with each and every extra fundamental building block toward every path [12].

2.4.3 Neural Networks Types

a. Single Layer Feed Forward Network

A single feed-forward or non-cyclic network is a NN where the information layer regarding the origin hubs is coupled to the result layer of neurons but not the other way

around. The yield layer of the calculating hubs is referred to as the "single layer" in a single-layer network, as shown in Figure 2.13 [13].

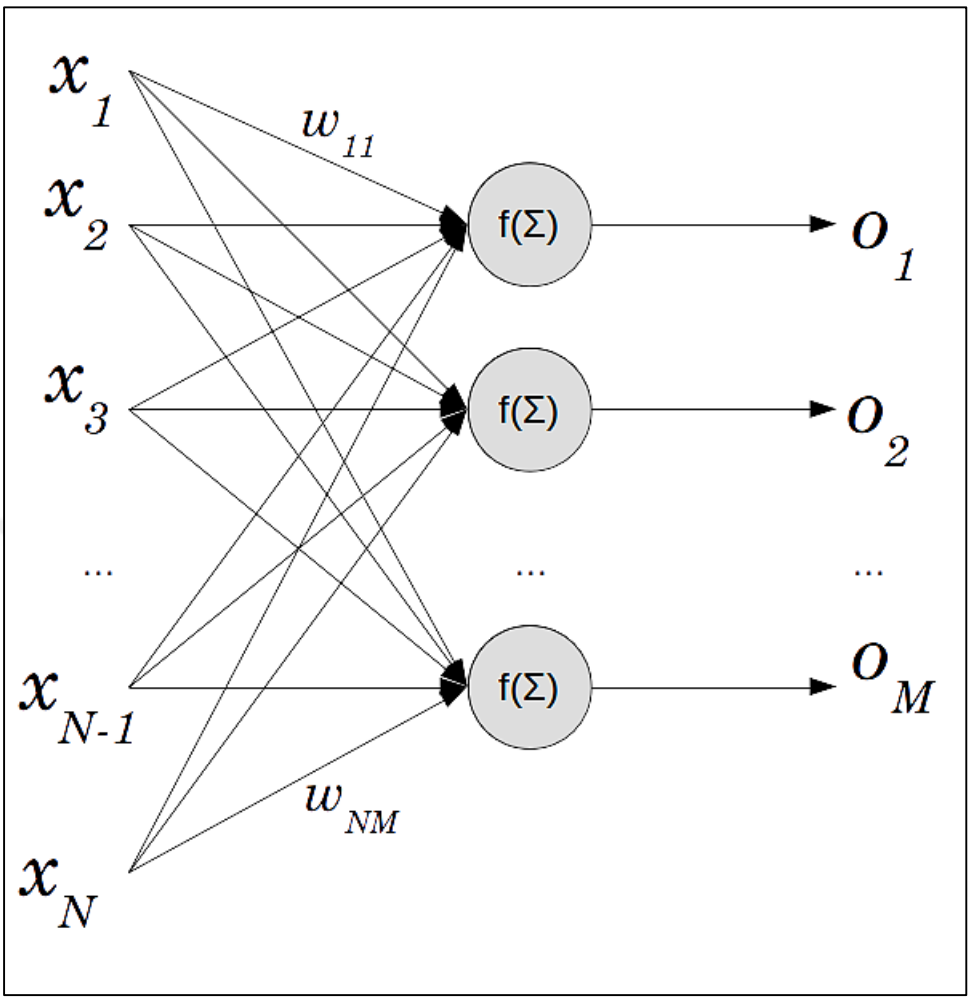

Figure 2.14: Schematic diagram of Single Layer Feed-Forward Neural Networks, SFFNN [12].

b. Multiple Layer Feed Forward Network

This particular network has at least one secret layer whose calculation hubs are referred to as secret units or secret neurons. The ability of neurons that are stored away is to collaborate with the network and external information. Neurons in the second layer, regarding the early inner hidden layer, are supplied with information waves by the network's original hubs in the entrance layer. The second layer's signs are used to contribute to the third layer, etc. According to Figure 2.14, the network's overall response to the initiation design provided by source hubs in the info first layer can be seen in the layout of the neurons' result signs in the network's result layer [13].

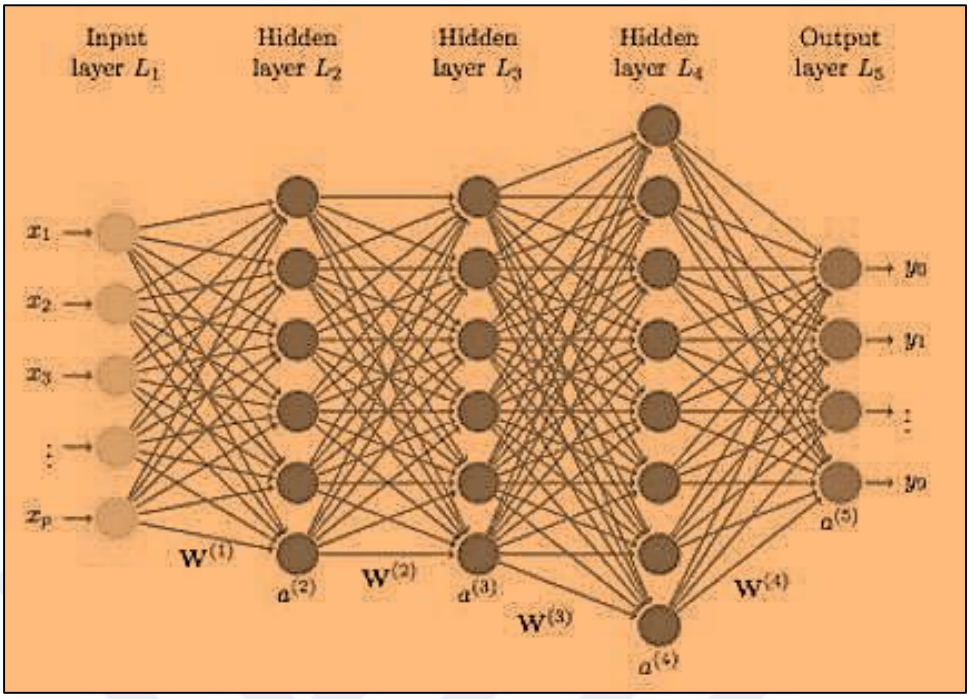

Figure. 2.15: Schematic diagram of Multiple Layer Feed-Forward Neural Networks, MFFNN [13].

c. Recurrent Neural Networks

A feed-forward brain network having at least single stowed-away layers with something like one feedback circle is referred to as an intermittent network, as displayed in Figure. 2.15. The feedback could be self-feedback, in which case a neuron's performance is rewarded by providing feedback to itself. Feedback circles occasionally make use of unit defer components, leading to a nonlinear dynamic route of behavior and assuming the presence of non-direct units in the NN. There are numerous additional NNs, including delta-bar-delta, vector quantization, Hopfield, probabilistic, counter engendering, Boltzman, Hamming, bidirectional affiliated storage, spatio-transient examples, self-getting sorted out the map, flexible reverberation, distribution, and others [14].

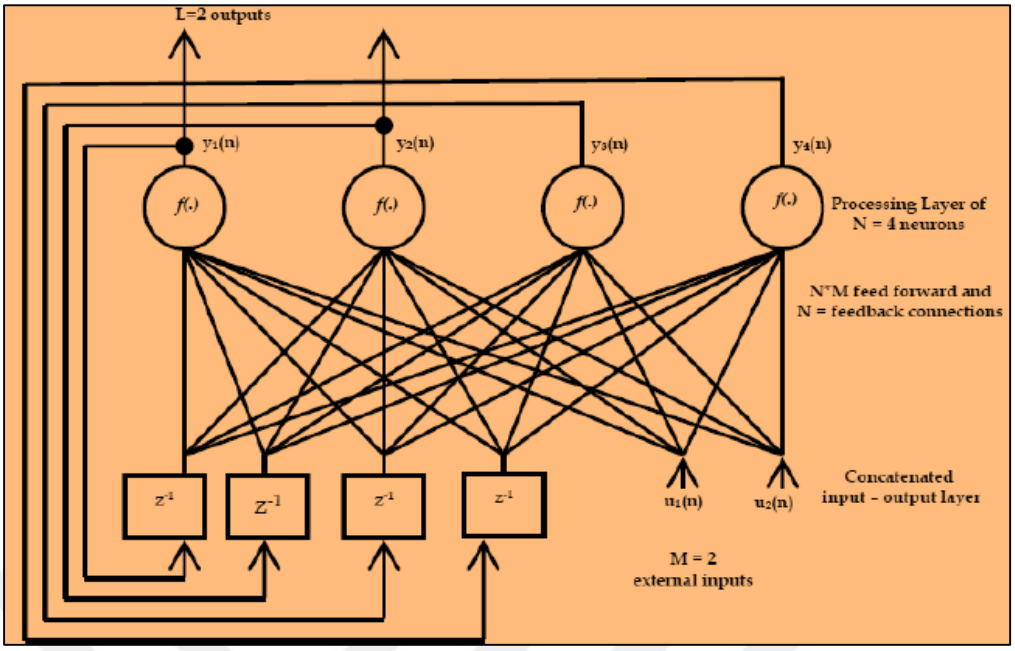

Figure 2.16: Schematic diagram of Recurrent Neural Networks, RNN [14].

2.5 ARTIFICIAL NEURAL NETWORKS (ANNs)

Actually, ANNs might be considered one of the most important categories of NNs. ANN, commonly called neural networks (NN) or neural networks [24], are computational systems derived from biological neural networks that resemble animal brain cells.

2.5.1 ANNs Structure

A set of connected units or nodes known as artificial neurons serves as the foundation of an ANN and serves as a model for neurons in the biological brain. Each connection could transmit signals and impulses to neighboring neurons, just way synapses do in the biological brain. The artificial neurons could reveal which neurons are connected to them after receiving and processing the signals. The next structural elements make up ANNs.

a. The Biological Neuron

The biological neuron is an exceptional biological cell that measures data. As per [22], there is a gigantic number of neurons in the human brain, around 1011, and every neuron is associated with 103 up to 104 different neurons. Altogether, roughly 1014 to 1015

interconnections. As displayed in figure 2.16, a run-of-the-mill neuron basically comprises the accompanying three sections:

i. The dendrites, which are the contributions of the neuron, gather electrical data from the sensory system.

ii. The soma that measures this data and conveys back an electrical message of drive type.

iii. The axon through which the active sign is sent to adjoining neurons.

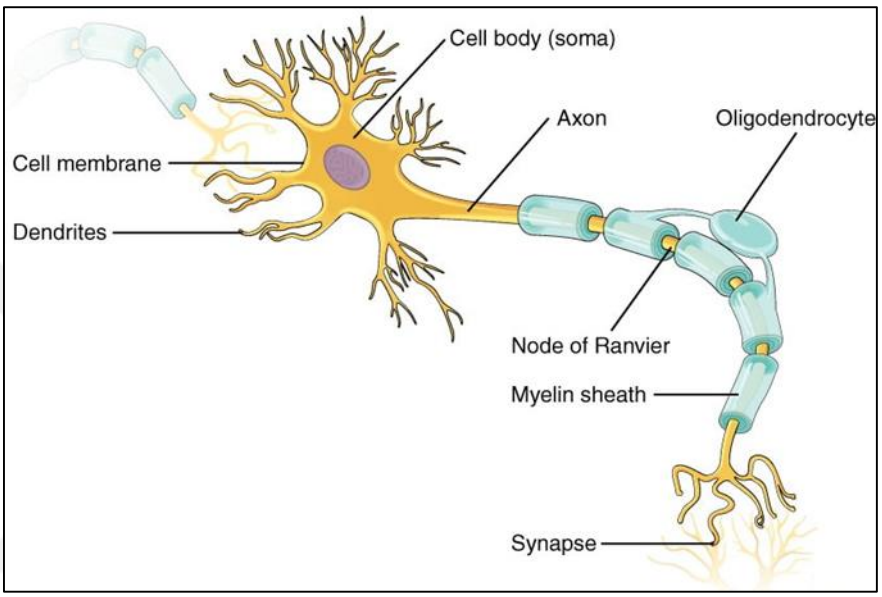

Figure 2.17: Sketch of the biological neuron

b. The Formal Neuron

A regular neuron (Figure 2.17) is a numerical value; it is represented as the structure of a biological neuron. Regular neurons are primitive cells in a hidden neural system. The concomitant graph locations the total algorithmic scheme of a regular neuron [23]:

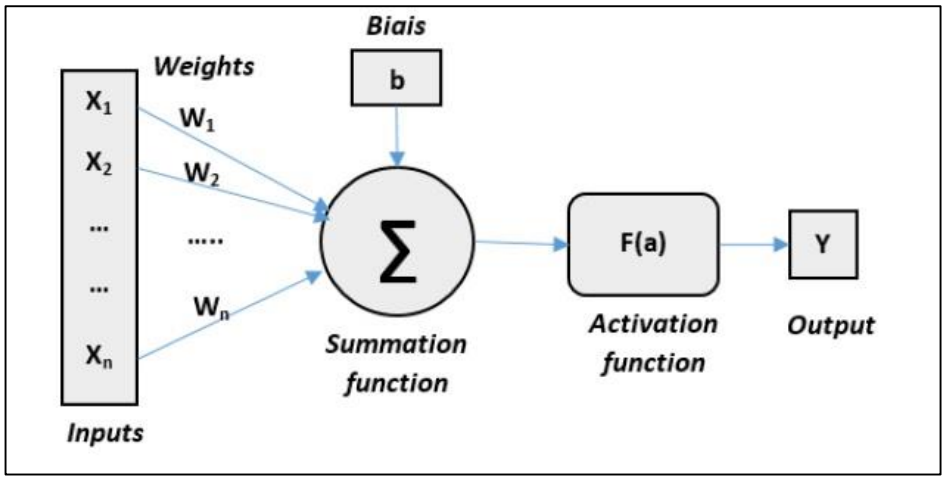

Figure 2.18: Numerical model of the formal neuron.

The regular neuron, which is illustrated in the above chart, has n entries represented as $\{X1,X2,\ldots,Xn\}$. Every direction that interfaces such improvements to the addition of weight is assigned to indicate the intersection as $\{W1,W2,\ldots,Wn\}$. The nets data yin might be represented as below:

$$yin = x_1.w_1 + x_2.w_2 + x_3.w_3 + \ldots + x_n.w_n + b \quad (2.9)$$

The improvement function $F(a)$ is part of the essential remains of a neuron. A few starting abilities might become along (restriction function, direct density, sigmoid function). With such a section, we have selected a sigmoid function (Figure 2.18) for its nonlinearity which consists of it probable to imprecise either quantity. Finally, the result $\boldsymbol{y}$ of the neuron is provided in the hidden layer:

$$y = F(y_{in}) \sum w_i * x_i + b \quad (2.10)$$

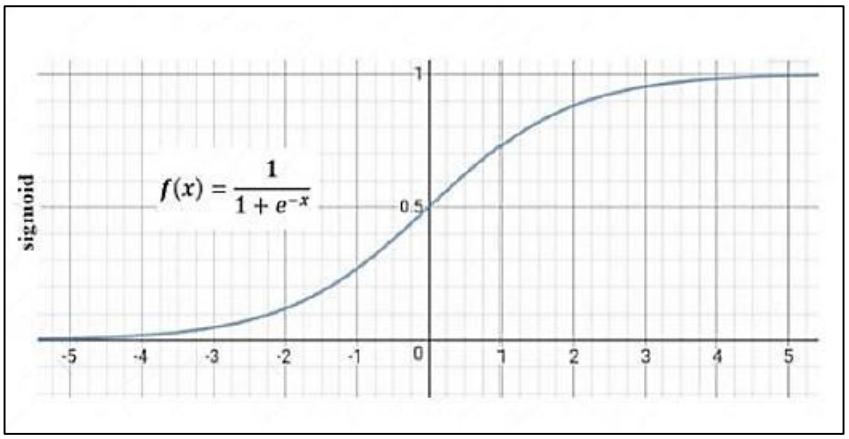

Figure 2.19: Demonstration of the sigmoid function [22].

c. Multi-Layer Perceptron

MLP (Figure 2.19) can be defined as a class of feed-forward neural networks which have somewhere near three layers of center points. It makes a lot of yields $\{y1,y2,\ldots,y\text{m}\}$ along a lot of information sources $\{X1,X2,\ldots,X\text{n}\}$. Except for the data center points, each center is a neuron that uses a nonlinear inception work [24-26].

$$e(t)= y_d(t)- y_m(t) \tag{2.11}$$

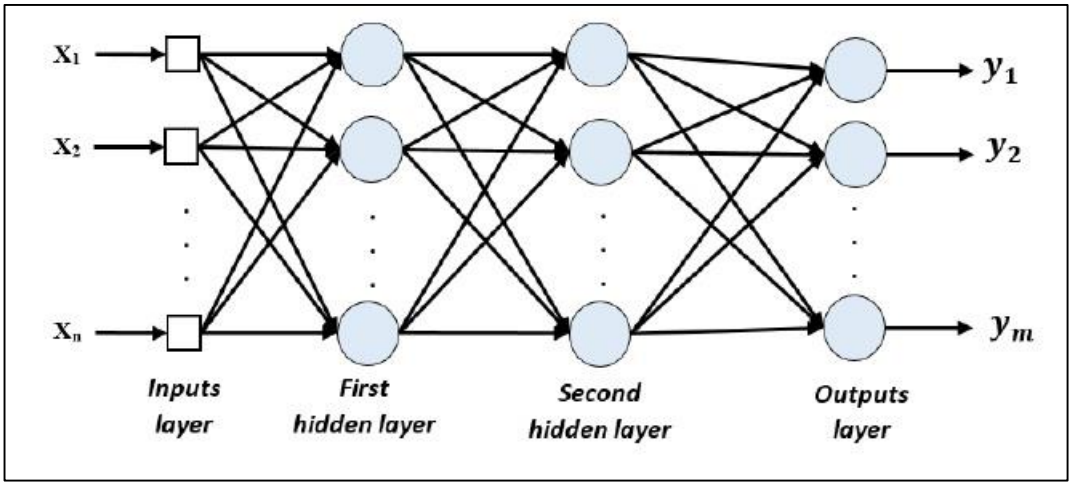

Figure 2.20: Block diagram of MLP model [23].

A neural network is ready along data and objective pair plans against the limit of learning. MLP can seclude data that isn't straightforwardly conspicuous [25]. It is specially arranged

using a supervised learning strategy returned to proliferation (BP) technique [26], that objectives restricting the overall error assessed at the output layer by the association layer:

$$E_g(t)=\frac{1}{2}\sum_{i=1}^{n}\left(y_{d,i}(t)-y_{m,i}(t)\right)^2 \quad (2.12)$$

Where y d (t) implies the best yield, and y m (t) the conscious result of the neuron.

BP algorithm uses an iterative supervised training framework, whereas MLP is ready against a lot of predefined wellsprings of data and results. The overall misstep g not entirely set in stone by relation (2.12). This error might be restricted by the gradient descent method [27]. There are a couple of planning algorithms that could be used to prepare an MLP organization. In this review, we will present an emotional assessment of two getting-ready algorithms: semi-newton and structure slant. Wherein the used getting ready limits are independently train-LM: (Levenberg Marquardt (LM)) and train-SCG (Scaled Conjugate Gradient (SCG)).

2.5.2 ANN Implementation

We have proposed an ANN algorithm as the proposed strategy for our project; the ANN technique is illustrated in (Figure 2.20). The quantity of info layer neurons n is fixed by the focus number (highlights) in the caught signal FFT vector, which is 1024, and we utilize a single neuron in the yield layer (H_1 or H_0) [21,22]:

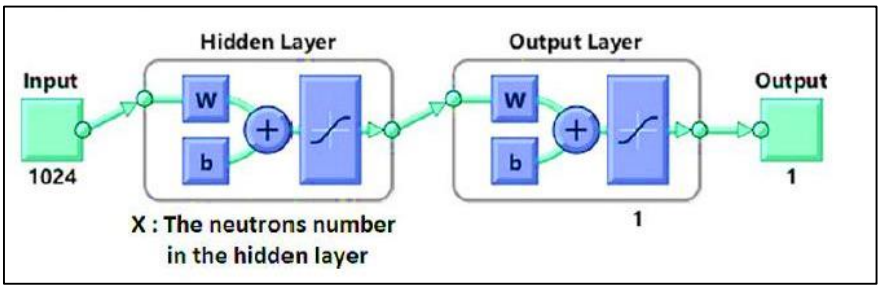

Figure 2.21: Structure of the ANN architecture [22].

2.5.3 Levenberg-Marquardt

A mathematical answer to the problem of limiting a nonlinear capacity is provided by the Levenberg-Marquardt algorithm [14,15], which was developed by Donald Marquardt and Kenneth Levenberg. It has a stable union and is rapid. This algorithm is excellent for preparing medium- and small-sized difficulties in the field of fake neural networks.. Numerous various strategies have previously been obtained for brain network preparation. The steepest plunge algorithm, otherwise named the error back-propagation (EBP) algorithm [16,17], scattered the foreboding shadows upon the area of fake brain networks and also might become viewed as part of the essential forward jumps for preparing brain networks. Numerous enhancements have been made to EBP [18-20], yet these upgrades are moderately minor [21-24]. The EBP algorithm remains generally utilized today; in each issue, it is too known as a consumed algorithm because of its dummy assembly. There are dual principle purposes behind the slow assembly: the principal reason is that its progression sizes ought to be sufficient for the inclinations (Figure 2.21). Intelligently, little advance sizes should be taken where the inclination is steep so as not to shake out of the required minima (due to wavering). In this way, assuming that the progression size is consistent, it should be picked a little. Then, at that point, in the place where the inclination is delicate, the preparation interaction would be exceptionally sluggish. The subsequent explanation is just the curve of the mistake surface might not be something similar every that method, for example, the Rosenbrock study, so the study of the art "mistake valley" issue [O92] might exist and also might bring about the sluggish union. The sluggish assembly of the steepest plunge strategy might be enormously improved by the Gauss-Newton algorithm [25]. Utilizing second-request subsidiaries of noise capacity to "normally" assess the bend of blunder surface, The Gauss-Newton algorithm might observe appropriate advance sizes for every course and meet exceptionally quickly, particularly in the event that the mistake work has a quadratic surface; it might merge straightforwardly in the early cycle. In either situation, such enhancement possibly happens whenever the quadratic estimation of mistake study is sensible. In any issue, the Gauss-Newton algorithm would be, for the most part, various.

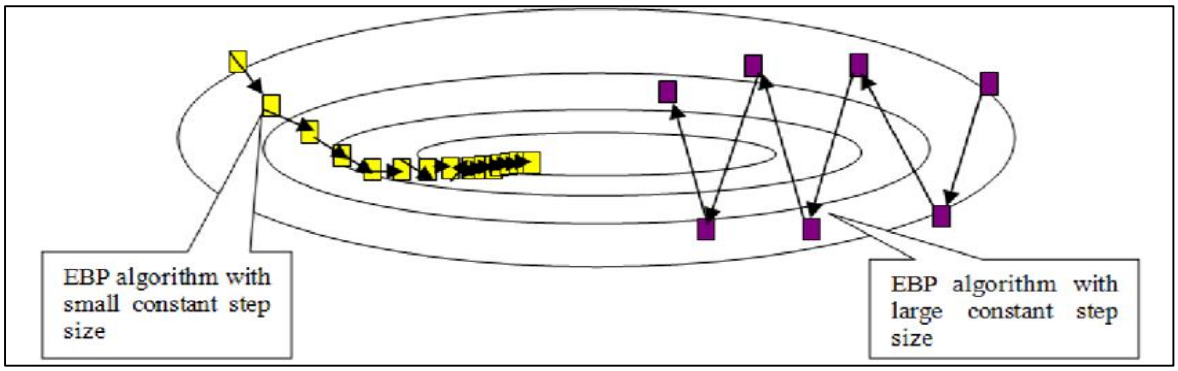

Figure 2.22: The searching process of the steepest descent approach for various learning conditions [25].

2.6 DATA TEMPORARY STORAGE

This part has been discussed and illustrated in the official proposal of the project. There are no more constraints on the design of the Hadoop Distributed File System (HDFS) since it is used to store the data instead of the data warehouse. This stage is specified by the designer corporation, such as the Intel@ manager of the Hadoop System.

The Hadoop Distributed File System (HDFS) is Hadoop's stockpiling layer housed on various servers, and information is separated into blocks based on record size. These squares are then randomly dispersed and put away across slave machines. HDFS in Hadoop Architecture isolates enormous amounts of information into various squares. Hadoop is the most well-known open-source execution of a solitary computing hub, or on bunches [21] Hadoop and apache flash projects are utilized in managing a colossal measure of information. Hadoop can be utilized for putting away enormous amounts of information and for handling information, for example, information mining, report age, record examination, web ordering, and bioinformatics research. As the name suggests, "Huge Data" presents a few difficulties to Information System experts. Most DBMSs are intended for proficient exchange handling: adding, refreshing, looking for, and recovering limited quantities of data in a huge database. Apparently, stages have been made to manage the mass and design of Big Information. Further, as one would expect, they use circulated handling as well as programming optimization strategies. This work will examine both even dispersed document systems like Hadoop (and its replacement Spark) and vertical systems that depend on elite execution arrangements which influence various centers. Additionally, it will zero in on the flat system Hadoop. The Hadoop document system and

its related parts make a complex yet effective design that can be utilized to help Big Data examination. Figure 2.22 shows an illustrative diagram of the Hadoop architecture.

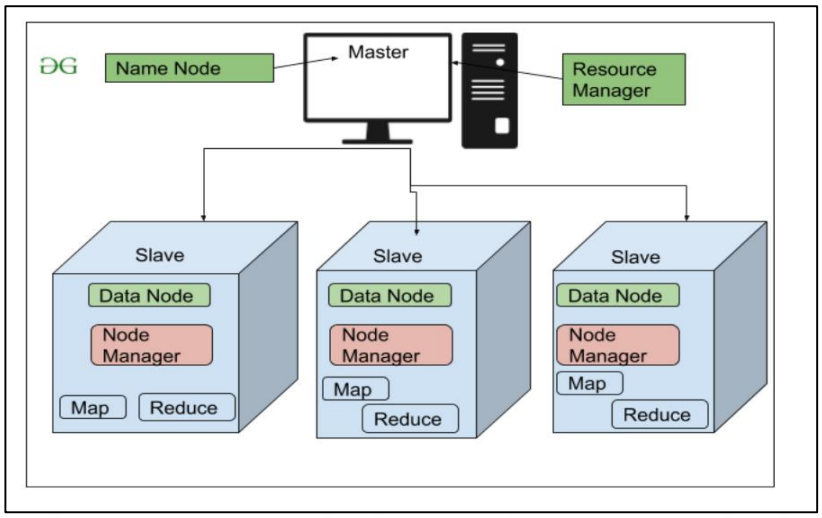

Figure 2.23: Block diagram of Hadoop architecture [14].

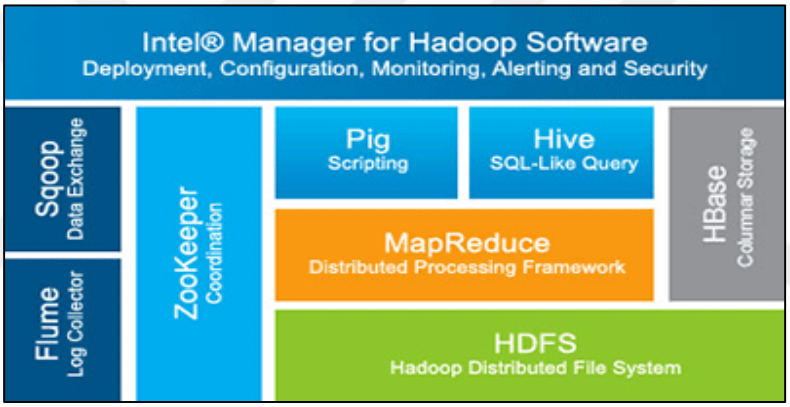

Figure 2.23: Block diagram of Hadoop architecture [14] 'Figure Contied'.

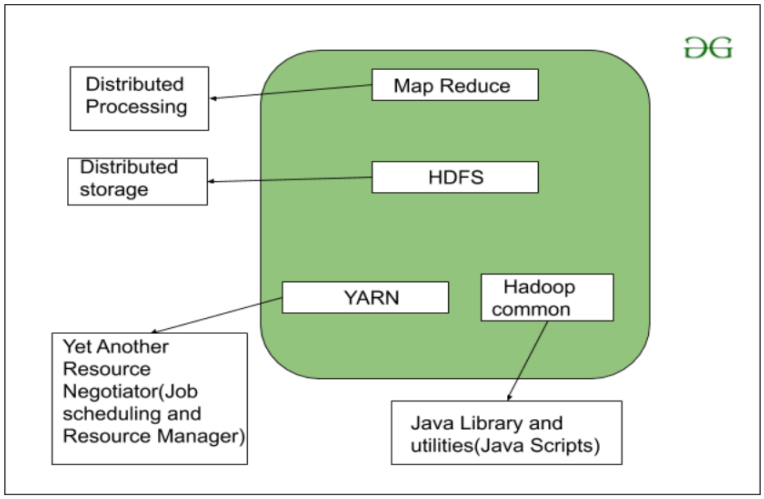

Figure 2.23: Block diagram of Hadoop architecture [14] 'Figure Contied'.

The main functions of the Hadoop architecture are to arrange the analysis of the big data action after classification by providing extra nodes and mapping strategies with reduction operations in order to sustain perfect data arrangement and grouping enhancements.

Referring to the literature [1-12], we can see that the best technique utilized for data analysis and feature extraction is the Convolutional Neural Networks (CNN) and the Levenberg Marquardt (LM) machine learning algorithms. This is due to the high accuracy provided by these approaches compared to other standards and well-known techniques. With the increase in the utilization of social media sites significantly and the enlarge in the user's sum as they provide all the basic services and daily demands of clients for most important activities at all commercial stages, social, marketing, education, and extra, there is an urgent requirement to produce a comprehensive analytical and predictive system which operates on reading and analyzing the desires of customers to provide a comprehensive description. It facilitates investigations and shortens effort, time, storage, and search domains for the servers and clients' needs. In this section, three data sets have been considered and examined by applying sentiment analysis with convolutional neural network (CNN) optimization technique, using hyper parameters optimized Tree – Structured Parzen Estimator with LSTM, and hybrid CNN, hyper-parameters optimization using Tree-Structured Parzen Estimator (TPE), and Define by Run deep learning algorithms. The data sets represent big data for Amazon social media containing information with various classes, items, and attributes. The classification of the analyzed info will provide a recommender system that simplifies the choosing operation for clients and customers in social networking sites by providing readings and analyzes of various types of information circulated on different types of websites so that the information is trained as a supervisory training for different tweets by collecting several client's data to predict their different interests and demands.

3. PROPOSED STRUCTURE

3.1 PROBLEM FORMULATION

The initial steps of our current research are planning the research problem and as indicated in the work steps. Where each research starts by defining the problem and arranging the steps to address this problem using an organized methodology to reach the appropriate solutions to form the conclusion or results of the research. Detailing a general point in a particular research problem is the essential step in any methodological and scientific inquiry. Two steps available in any research problem are to discover the problem, understand it carefully, and reformulate and analyze it towards consequential details according to an analytic impression. The ideal method to understand the problem is to examine it with researchers who have little experience in the field. With regard to public schools, it is usually the presentation of the problem through the supervisory companies against which we might explain how the problem basically occurred and what proposals were included in providing potential results. Later reconstructing the problem through analytic terms, i.e., defining the problem in specific terms as expected. Such procedure in reviewing the problem is considered a place of great importance in the investigation operation once and for all. You must specify the problem to be explored in order to support the applicable information that is drawn from the irrelevant information. A research problem plan frequently adheres to a fundamental step-by-step research model so that various details are organized, with each definition becoming more specific and distinct from the previous definition as each is explored with more analytical concepts and terms, each becoming more functional regarding data and visual resources. The following list could serve as a summary of the project's major drawbacks and problems:

a. The problem of the limited online feedback to the students.

b. The social isolation which might be produced by e_learning operation.

c. The need for strong and efficient devices and servers, which do not always exist.

d. E-learning requires powerful students' self-learning skills and precise administration management abilities.

e. Difficulties of cheating prevention and limited observation abilities.

The flow chart of the suggested CLEM model is displayed in Figure 3.1.

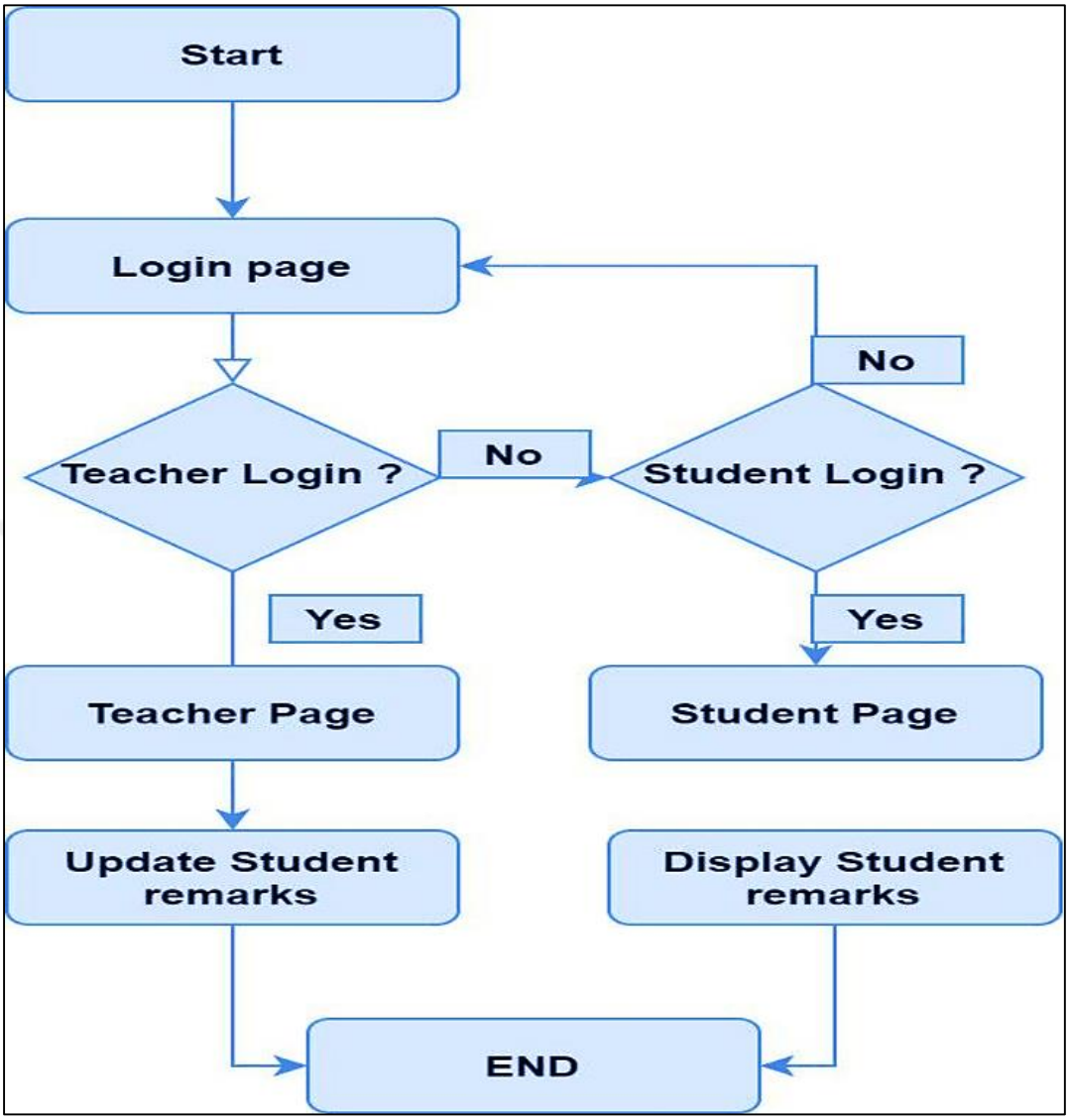

Figure 3.1: Flow chart of suggested CLEM model.

3.2 SUGGESTED SYSTEM PROCEDURE

A cloud-based model for e-learning in mechatronics is the proposed architecture. This proposal shows the general layout regarding the Cloud e-Learning for Mechatronics project. An explicit region cloud luminance that is specially adapted to the needs of Vocational Education and Training (VET) trainers is known as a CLEM. The cloud-based configuration of remote research facilities represents the most astounding advancement. Students could practice using the majority of virtual lab resources here, allowing them to learn remotely and virtually without having to set up labs in their own institutions. To essentially present a convenient environment for students and teachers, the cloud framework enables several research centres to converge. Through such framework, teachers could select and combine resources to design courses that are suited for their students and give them access to a variety of instruments and laboratory equipment via the cloud network. This study presents an integrated blueprint for this state-of-the-art cloud-based e-learning technology and illustrates the results. This study analyses how distributed computing is implemented and supported in other technologies, in addition to showing how to aggregate the overall e-learning experience along with the use of static and dynamic branch graphics Intuitive for development and collaboration.

Engineering's crucial CLEM stage includes an employer that keeps static training materials, such digital books and energy point slides with discussion notes. Moodle, which offers the Integrated Learning Environment in addition to what the static substantial might be needed to, is another resource that the business has available. Along with wiring to various remote research attachments, the employer also provides a booking and access framework with the intention of allowing instructors or students to reserve and receive the laboratories. Moreover, the employer has a combined collection office named CLEM ROOM with the aim that staff might obtain master guidance with more assistance every another as data as well practice improves. CLEM ROOM, which associates an Expert Channel, makes the analysis and agreement of collecting to provide a better theoretical description of transaction and communication meeting among convections sums and relies on our last production, frame professionals are recruited. In the beginning, the technicians are the planners of the structures against the discoverers of the supply statistics.

The proposed simulated CLEM model and its subsystem organization are shown in Figure 3.2. The proposed CLEM model, as shown in Figure 3.2, consists of five fundamental classes: Cloud Management System, Client Request Server, Physical Hardware, Virtual Storage & Machines, and the Mechatronics Virtual Laboratories Classes. Each unit regarding such classes was meticulously simulated and planned using the big data network classification objective concepts. The operation of such a subsystem is to carry out the client's data with the essential information for achieving the cloud management subsystem in opposition to the client mechatronics categories information, like the student number and the class period. Figures 3.3 and 3.4 show how each subsystem in the following subsystem, the Virtual Storage & Machines, is organized.

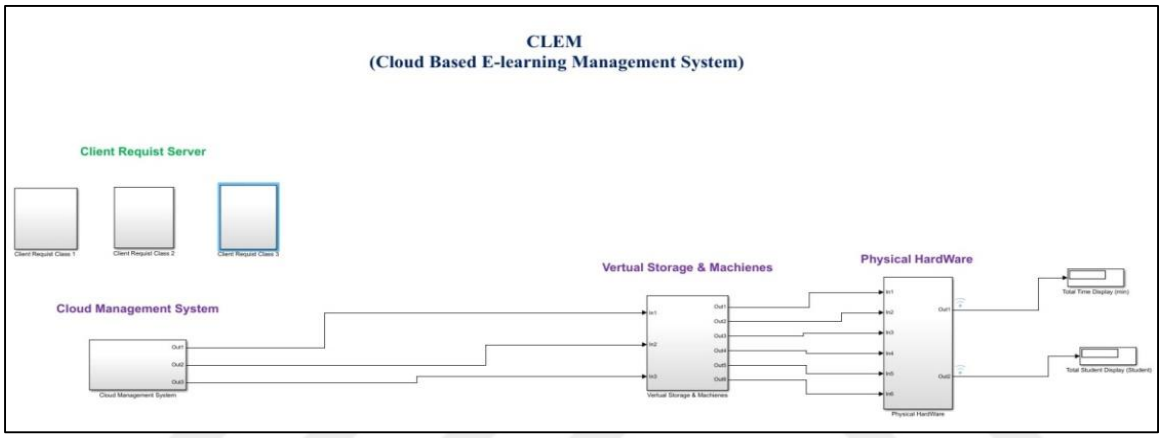

Figure 3.2: The proposed Simulated CBEM system.

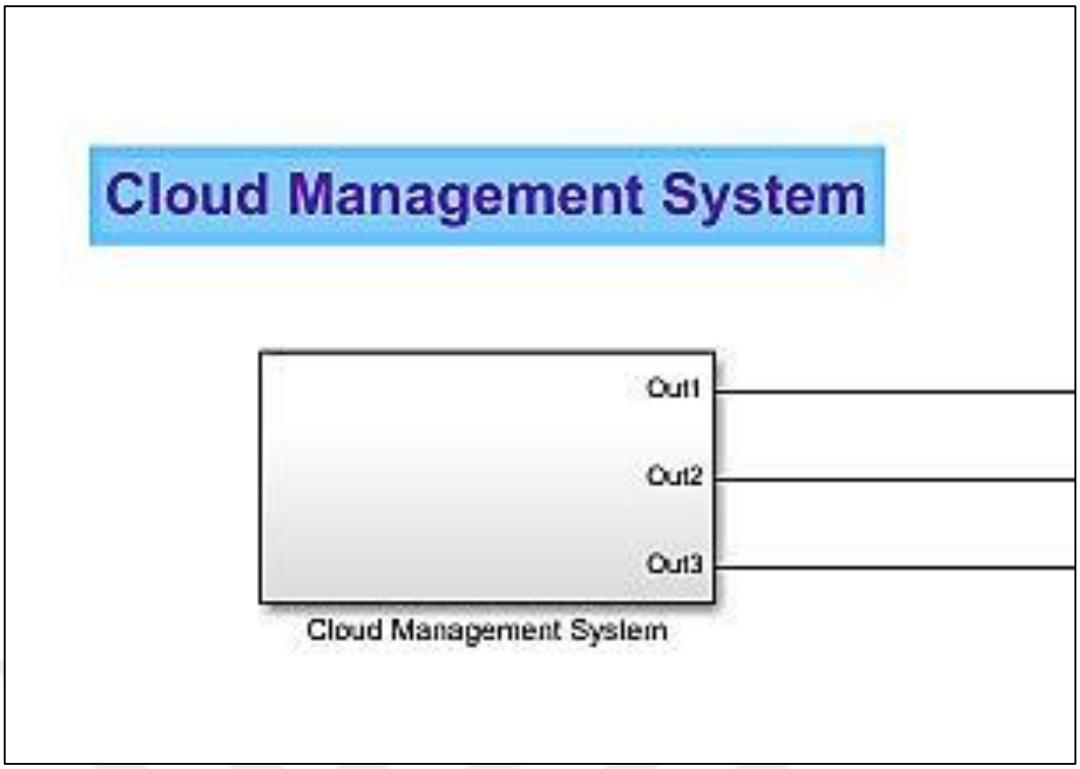

Figure 3.3: CBEM Cloud Management System subsystem.

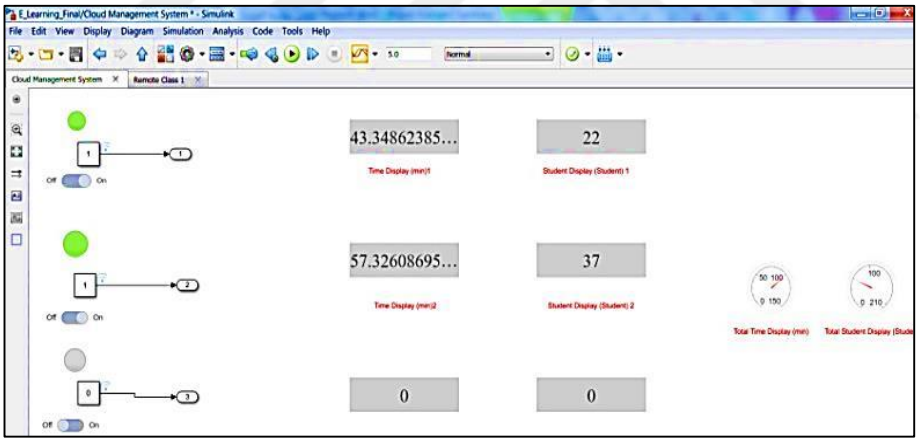

Figure 3.3: CBEM Cloud Management System subsystem 'Table Contied'.

In fact, this subsystem might be considered the essential one in the CLEM model that has been devoted to controlling and monitoring the overall CLEM structure. Figure 3.3.a shows three outcomes from this work's cloud management system that illustrate a specific client mechatronics laboratory virtual class. As shown in Figure 3.3.b, such virtual classes were fully monitored and adjusted along such subsystems. In this example case study, the first and second virtual stages are displayed with green lumps that were plugged in,

whereas the third class is shown with a black lamp that has been unplugged. Figure 3.4.b makes it clear that the class period and the student's grade have been depicted using controlled digital gauges. In addition, analogue control displays display the entire mark of classes along with the student's grade.

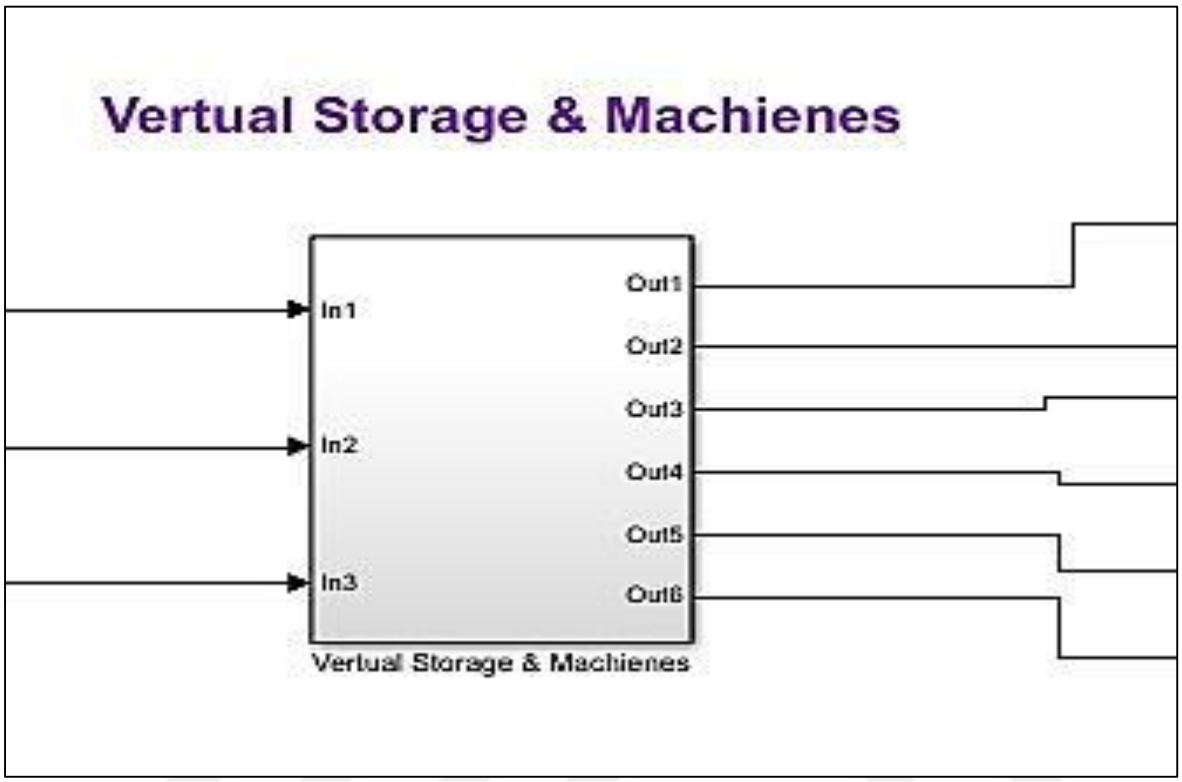

Figure 3.4: The subsystem of CBEM Virtual Storage & Machines System.

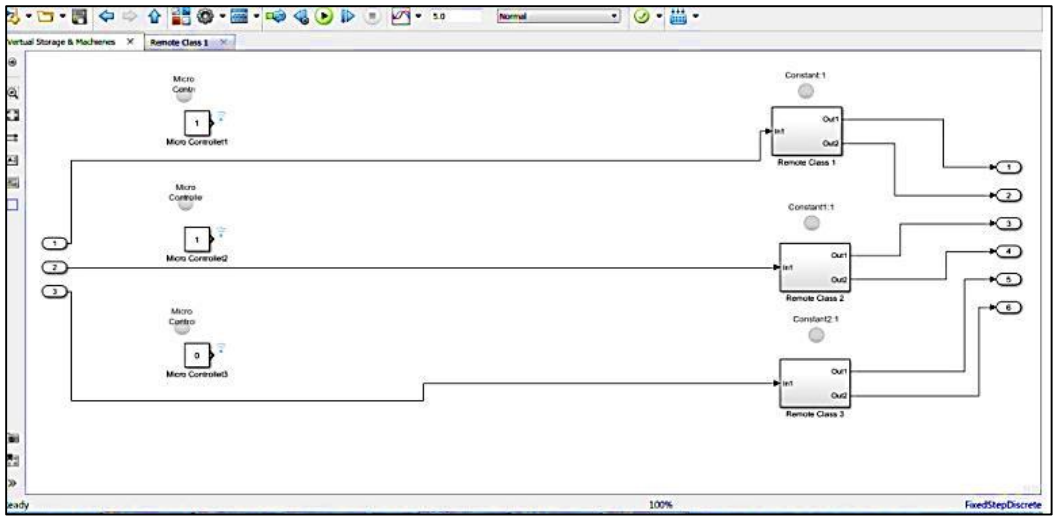

Figure 3.4: The subsystem of CBEM Virtual Storage & Machines System 'Table Contied'.

In this section, data could be sent between the cloud management subsystem and the physical hardware subsystem. As it functions as virtual memory storage, the information transfer management process is the fundamental purpose of the subsystem. The program of such a subsystem is analysed to be implemented by servers that are possible to save info, with the software will share a portion of the computer's memory accessed in order to maintain this task. At last, the physical hardware subsystem would become contracted for the hardware management of info with waves collected to and along the storage subsystem and the machines in use.

Moreover, by employing MatLab2020b Simulation Tool-Box, the suggested structure that has been implemented utilizing the ***Classification Learner*** function is shown in Figure 3.5.

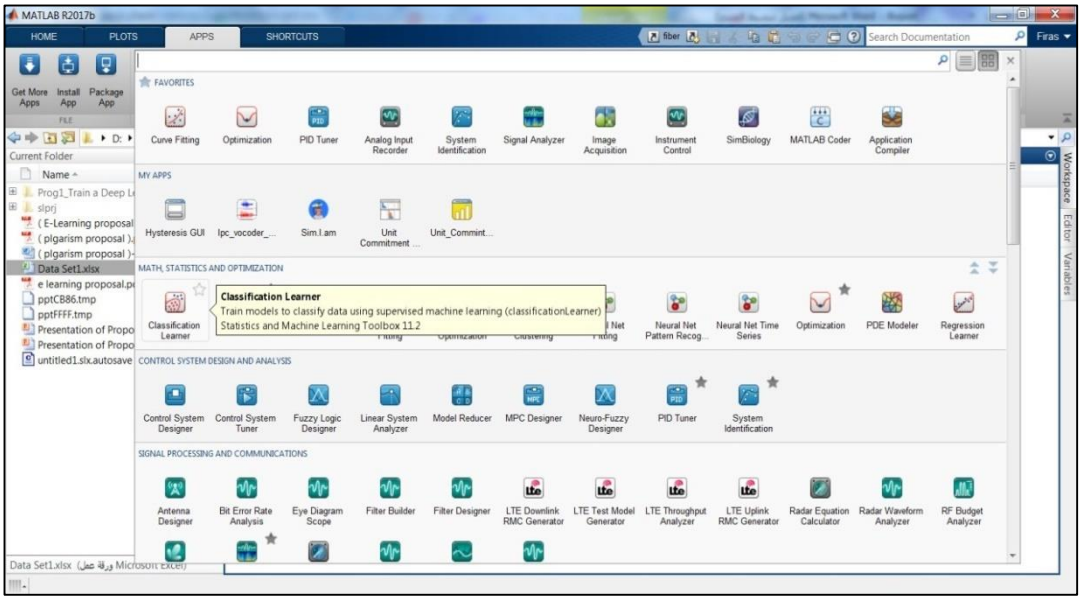

Figure 3.5: Classification Learner function.

This function has the utility to provide so many complicated mathematical operations; thus, this will save a lot of effort and programming time. The classification learner function will be implemented to sustain classification operations on the tested data in the project utilizing the model selection window as can be seen in Figure 3.6.

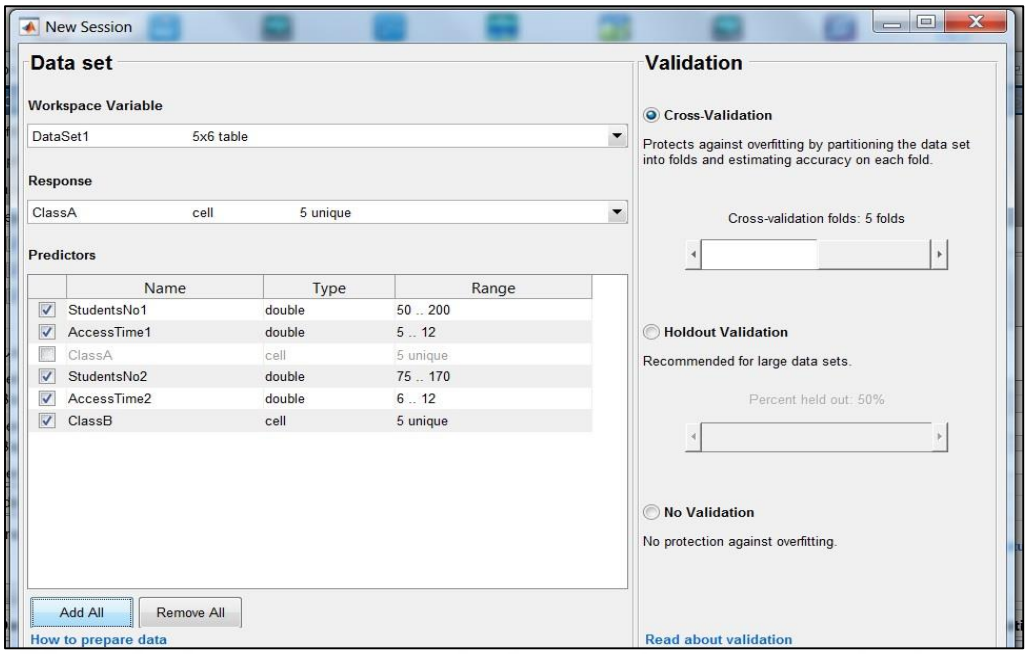

Figure 3.6: Structure set selection tool utilized in Classification Learner function.

This function has the utility to provide the utility selection of the entered data set; thus, this will save a lot of effort and programming jobs. Executing this tool on the project with the proposed model will provide further programming facilities during the processing of the examination results. Another examination algorithm has been suggested to be utilized with the proposed model, which is the artificial neural networks (ANN) supported with Levenberg Marquardt (LM) activation function. As reviewed in history [20-24], the LM technique has been regarded as the ultimate better feature extraction and data analysing applied strategy, which illustrates important data to assist managers, and commanders, with another collective terminal client compose learned employment agreements. The utilized software is a group of info-obtaining data of various kinds of object images called mat3.mat. The process of the software will rely upon classifying such info utilizing the ANN algorithm depending on the data possible in every matrix component. Later, the LM algorithm will operate to evaluate such info also displays their characteristics in a distributed manner to achieve the client of every available feature regarding such info so that the client would become capable of selecting as well compose the correct determination for his choice. The ANN model will be discussed in the results will be as shown in Figures 8-10. Actually, there are so many reasons for applying to the MatLab2020b Simulation program in this project. The dominant reason for utilizing this program is its ability to implement complex mathematical tasks with a huge number of

computations. Also, this program provides a very powerful library in different scientific fields, which simplifies the tasks of programming and saves time with efforts to complete the training with high efficiency and minimum error. The artificial neural networks (ANNs) using LM are one of the most powerful built-in functions provided by the MatLab2020b Simulation program with enormous abilities of data entering, processing, analysing, training, and execution. Figure 3.7 and 3.8 illustrate the implementation of the ANN tool provided by the MatLab2020b application library (Apps.).

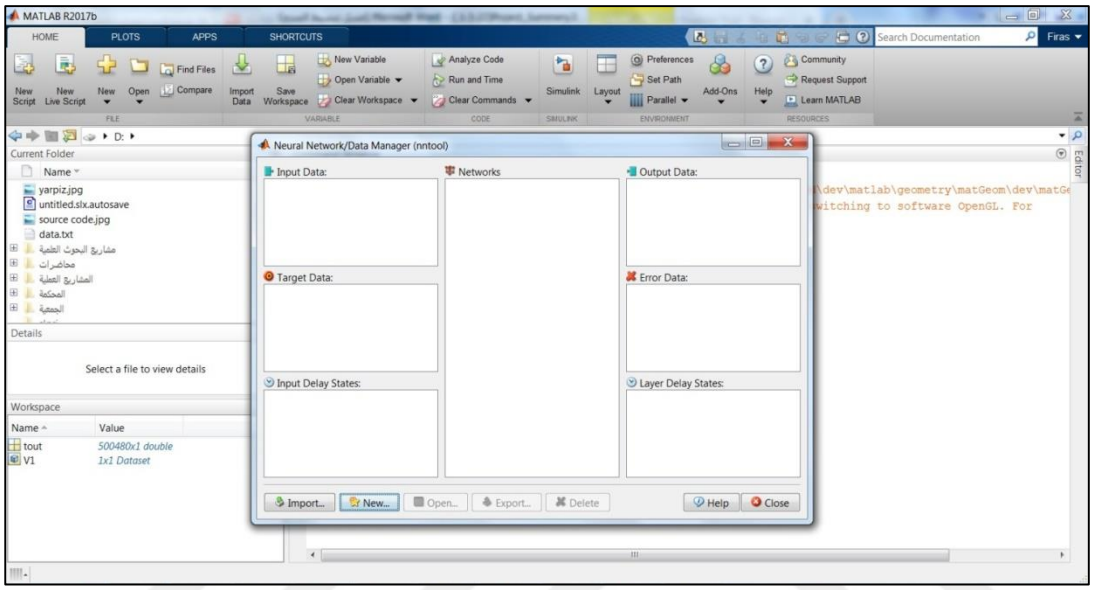

Figure 3.7: Demonstration of the ANN tool utilized by MatLab2020b.

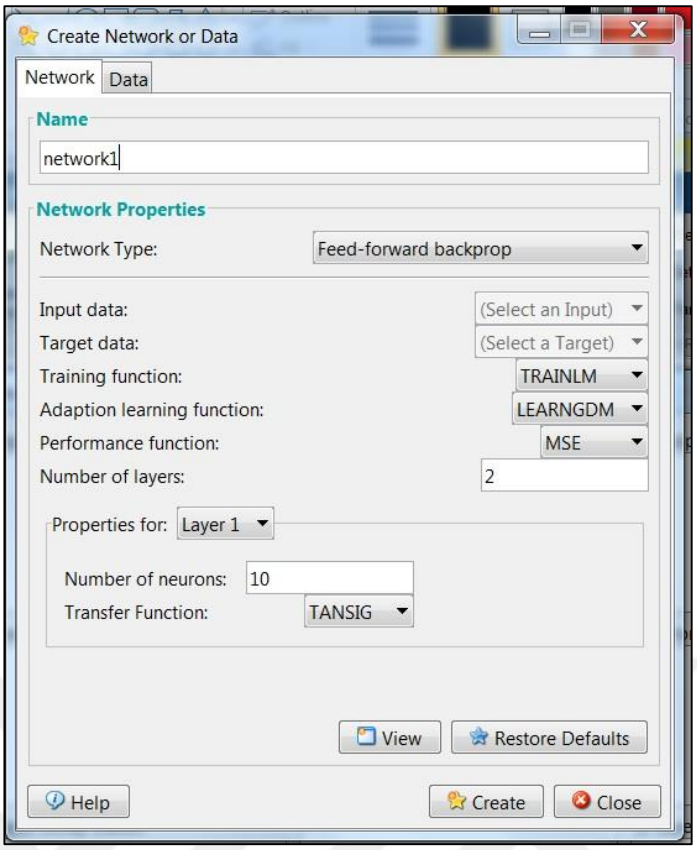

Figure 3.8: The ANN network specifications window.

4. SIMULATION RESULTS

4.1 PROGRAM DEMONSTRATION

In this Section, the proposed model presented in Chapter three has been implemented utilizing the MatLab2020b Simulation program with a compact toolbox and m.files coding script utilities. The choice of MatLab software was that it is characterized by its high ability to direct programming and its great potential by providing libraries of tools and supporting applications that provide multiple algorithms and techniques in various fields of engineering, artificial intelligence, statistics, mathematics, and others, which shortens the programming effort and time in completing the required studies. In this project, the classifier application utility has been applied beside the Simulink ToolBox to perform the required study objectives. Also, the and start command has been utilized to initiate and open ANNs application utility to complete the implementation of the proposed model.

4.2 SIMULATION RESULTS

a. First Examination

The first examination software will focus on the utility of data collection and classification from and to the CLEM system. In this example, the best classifier for a web server is pre-tested to find the perfect server classifier where the data set is taken utilizing the server. The information contains a set of E-Learning classes. Each class contains information on the number of students taking online, and each class corresponds to the time taken to open the site for that class. This information is tested using the Classifier Learner. To access the best workbook used to interact with this server. Through programming and testing, we see that the best classifier is the SVM. Table 4.1 presents the specifics of the example.

Table 4.1: Details of the examination.

DataSet1					
StudentsNo1	AccessTime1	ClassA	StudentsNo2	AccessTime2	ClassB
Number	Number	Text	Number	Number	Text
200	10	C1	100	8	C1
150	12	C2	120	10	C2
180	9	C3	90	7	C3
50	5	C4	170	12	C4
130	8	C5	75	6	C5

Also, Table 4.2 illustrates the various types of Learning Classifiers

Table 4.2: Comparison among various types of Learning Classifiers.

Learning Type	Classifier Type	Advantages	Disadvantages
Fine Tree Medium Tree Coarse Tree	Decision Tree	i) No extensive training and design. ii) Decreased computational time.	i) Complex calculation. ii) Accuracy depends totally on feature selection.
Linear SVM Quadratic SVM Cubic SVM	Support Vector Machine	i) Decreased computational complexity.	i) Training is time-consuming. ii) Structure is complicated to know. iii) Accuracy might depend on the number of classes.
Fine Gaussian SVM Medium Gaussian SVM Corse Gaussian SVM Non-Parametric KNN	Gaussian SVM	i) Conceptually, this is a really simple concept.	i) loss of accuracy due to class conditional independence. ii) Practically, there are dependencies between variables.

Table 4.2: Comparison among various types of Learning Classifiers ‘Table Contied

Lazy Learning KNN	K Nearest Neighbours	i) low efforts and costs required for learning.	i) in the case when the sample dataset is large, finding the K neighbours is computationally expensive. ii) the number of dimensions affects performance.

By referring to Table 4.1, the data set are divided into two examples; each example consists of two tables and has three columns. The third column represents the number of far classrooms, while the first column defines the student's number in each classroom, and the second column shows the access time required to select each far classroom server. The difference between the two examples is in the values of the parameters.

Using MatLab2020b Simulation Tool-Box, the above example has been implemented and tested by applying the Classification Learner function as can be seen in Figure 4.1.

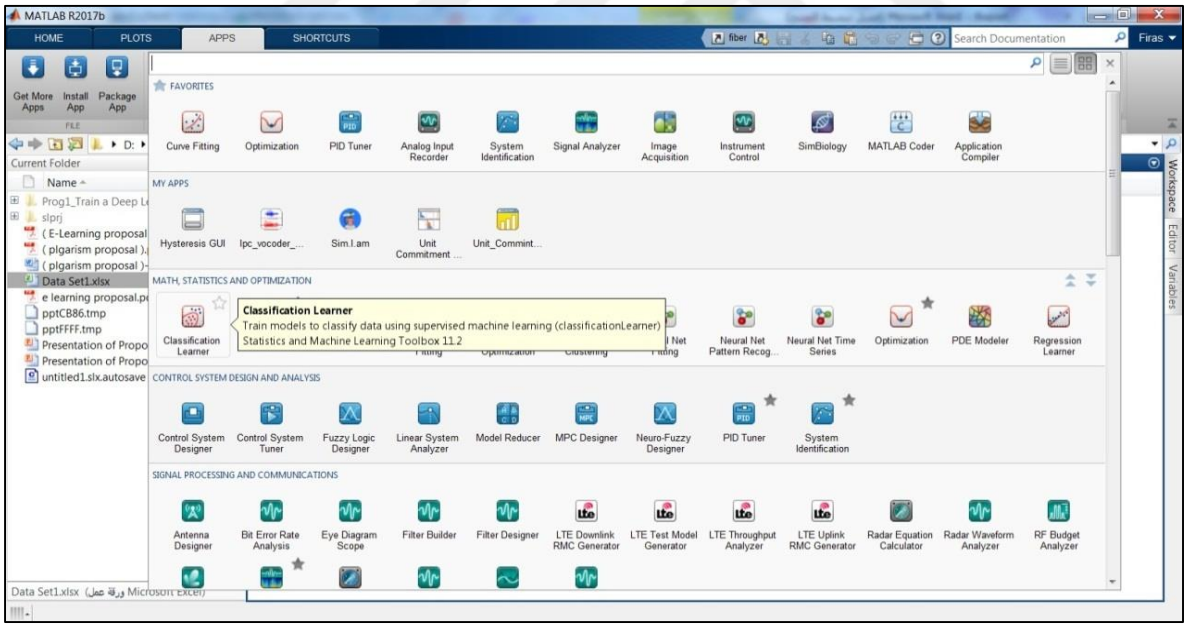

Figure 4.1: Classification Learner function.

This function has the utility to provide so many complicated mathematical operations; thus, this will save a lot of effort and programming time. By executing the classification

learner function on the project example exhibited in Figure 4.2, the results will appear as can be seen in the next figures.

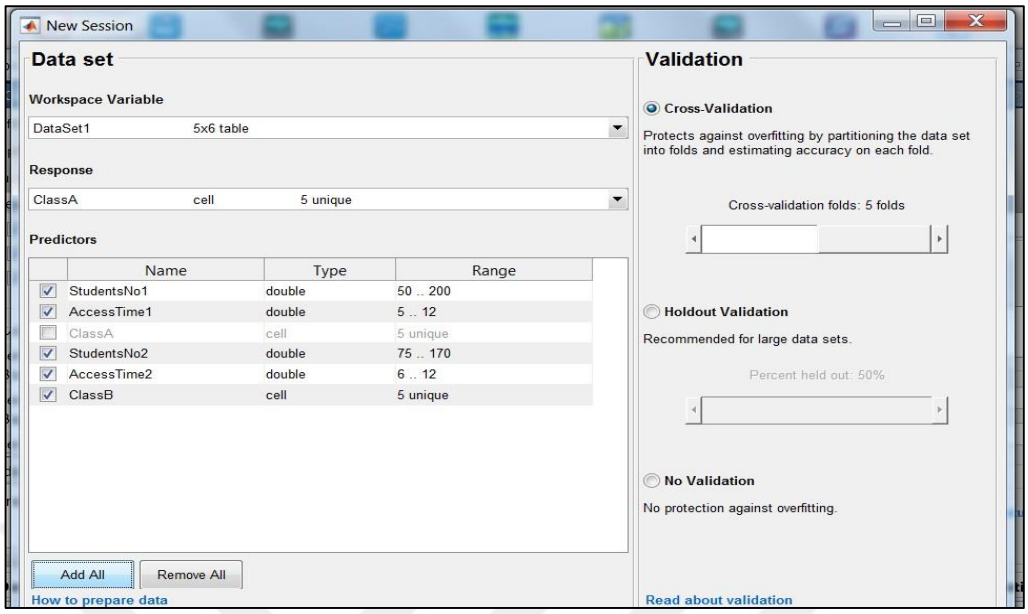

Figure 4.2: Model set selection tool utilized in Classification Learner function.

This function has the utility to provide the utility of selection of the entered data set; thus, this will save a lot of effort and programming jobs. By executing this tool, on the project example shown in Table 4.1, the results will appear as illustrated in the following figures.

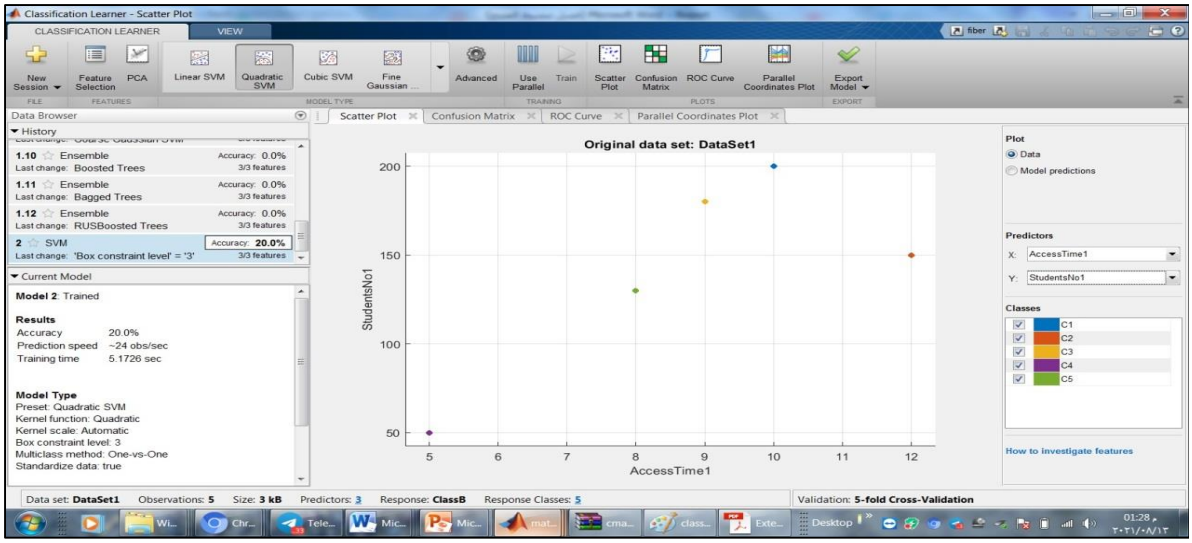

Figure 4.3: SVM Classification Learner result of example 1, Student Number Vs. Access Time.

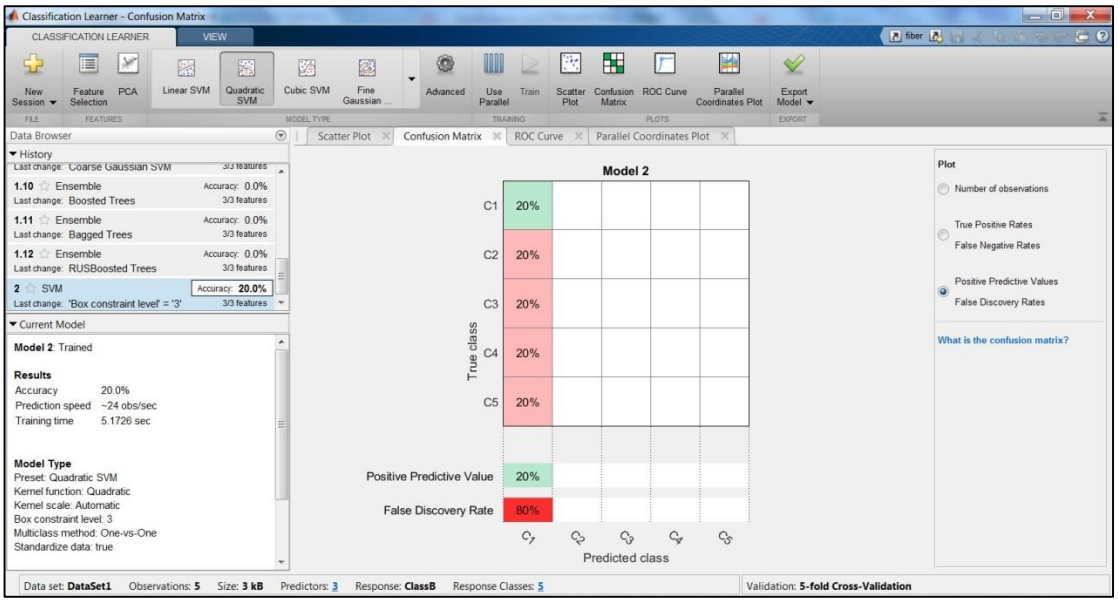

Figure 4.4: SVM Classification Learner result of the first examination, Number of Observations.

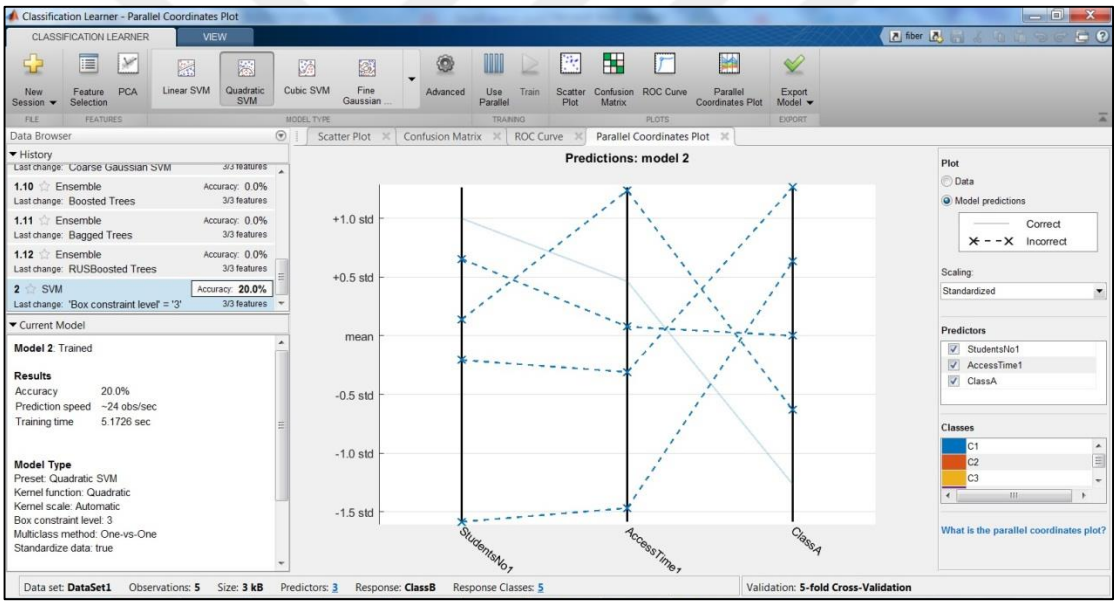

Figure 4.5: SVM Classification Learner result of the first examination, Predictions of the best Class.

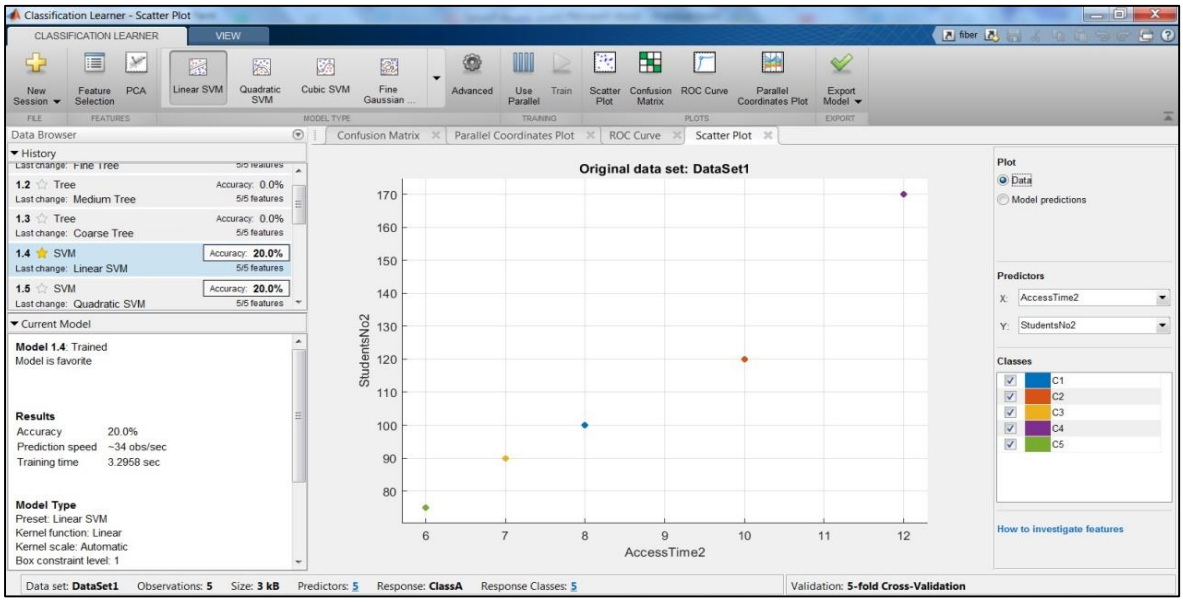

Figure 4.6: SVM Classification Learner result of the first examination, Predictions of the best Class.

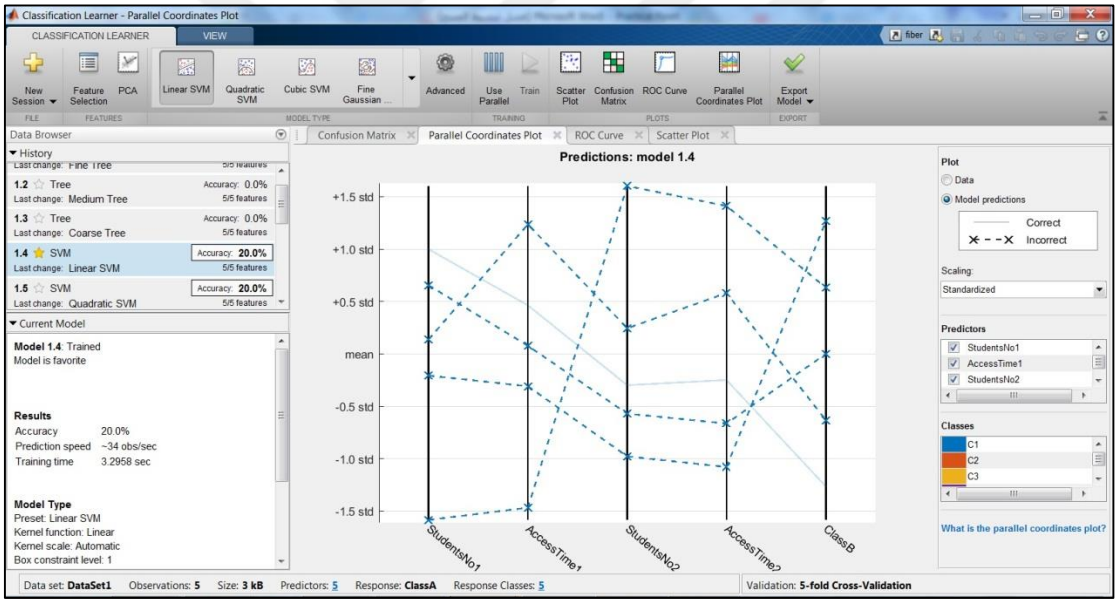

Figure 4.7: SVM Classification Learner result of all data set in Table 4.1, Predictions of the best Class.

From the above figures, we might observe that the idea of the project example is to examine a certain set of data that represents the arrangement of various study classrooms with certain conditions by utilizing various types of classifications of E-Learning algorithms. The classification learner tool will import the data set along the input entry

excel sheet and will try to select the optimum algorithm which produces the best choice between the set parameters. In other words, and referring to Figure 4.2, we might see that by testing the data set of the project example presented in Table 4.1, the number of students in each classroom has been presented in terms of the available access time of the server. Furthermore, by referring to Figure 4.3, we might clearly see the SVM Classification Learner result of example, Student Number1 Vs. Access Time1 will show the distribution of the student's number versus the access time for the first data set in Table 1. We might observe the result of the SVM classifier algorithm, which will provide a suitable selection of the data set parameters among other algorithms according to their distributions, and in this example, we might observe that the best class numbers have been viewed connecting between student's number and the classroom server access time. Figure 5 shows the training between the truly utilized classrooms and the predicted ones. It is clear that the best-accessed classroom is class number 1, C1, since it provides the shortest access time from the server to the remote class node. Also, noting Figure 4.5, we might have a complete prediction path of the training data set tested in the example utilizing SVM Classification Learner. At last, by a similar procedure, we entered the total data set in Table 4.1 to the classification learner, and the test will be implemented with resulting outcomes, as shown in Figures 4.6 and 4.7.

b. Second Examination

The process of each subsystem in the suggested CLEM model has been illustrated and also explained in specifics. The 1st CLEM subsystem has been presented in Figure 4.8. This subsystem operation will be to supply the user's demands info important to maintain the cloud management subsystem against the user mechatronics stages data in which the Student Number with the Class Time. As shown in Figure 4.8.b, each subsystem in Figure 4.8.a might have two displays. The class time (min) is shown in the top display, while the student's sum is shown in the 2nd display. This data will be modified in accordance with the cloud management model. Figure 4.1 shows the 2nd subsystem, the Cloud Management System. In reality, this is the crucial subsystem of the CLEM model, which was designed to regulate and keep an eye on the entire CLEM structure. As seen in Figure 4.9.a, the cloud management model in this test includes three results, each of which is specific to a particular client mechatronics laboratory virtual stage. As shown in Figure 4.9.b, such virtual stages were thoroughly changed along these subsystems. The 1st and 2nd virtual divisions in our example are plugged ON as indicated by green lumps, whereas

the third division is plugged OFF as indicated by the black bulb. Figure 4.8.b makes it clear that the division period and the student's grade have been shown on monitored digital gauges. Also, analogue control display shows the full divisions instant along with the student's number.

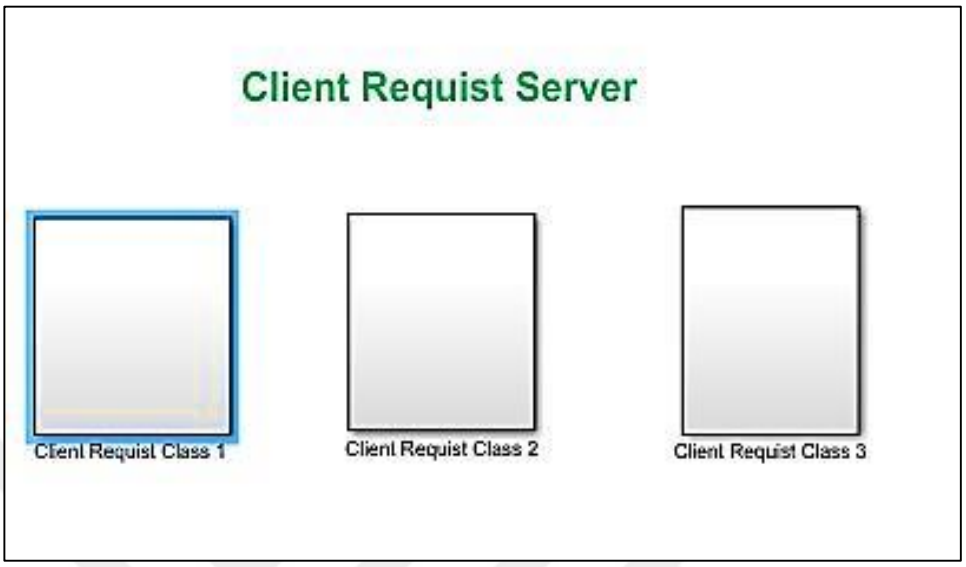

Figure 4.8: CBEM Client Request Server subsystem.

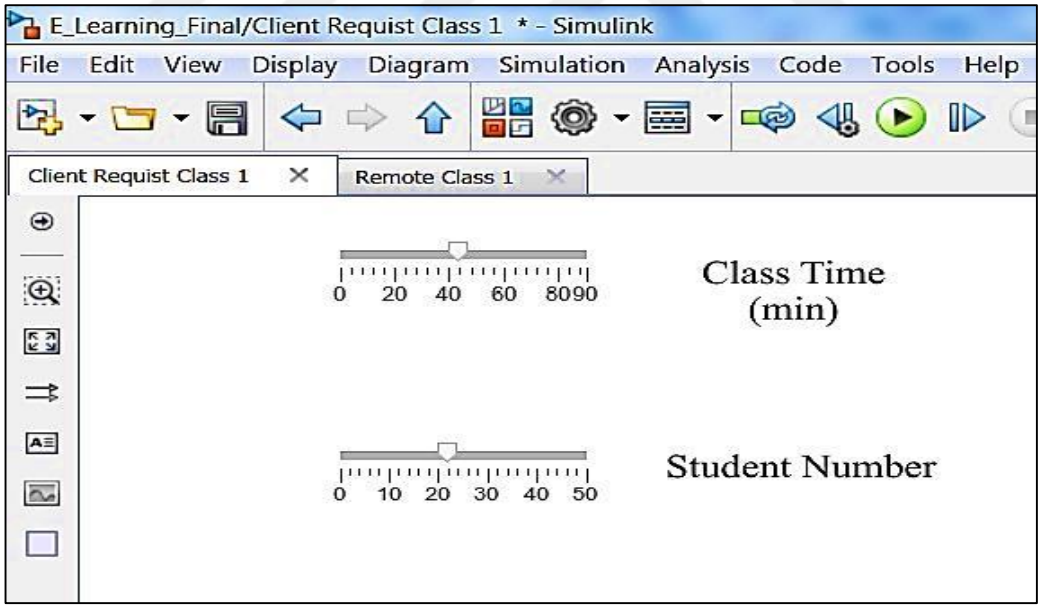

Figure 4.8: CBEM Client Request Server subsystem ‘Figure Contied’.

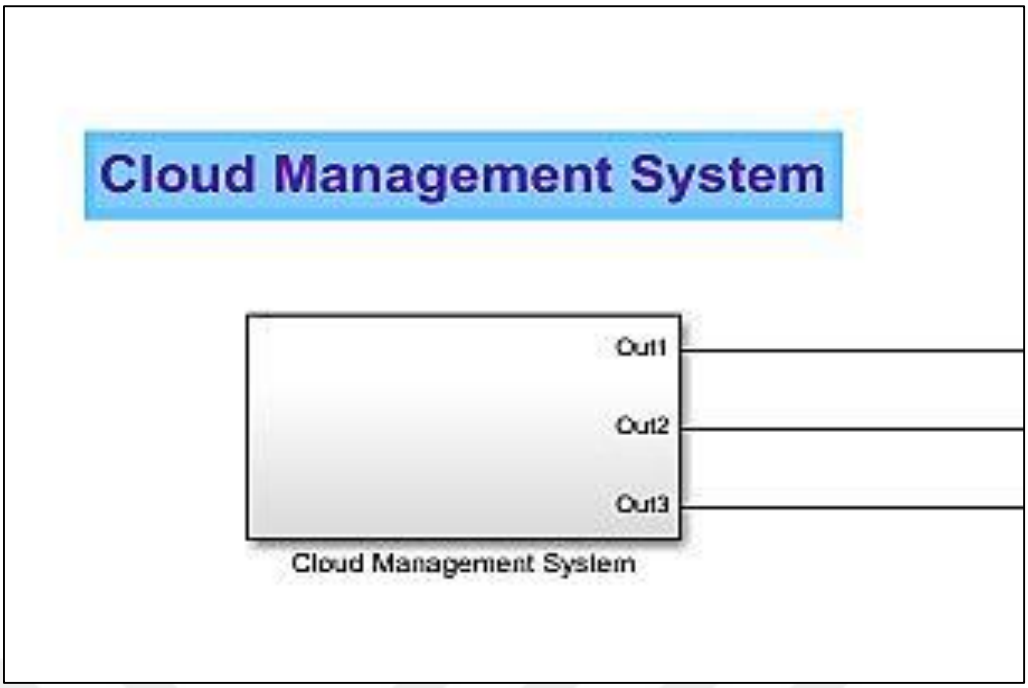

Figure 4.9: The subsystem of the CBEM Cloud Management Model.

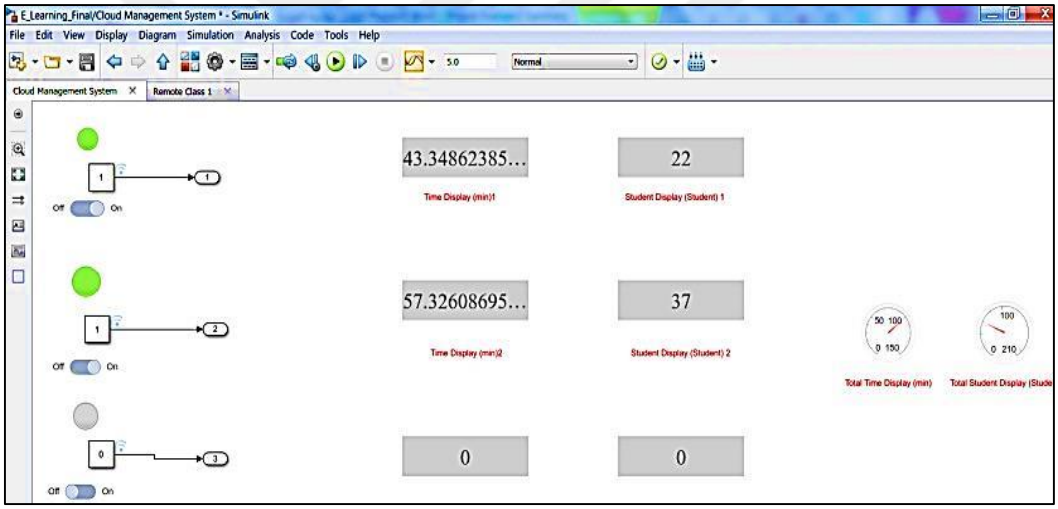

Figure 4.9: The subsystem of the CBEM Cloud Management Model 'Figure Contied'.

In order to set up the cloud management subsystem against the user's mechatronics division data with the student number and class time, the subsystem operation will supply the user's requirements information. Figure 4.10 shows each subsystem of the second subsystem, Virtual Storage & Machines.

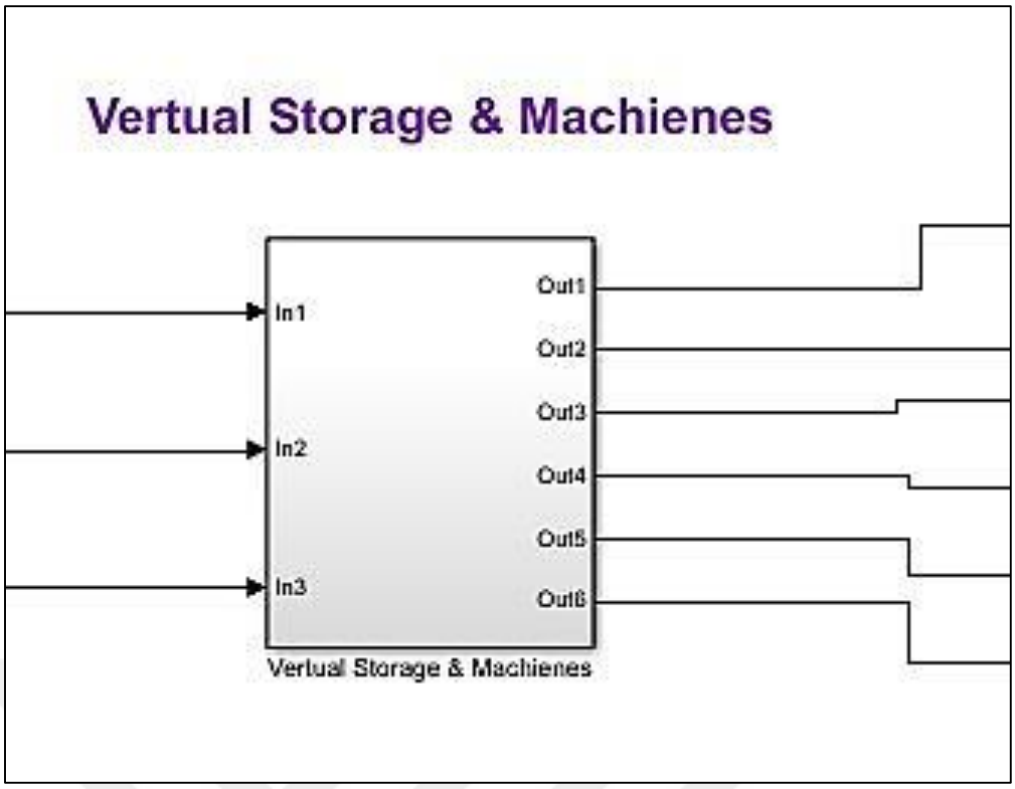

Figure 4.10: MatLab2021b Simulink of CBEM Virtual Storage & Machines System subsystem.

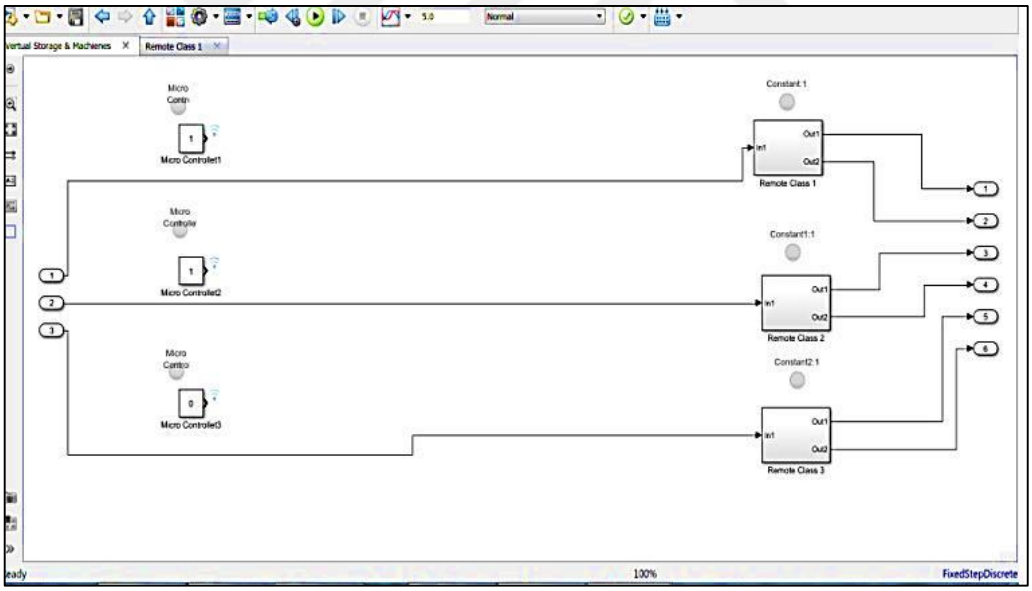

Figure 4.10: MatLab2021b Simulink of CBEM Virtual Storage & Machines System subsystem 'Figure Contied'.

With such a subsystem, the data can be exchanged between the Cloud Management subsystem and the Physical Hardware subsystem. This type of subsystem, which functions as a virtual memory storage, has as its primary function the organization of information communication. The software regarding such a subsystem is examined to determine how it

may be used with the many potential servers for information storage; in addition, the software will contribute side by side with the penetrated computer's storages for maintaining such a task. In the end, the Physical Hardware Subsystem will be crucial in the hardware arrangement of the collected waves and will compete with the Machines Subsystem &. Virtual Storage.

c. Third Examination

The third test program depends on the artificial neural networks (ANNs) classifier technique supported against Levenberg Marquardt's (LM) activation function utility. As mentioned in history, LM was treated as optimal best strategy applied for character abstraction with info testing, also illustrating helpful data to assist managers, administrators, and other associated terminal clients in constructing learned employment arrangements. The software applied a group of info having data of various kinds of mechatronic info regarding mat3.mat and excel file formats. The action of the software will rely upon classifying such info utilizing the ANN algorithm corresponding to the data possible in every matrix component. Later, the LM technique will operate to evaluate such info also display their patterns in an assigned situation to specify to the client of every available feature regarding such info, which the client will be capable of selecting as well making the correct choice for such selection. The software outcomes will be as presented in Figures 4.11-4.13.

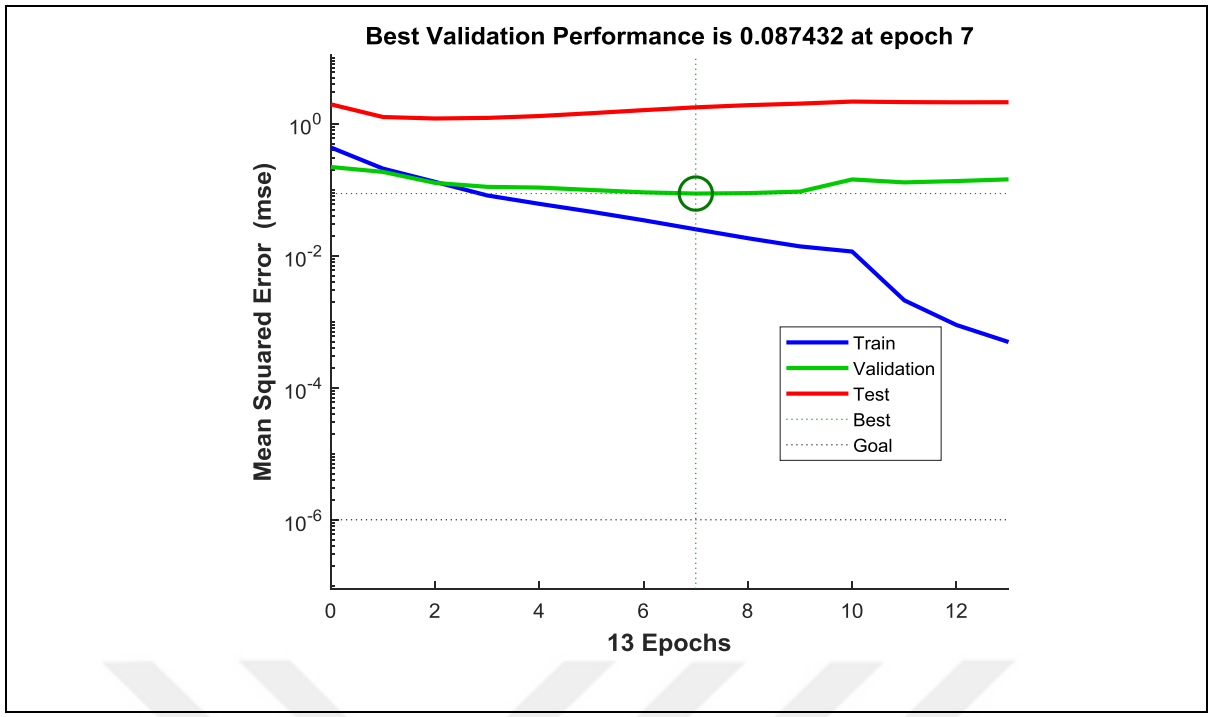

Figure 4.11: Characteristics curve of obtained MSE against time steps.

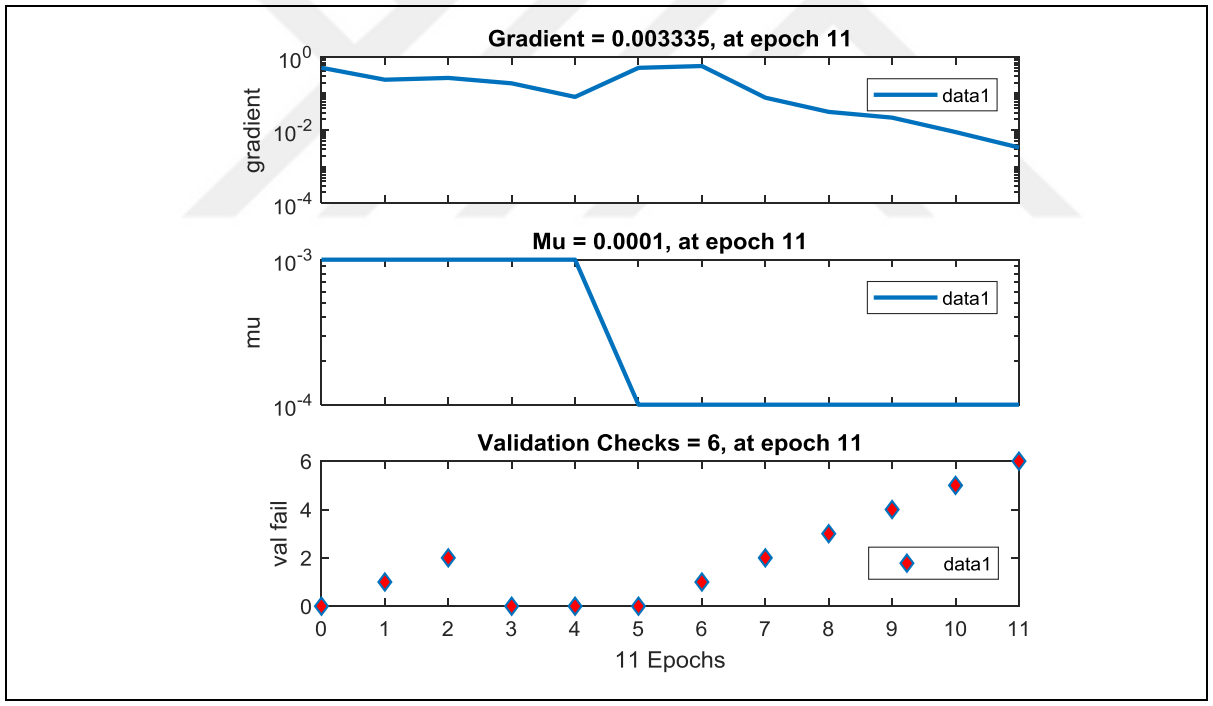

Figure 4.12: Training phase utilizing ML on info group resulting statistics against time steps.

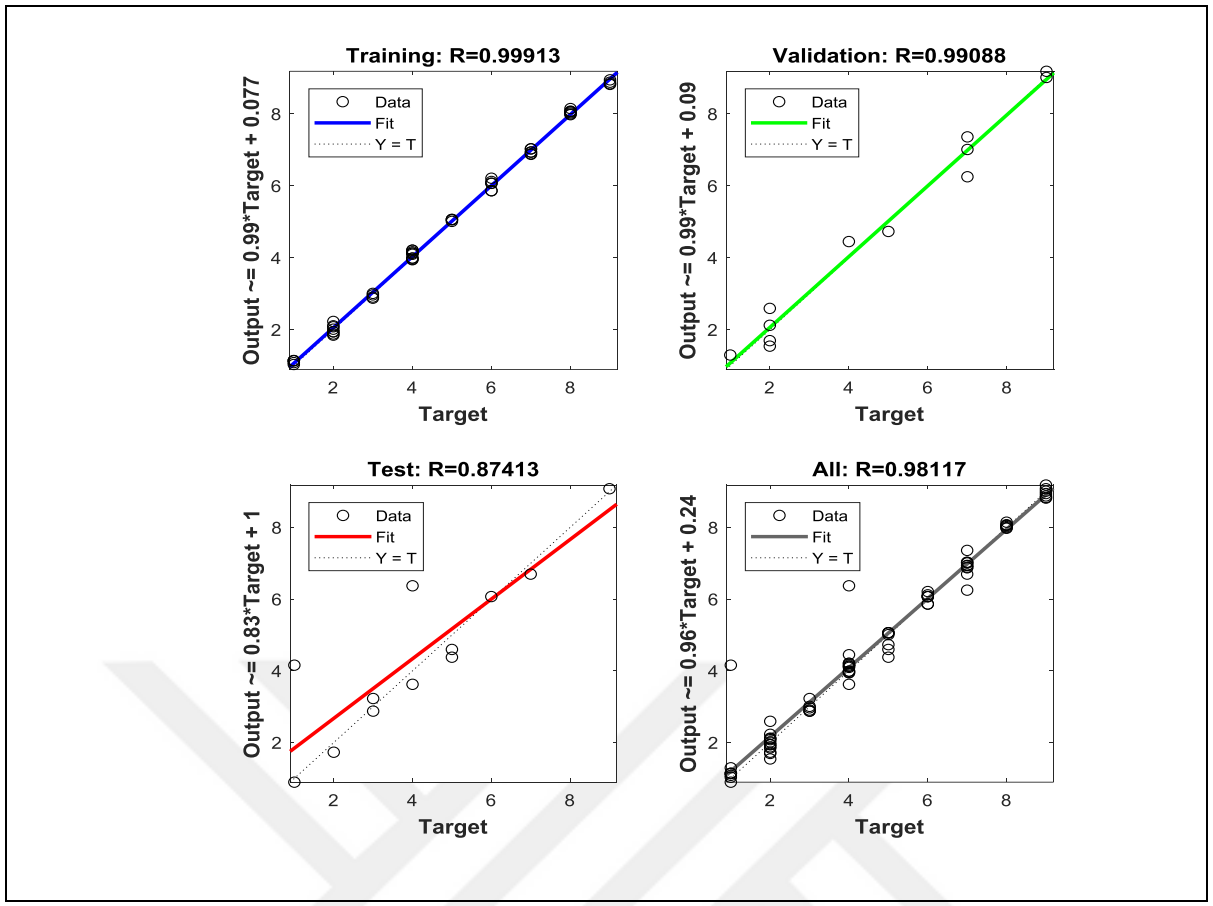

Figure 4.13: Regression phase utilizing ML algorithm on info set.

As shown in Figure 4.11, the MSE is clearly lower when comparing trained data with the use of the ML algorithm (blue curve) to the average value regarding the tested data beyond the ML (red curve). Because of this, the mean MSE curve outperforms the mean error acquired with the use of ANN and ML on the trained data for various instants (epochs) of the period. As can be seen in Figures 4.11-4.13, we can infer that the software's classification of this information will be based on the data that may be present in each component of the matrix and will use an ANN algorithm. Later, the LM algorithm will operate to evaluate such info and illustrate their characteristics in an assigned situation to produce the client of every available feature regarding such info so that the client will be capable of selecting also composing the correct conclusion.

5. CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The effects related to cloud-based mechatronic learning for mechatronics are examined analytically in the presented work in light of the widespread Internet usage as well as the demands of modern learning. Additionally, using cloud computing has become widespread and important because of the accessibility and simplicity of doing so through a variety of technological devices, including phones, iPads, and tablets. E-learning can be defined as an important topic since it cuts the time and expense of traditional learning in mechatronics (that is, a specialty of computers, devices, and mechanics). Applying cloud e-learning will make it clearer for students, instructors, and clients to improve their vision of mechatronics. Additionally, they might create courses that strengthen it while taking into consideration having dependable and simple access. Virtual homerooms have been simulated to prepare different arrangement calculations to represent the mechanism of distance e-learning by getting the variables of student preparation, lesson type, and class time. Classification tests were performed using SVM, Decision Tree, and KNN on a data set representing tables of the Mechatronics Labs system. The server system and the communication network were simulated using the Matlab 2020b program to implement the idea of distance education. Finally, the results were compared with the smart neural network algorithm as an excellent trainer, and the best performance was reached with a high efficiency of 94% and a small error rate of 2%.

5.2 RECOMMENDATIONS

The next list of suggestions could be used to outline this study's future work:

a. Implementation of the software aspect applied in this study in practice by providing servers and an actual network system to provide an electronic training system to represent the electronic mechatronics laboratories.

b. Using other smart training algorithms, such as the Fast RCNN algorithm and the U_Net algorithm, which is characterized by high efficiency and the ability to distinguish characteristics and features.

c. Increasing the number of laboratories and electronic classrooms to increase the testing area of the proposed system.

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APPENDIX A1

Program Codes

```
% ------------------------------------------------------------------------
%
%                    Data Classifications
%                  Artificial Neural Networks
%
% ------------------------------------------------------------------------

clc; clear; close all;

image_folder = 'New Citra Latih';
filenames = dir(fullfile(image_folder, '*.jpg'));
total_images = numel(filenames);

area = zeros(1,total_images);
perimeter = zeros(1,total_images);
metric = zeros(1,total_images);
eccentricity = zeros(1,total_images);
convexarea = zeros(1,total_images);
majoraxislength = zeros(1,total_images);
minoraxislength = zeros(1,total_images);
Contrast = zeros(1,total_images);
Correlation = zeros(1,total_images);
Homogeneity = zeros(1,total_images);
Energy = zeros(1,total_images);

for n = 1:total_images
    full_name= fullfile(image_folder, filenames(n).name);
    I = imread(full_name);
    J = I(:,:,2);
 %tresholding
    level = graythresh(J);
    K = im2bw(J,level);
    L = imcomplement(K);
    str = strel('disk',5);
    M = imclose(L,str);
    N = imfill(M,'holes');
    O = bwareaopen(N,5000);
    offsets = [-1 1];
    glcms = graycomatrix(O,'offset',offsets,'Symmetric',true);
    stats2 =
regionprops(O,'Area','Perimeter','Eccentricity','ConvexArea','MajorAxisLeng
th','MinorAxisLength');
    stats = graycoprops(glcms,{'Contrast','Correlation','Energy',
'Homogeneity'});
    area(n) = stats2.Area;
    perimeter(n) = stats2.Perimeter;
    metric(n) = 4*pi*area(n)/(perimeter(n)^2);
    eccentricity(n) = stats2.Eccentricity;
    convexarea(n) = stats2.ConvexArea;
    majoraxislength(n) = stats2.MajorAxisLength;
    minoraxislength(n) = stats2.MinorAxisLength;
    Contrast(n) = stats.Contrast;
    Correlation(n) = stats.Correlation;
    Homogeneity(n) = stats.Homogeneity;
    Energy(n) = stats.Energy;
end
```

```
input =
[area;perimeter;metric;eccentricity;convexarea;majoraxislength;minoraxislen
gth;Contrast;Correlation;Homogeneity;Energy];
target = zeros(1,78);
target(:,1:8) = 1;
target(:,9:21) = 2;
target(:,22:27) = 3;
target(:,28:40) = 4;
target(:,41:47) = 5;
target(:,48:54) = 6;
target(:,55:64) = 7;
target(:,65:71) = 8;
target(:,72:78) = 9;

net = newff(input,target,[11 6],{'logsig','logsig'},'trainlm');
net.trainParam.epochs = 1000;
net.trainParam.goal = 1e-6;
akurasi = 0;
ct = 0;
while (akurasi < 90 && ct < 150)
    ct = ct+1;
    net = train(net,input,target);
    output = round(sim(net,input));
    [m,n] = find(output==target);
    akurasi = sum(m)/total_images*100;
end
save net3.mat net
akurasi
```

Sub Program

```
function varargout = Klasifikasi_daun(varargin)
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Klasifikasi_daun

% Begin initialization code
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
    'gui_Singleton',  gui_Singleton, ...
    'gui_OpeningFcn', @Klasifikasi_daun_OpeningFcn, ...
    'gui_OutputFcn',  @Klasifikasi_daun_OutputFcn, ...
    'gui_LayoutFcn',  [] , ...
    'gui_Callback',   []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
```

```
% End initialization code - DO NOT EDIT


% --- Executes just before Klasifikasi_daun is made visible.
function Klasifikasi_daun_OpeningFcn(hObject, ~, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Klasifikasi_daun (see VARARGIN)

% Choose default command line output for Klasifikasi_daun
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);
movegui(hObject,'center');

% UIWAIT makes Klasifikasi_daun wait for user response (see UIRESUME)
% uiwait(handles.figure1);


% --- Outputs from this function are returned to the command line.
function varargout = Klasifikasi_daun_OutputFcn(hObject, eventdata,
handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;


% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
[nama_file,nama_path] = uigetfile({'*.*'});

if ~isequal(nama_file,0)
    I = imread(fullfile(nama_path,nama_file));
    axes(handles.axes1)
    imshow(I)
    handles.I = I;
    guidata(hObject,handles)
    pushbutton2_Callback(hObject, eventdata, handles)
else
    return
end


% --- Executes on button press in pushbutton2.
function pushbutton2_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
I = handles.I;
```

```
J = I(:,:,2);
%tresholding
level = graythresh(J);
K = im2bw(J,level);
L = imcomplement(K);
str = strel('disk',5);
M = imclose(L,str);
N = imfill(M,'holes');
O = bwareaopen(N,5000);
glcms = graycomatrix(O,'Symmetric',true);
stats2 =
regionprops(O,'Area','Perimeter','Eccentricity','ConvexArea','MajorAxisLeng
th','MinorAxisLength');
stats = graycoprops(glcms,{'Contrast', 'Correlation'
,'Homogeneity','Energy'});
area = stats2.Area;
perimeter = stats2.Perimeter;
metric = 4*pi*area/(perimeter^2);
eccentricity = stats2.Eccentricity;
convexarea = stats2.ConvexArea;
majoraxislength = stats2.MajorAxisLength;
minoraxislength = stats2.MinorAxisLength;
Contrast = stats.Contrast;
Correlation = stats.Correlation;
Homogeneity = stats.Homogeneity;
Energy = stats.Energy;

input =
[area;perimeter;metric;eccentricity;convexarea;majoraxislength;minoraxislen
gth;Contrast;Correlation;Homogeneity;Energy];

load ('net2.mat')
output = round(sim(net,input));

axes(handles.axes2)
imshow(O)

R = I(:,:,1);
G = I(:,:,2);
B = I(:,:,3);

R(~O) = 0;
G(~O) = 0;
B(~O) = 0;

RGB = cat(3,R,G,B);
axes(handles.axes3)
imshow(RGB)

if output == 1
    kelas = 'Acer Campestre';
elseif output == 2
    kelas = 'Aesculus Paxi';
elseif output == 3
    kelas = 'Metasequoia Glyptostroboides';
elseif output == 4
    kelas = 'quercus marilandica';
elseif output == 5
    kelas = 'quercus nigra';
```

```
elseif output == 6
    kelas = 'salix caroliniana';
elseif output == 7
    kelas = 'staphylea trifolia';
elseif output == 8
    kelas = 'stewartia pseudocamellia';
elseif output == 9
    kelas = 'styrax obassia';

end

set(handles.edit1,'String',kelas)


function edit1_Callback(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit1 as text
%        str2double(get(hObject,'String')) returns contents of edit1 as a
double


% --- Executes during object creation, after setting all properties.
function edit1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end
```

APPENDIX A2

Simulink

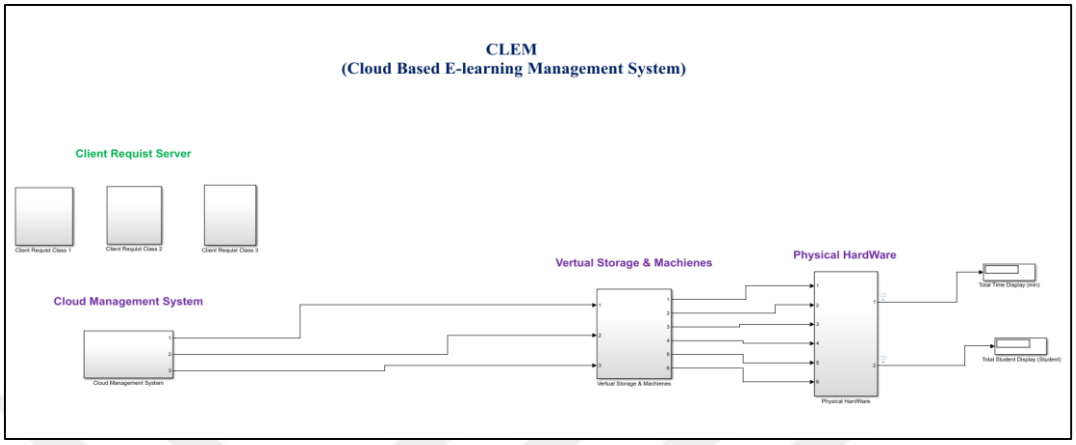

Figure A2.1: Cloud Based E-learning Management System (CLEM).

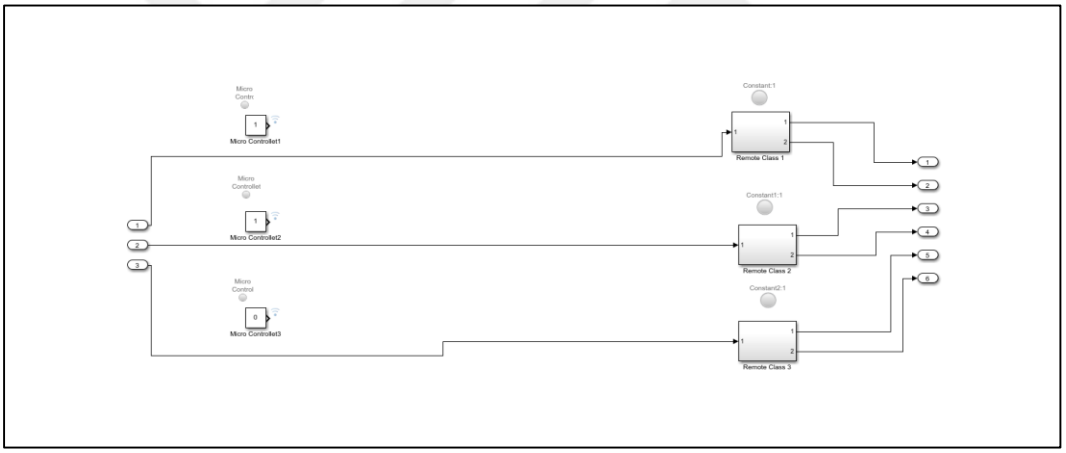

Figure A2.2: Vertual Storage & Machienes (CLEM) sub system.

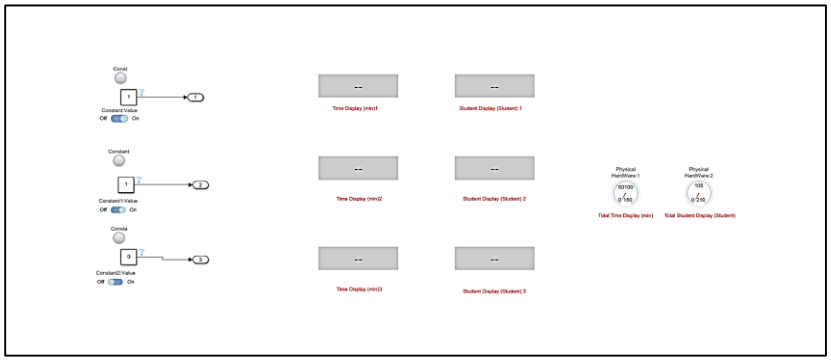

Figure A2.3: Cloud Management (CLEM) sub system.

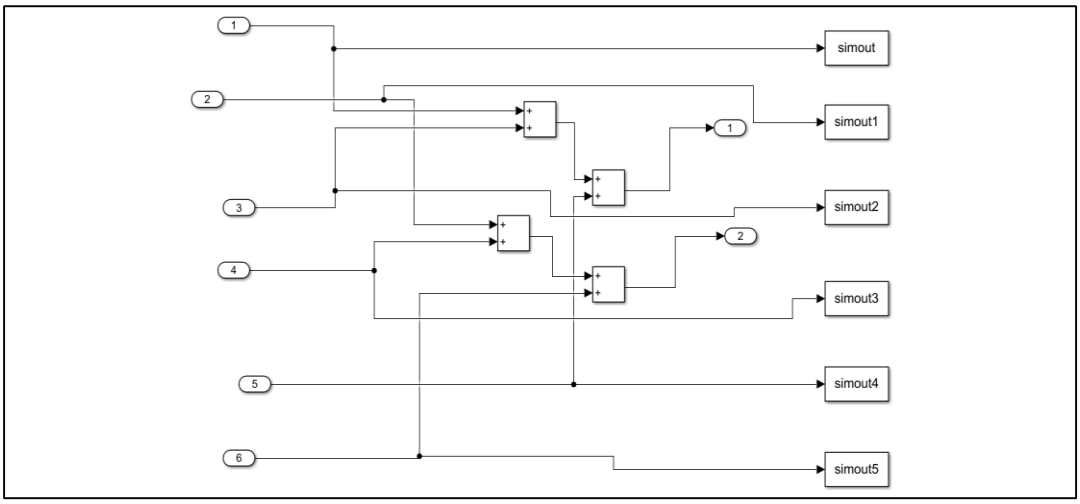

Figure A2.4: Physical HardWare (CLEM) sub system.

Support Simulink

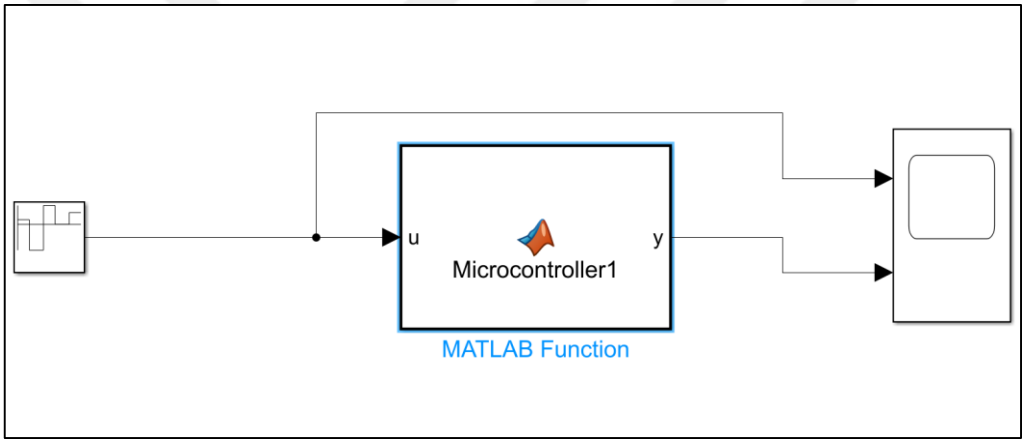

Figure A2.5: Microcontroller (CLEM) support simulink system.