

# Designing Mobile Learning Smart Education System Architecture for Big Data Management Using Fog Computing Technology

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## ABSTRACT

The mobile learning system will not only bring the attention of students towards education but also higher results can be achieved. One of the motives of the research is to involve the students in their academic assignment by using a system that lets the students work on the assignment with interest. Moreover, better results from students are expected after implementing the mobile learning system. Manual work will be given to students before the mobile learning system to get the attention of students and then work on the mobile learning system will be assigned. The difference between both traditional and computerization mobile learning systems will be analyzed by surveying students. The traditional cloud computing structure is physically centralized.

## KEYWORDS

Big Data Management, Cloud Computing Network System, Design Mobile Learning Smart Education Architecture, Fog Computing System, Internet of Things, Mobile Learning System, Reduce Database System

## 1. INTRODUCTION

Today, technology is directly or indirectly connected in every sphere of life, it is the backbone of every institution like banking, business, entertainment, weather forecasting, clarity, government organizations, etc. Similarly, information and communication technology has also benefited the education sector. The academic performance of students, as well as teachers, have increased dramatically since the past decade. Teachers and students can work on the same platform on the internet. Students can use many educational materials from distance (Schöbel & Söllner, 2016). Technology is not limited here because it plays its part by implementing computerized systems. Failure in student attention for education or a major reason for the lake is the lake of interest. True, mobile

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learning design is not following one size because each course is unique, and every design process requires accountability. Mobile technologies are more widely available at reasonable prices and use IoT in fog computing environments without infrastructure problems that run computing in front and distribute computing architecture network edges for education. Design of fog (Sarkar et al., 2018), he said of the algorithms proposed for work determination that are proposed only to provide space awareness, reduce delays as well as deal with large data. Because there is a significant problem with suggesting large amounts of data.

### 1.1 Mobile Learning System

Mobile learning system is a term that uses the app to complete tasks such as gameplay and level completion. The application interests' students as work can be completed like playing games. The students will be assigned the deadline to complete the work. The status of students will be created after the completion of the work. Higher assignments will increase the ranking of students (Alhumaid, 2021). A mobile learning system will be very useful for students. The mobile learning system provides the graphical user interface for interaction with computers or Mobile devices.

### 1.2 Use of Mobile Learning Systems

Mobile learning systems are commonly used. Mobile learning systems can be used to keep student records in major organizations. In addition, the system is also used to encourage students to study time and bring entertainment into work. There are many tasks to implement, some of them are very easy to implement and plan, to write coding or technical expertise. Anyone can use an enterprise mobile learning system.

### 1.3 Mobile Learning System Architecture

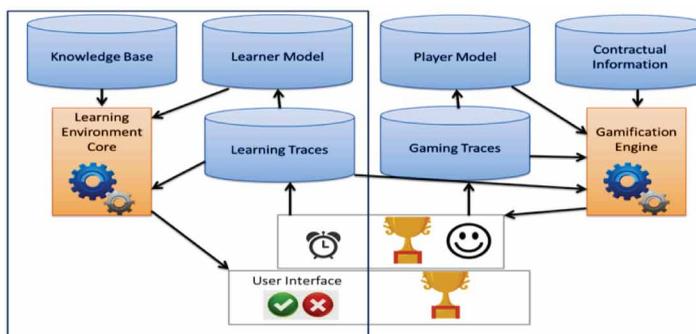
Mobile Learning System works as the architecture shown in Figure 1 (A., 2015).

The above architecture deals with a mobile learning system engine database management system that can store the scores of each student. Knowledge Base Management System is related to mobile learning system engine to verify the work of students.

### 1.4 Network Traffic Analyses

Microdata cantor in fog computing presents on-site strategies that can be up and down with faculty needs. For example, the capacity of this system can increase traffic due to students who have access to both after-school staff and MLMS (mobile learning management system). Mobile Learning System This application of a mobile learning system with support fog computing will not only be useful for students but will also be very fruitful for teachers as well as educational institutions. Teachers can

Figure 1. Mobile learning system architecture (A., 2015)



check assignments and their ratings very easily. Educational institutions will benefit from this system as higher results will be achieved and finally, the ranking of educational institutions will be increased. Traditional assignments will be transferred to computerization very easily because computer usage is very easy and common nowadays. Mobile Learning System This application of a mobile learning system with support fog computing will not only be useful for students but will also be very fruitful for teachers as well as educational institutions. Teachers can check assignments and their ratings very easily. Educational institutions will benefit from this system as higher results will be achieved and finally, the ranking of educational institutions will be increased. Traditional assignments will be transferred to computerization very easily because computer usage is very easy and common nowadays.

### 1.5 Problem Statement

The traditional education and assignment system has reduced student interest towards completing assignments as maintaining concentration is very time-taking and difficult as students are feeling bored to complete this big task without any interest. The concept of a mobile learning system is being introduced in the existing research work to solve such a problem. Connections and network communications must be a top priority for working efficiently. However, these faculties can be an undertaking for many divided organizations, specifically faculties spread throughout one-of-a-kind campuses. The benefit of fog computer systems is that educated IT experts can manipulate duties from a distance. The most essential way to work is no longer solely due to the fact of the price of traveling these web sites however additionally the minimal downtime due to delayed response time due to journey (Parlakkılıç, 2019).

## 2. RELATED WORK

Students might also be mendacity digitally the usage of IoT (Predictive Quality and Yield Solution, n.d.). The responsive diagram technique needs to additionally think about the limitations concerned in all degrees of education graph and implementation. The alternate in schooling in the direction of computerization structures has improved rapidly. Designing for instructing and mastering in schooling has received recognition in the digital age. To produce responsive cellular getting to know machine content, it is necessary to maintain in thinking that e-learning content material desires to be redeveloped for responsive mobile learning. It is essential to increase goal customers and diagram techniques for profitable mobile studying initiatives. Users reply to getting to know diversely due to the fact of the nature of Mobile mastering and content. Since Sahara (who grew up in cutting-edge technological times) is, Mobile getting to know environment, Mobile studying Developers want to assume about these technological know-how beginners when creating cell learning. Mobile mastering is typically time-honored in a casual way of the use of content material socially. So, many cell apps are supported through overall performance for on-demand content material and training (Gaved & Peasgood, 2017). Most Mobile getting to know guides are run on structures like Android or (IOS). This pastime can in no way be improved until the interest of college students is drawn to the entertainment-based schooling system to center of attention smartphones on pupil assignments. A request has been counseled for a sport recognized as a cell mastering machine (Sotirakou et al., 2016). Some sorts of lookup are cross-platforms i.e., in charge however do no longer assist cell getting to know much. Thus, the improvement of responsive Mobile mastering is very vital (Adkins, n.d.). The web has affected faculties and has grown upto be a main implementer in the digital studying college system. But the use of the net of the matters (IoT) in training has many and has incredible implications. Internet devices are associated to altering many purposes in everyday lifestyles and training is on the agenda. So, mobile science, and (IoT) assist instructors' diagram cellular tools that is available from any machine in fog computing (Mishra et al., 2020).

The Quality Experience (QoE) is referred to as consumer satisfaction, enjoyment, learning, and comparison level about offerings or products. Recently, the satisfactory of journey is used to enhance

the lifestyles cycle of product improvement after getting comments from end-users and provider companies also use QOE to measure the pleasant of offerings (QoS) (Laghari, He, Shafiq et al, 2017). Cloud computing benefits three unique models and spoils the cloud: performing the work required in mid-monitoring assets for reliable registration. This thesis provides correlation and describes both fog and cloud computing as different inter-disciplinary layouts, management, management, and equipment for associations and customers (Kumar et al., 2019) total The Aid Computing Framework stores user Quality Experience (QoE) standards together and provides service (QoS) standards as per the requirements announced in Service Level Agreement (SLA). (Laghari, He, Halepoto et al, 2017) The newspaper presents a review, after which the QoE framework known Specific features for cloud computing such as deployment parameters, network and client monitoring, Q data analysis, reporting tools and dynamic policy changes are analyzed. Users can use game standard data from the cloud using thin lying diverse devices through the internet to play games at anytime and anywhere. Cloud gaming's popularity has increased since the late 20s that attract industry and education. Experience Quality (QI) domain is added to cloud gaming model to assess user satisfaction, enjoyment and needs during online gaming (Laghari et al., 2019) In end-do this research paper.

### 3. METHODOLOGY

The study aims to design a responsive mobile Learning Knowledge of software and Work on unusual mobile devices in Fog Computing Network System. To achieve this technology, this study will the following part of the Mobile technology:

- Steps For Mobile Learning System Layout
- Fog Computing Influence Mobile Learning System Layout
- Cloud of the Mobile Learning System Layout

#### 3.1 Mobile Learning Process

Mobile learning system any educational organization in cloud computing to reach the target needs the following steps to analysed fog computing performance. The design responsible for mobile gaining knowledge of guides is appropriate for any path to be used from any Mobile system or PC Brower's. Design factors such as text blocks, photos, and movies can be displayed barring any hassle. The responsive sketch can furnish a large vary of advantages for Mobile gaining knowledge of courses, as follows:

- Mobile Learning System Framework
- Mobile Learning System Increased target
- Mobile Learning System Reduces costs
- Mobile Learning System Improves accessibility
- Mobile Learning System easily maintains and easily to used.

The technique of designing a basic utility is linear. The subsequent step starts off evolved when a step is taken. The development of the measures is solely in one direction, however when troubles arise, it is no longer resolved beautifully. One of the troubles with the basic utility format is simply developing a popular computing device browser and Mobile primarily based gaining knowledge of application:

*i) Plan: The aspects must be designed for special thoughts and the display screen must know not be viewed a page. Pages are designed with sliders, materials, shapes, and different components. The body ought to characterize special show screen size and become fluid. A column can be delivered from three*

columns to two columns and even for the smallest column. display screen of a cellular smartphone. The consumer trip must additionally be modified to interact with a small display through touching the mouse. Frame schemes must be furnished as prototype equipment instead, and some improvement and trying out ought to be executed on them which are completely practical in the screening spectrum. Unknown improvement issues may additionally occur if the format begins earlier than the first test. However, the closing method of the mission ought to be maintained, so conversation strains between departments need to be saved open.

ii) **Design:** The graphic representation ought to have unique measurement assets and layouts and elements required to make higher use of task time. The right pixel diagram must be allowed for responsive Internet design. These designs are challenging to work on laptop scanners, however important designs can be arranged when they are considered bendy in a flowing screen. Using HTML, it is feasible to increase fluid layout in all media. It will take a long time to make exceptions for each browser width, however as an alternative focus on the integrity of the consumer experience. Experience graph is as important as the presence of the website in all display screen sizes.

iii) **Built:** The factors must be examined by way of planning, prototype, and technique developers. The code wants to be personalized to make certain they are the smallest unit for the ingredients. Ingredients can solely be examined by way of including and decreasing the unique unplanned layout, giving them peace of mind. Continued collaboration between developers, designers, and strategists will resolve the inevitable issues of change. With one-of-a-kind crew members, these issues.

iv) **Test System:** In a responsive process, you want to take a look at in more than one browser and display sizes, so that any troubles manifest faster. Problems with cell media that do not healthy the body can be observed in some one-of-a-kind systems as properly as in design. A work ventures. The prototype can be additionally developed, which allows users to make first assessments and get wins for all sides.

v) **Representation System:** In a responsive approach, the identical quantity of growth is received, and, for-profit, there is a stay code at every step of the way for the person to offer. It helps to proceed the subsequent tiers with searches made in the first levels and expects adjustments earlier than a new method to the computerized era of responsive and private net layouts. Given the priorities for the modern webpage diagram and sketch objectives, our antigerm programming-based optimizer creates an everlasting set of internet designs (Laine et al., 2021).

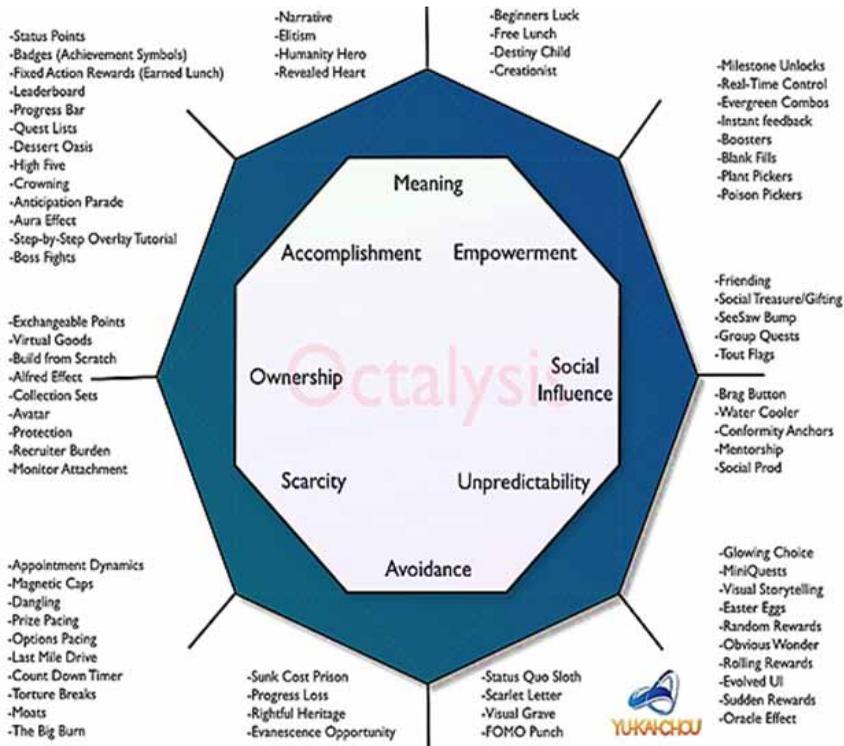
## 3.2 Mobile Learning System

One of the magnificent Mobile Learning System frameworks is referred to as Octalysis Framework. Octalysis is the usual framework of the Mobile Learning System. It is based totally on predefined attributes (see Figure 2).

### 3.2.1 Octalysis Mobile Learning System

Mobile Learning System Model is a concept of the common mobile learning system octa-license framework. In this concept, we used features that relate to the educational organization as per our app requirement (Octalysis, n.d.). Since the research is on assessing the performance of students, the mobile learning system model has all the required features that are related to the increase in the performance of the student of the educational organization. The mobile learning system model for improving the performance of students is as follows:

Figure 2. Octalysis framework mobile learning system framework (Octalysis, n.d.)



### 3.3 Fog Computing Using for the Mobile Learning System

Fog Computing using for the Mobile Learning System Network and Content Focus mobile Network (CFMN) can be used for each carrier pleasant and useful resource utilization of cellular networks. The centrality of content, naming data, and catching famous content material on the edges of the community can limit the transmission of reproduction content material to cellular networks, speed up the response to the tournament and enhance the use of community resources. It is helpful to beautify fog computing norms to control catching assets (Wang et al., 2017). The fog part consists of mild no SQL information storage and quite a number inside community operations (local location networks). They can be used to calculate specific elements to make them beneficial and to make any consistent predictions to generally interface with different users, such as teachers, teachers, and students, thru exterior software interfaces (Pecori, 2018). External software interface can work in accordance with a subscriber/notification paradigm that lets in nodes to work as an intermediary. This indicates that some stakeholders subscribe to some records streamers or assessors and, when possible, are getting facts with some notifications. On the different hand, the inner utility interface works in accordance with a push/bridge mannequin in which purposes and instructions are directed to the cloud when the facts movement relies upon now not solely on the fog degree however additionally on the information stream. Furthermore, whilst inner purposes information each interface manages and records information, exterior stakeholders regularly elevate especially academic content material to provide stakeholders how to tunnies their academic things to do as proven in (Pecori, 2018).

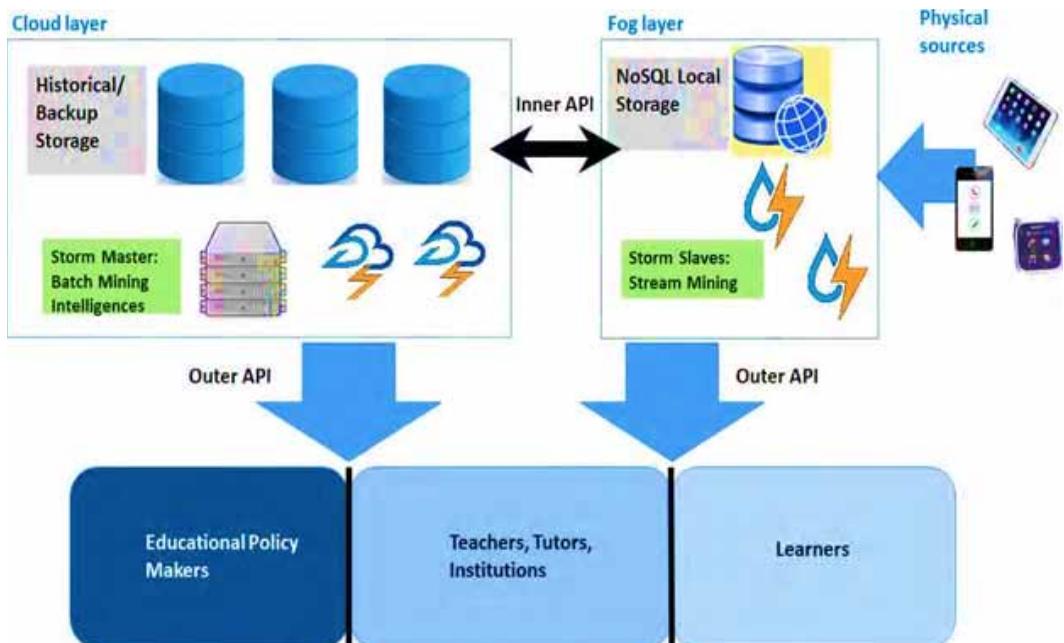
#### 3.3.1 Fog Computing Mobile Network (FCMN)

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There has been an interchange of information in the cloud in the job of online work via academic portals. Faculties support web-based offers to students and parents, as well as specific educational applications, by imposing well-known working place programmes, messaging services and digital desktops. Three ways below can alter classes through fog statistics. There has been an exchange in the task of on-line work via scholar portals the place information is saved in the cloud. By imposing well-known workplace Applications, messaging services and digital desktops, faculties help web-based offerings for students and parents, as appropriately as more and more specialized educational applications. Below are three approaches Fog data can affect classes. Microdata cantor in fog computing gives on-site technological know-how which can be completed up and down with faculty needs. For example, the capacity of the system may increase traffic due to students who have access to both employees and MLMS (mobile learning management system) after school. In the meantime,

Figure 3. Fog computing Mobile learning system (Pecori, 2018)



the infrastructure must be increased, and performance will not decrease to control traffic, but if they exist, everyone must count. These difficulties are high in the academic sector, even in higher education. Connections and network communications should be a top priority for working effectively. However, these faculties can be a project for many divided organizations, especially faculties unfold throughout one-of-a-kind campuses. Delays can be eradicated for non-stop and higher person ride through bringing information in the neighborhood. Also, some campuses may no longer have IT, staff. The advantage of fog computer systems is that educated IT officials can work remotely in the administration of tasks. The most important way to work is no longer just because of the value of travel on these websites, but because of the instances of late response due to travel, there is additionally minimal downtime.

### ***3.3.2 User Experience System***

Technology has become a new rule in the study room as lecturers appear in academics for new methods for using computer systems and online sources. Schools with more than one campus are touching fog computer systems as a sustainable response to helping educational institutions and impacting the person's experience due to ease of use. More specifically, educational institutions operate like remote locations and workplace groups with similar IT aspirations. Fog calculation is a neighborhood calculation that can be deployed quickly and requires overall performance and self-assurance at the center without any difficulty away from basic facts. The calculation of fog decentralizes computing sources and brings them closer to the record source. When faculties use accounting, they choose hyperlinks and networks on a range of campuses to do away with sluggish speeds, considerably improving the trip of college students and teachers.

### ***3.3.3 Using Digital Tools***

instructional establishments grant college students with exterior get admission to digital libraries and on-line software portals for the duration of the day. Fog Computer System provides chastity to work efficiently and efficaciously with the central website online and more than one device. Fog computing technological know-how improves coaching operations and offers them with a platform with chastity towards slowing or stopping them

## **3.4 Fog Computing Setting Up Network Traffic for Cloud Computing**

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in a similar fashion to far-flung places and department workplace groups whose IT desires are similar. Fog calculation is a neighborhood calculation that can be deployed rapidly and without difficulty away from the predominant facts Centre the place overall performance and self-assurance are required. The calculation of fog decentralizes computing sources and brings them nearer to the records source. When faculties use accounting, they choose hyperlinks and networks on a range of campuses to do away with sluggish speeds, considerably improving the trip of college students and teachers.

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### 3.5 Task Management System (Application)

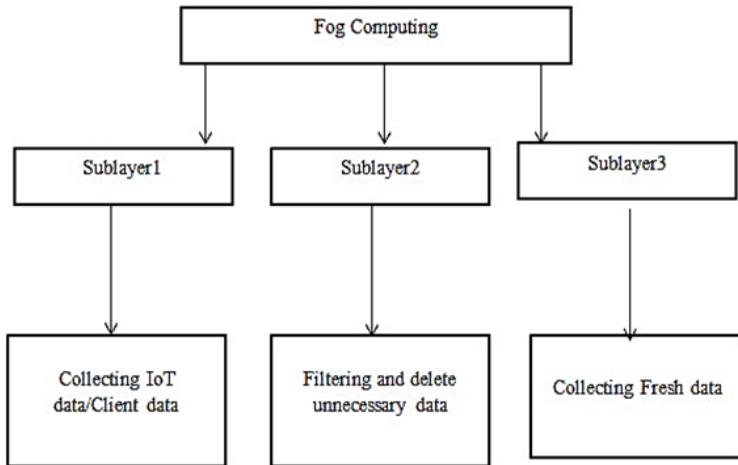
An application is developed in PHP after designing a mobile learning system model to analyze the performance of students. The application consists of features (points, badges, and leaderboards) of the mobile learning system. The application is called “Task Management System”. This is a specific Web-based application. This application will run inside. This means that this application will be accessible worldwide. A task/assignment is to be assigned by the teacher to the class through the Task Management System app. The following fields are included to assign any work:

- **Task Article:** There will be a text box in which the teacher will write a work/assignment title or article. (Such as creating a website).
- **Work Description:** There will be a multi-line text box (text area). The teacher in this box will write details about this work.
- **Start Date:** The current date should be the start date of the work. The application will automatically select the current date from the system date.
- **End Date:** Teachers will write/select the students for the last date to complete the work. The date will be selected from the pop-up J. Kori calendar.
- **Points:** Points will be shown in the dropdown list. The teacher will select points from the dropdown list whichever points the teacher assigns from this task/assignment.
- **Assignment:** Classes/Batches will settle in the drop-down list; the teacher will choose the class/batch by which a teacher wants to assign work/assignment.
- **Work Priority:** Whenever a teacher assigns any work to any class, the priority of the first task will be started, which means that work is now being started. When students start working on a job, students change it to start from the beginning. So that a teacher can see it, and whether the student started working on this work or not. When the student completes the work, he now changes the priority from the beginning. So that a teacher can check with his dashboard that the student has completed his work.

### 3.6 Data Reduce Ratio From Big Data

Figure 4 shows that the mist computing layers are separated into three sublayers. Sublayer1 has collected IoT information. At that point sub-f2 channels and superfluous information have been erased. Sublayer3 has collected this new information. New information implies information, important information in association with conditioning, significant information, and timestamps ought to too be kept. In our engineering, haze gear is sublayer 1 and the keen framework or shrewd nearby lattice acts as a sublayer2 and sublayer 3.

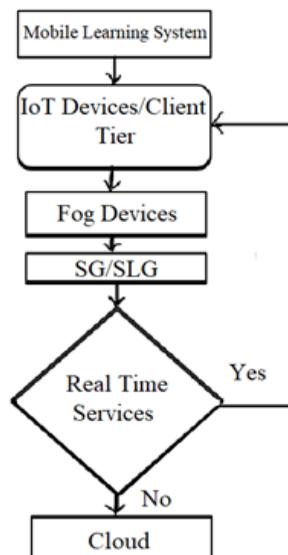
Figure 4. Fog computing data reduce ratio from big data



### 3.7 Fog Computing With Real-Time Services

With the utilize of mist computing, we are able without issues offer actual-time offerings in case of not on time-sensitive programs. Haze gear is without trouble providing region acknowledgment. A major issue is the mist framework memory may be exceptionally moo. So, we brought 0. 33-party memory administration in our structure, known as neighbourhoods’ capacity or keen local grid and imperative carport or shrewd framework. The advantage of nearby capacity is that when we require real-time offerings, this nearby carport can without issues dispatch the essential insights. In haze computing, we’ve got utilized a keen framework or savvy adjacent grid for a semi-everlasting carport that gives actual-time administrations, in Figure 5. Three. Chronicled data has to be sent into the cloud as time could be a totally basic issue to offer real-time administrations.

Figure 5. Mobile learning system using fog computing technology



One of the major parts within the case of the truth of the enormous information. Hub makes a difference the organization effectively discover the root of the information. We have proposed a classification structure to tally expansive figures within the mist design. Here, we prepared the enormous information as the premise of the design. For illustration, we have appeared 14 hubs for information preparing. Information preparing is effectively kept up, and destitute hubs are effortlessly found in this methodology.

### 3.8 Nodes Organization

One of the major parts within the case of the truth of the enormous information. Hub makes a difference the organization effectively discover the root of the information. Here we have wished-for two sorts of Gesticulation Association:

1. Master Slave Model System.
2. Complete Binary Tree System.

#### 3.8.1 Master Slave Model System

In Figure 6, we have proposed a classification structure to tally expansive figures within the mist design. Here, we prepared the enormous information as the premise of the design. For illustration, we have appeared 14 hubs for information preparing. Information preparing is effectively kept up, and destitute hubs are effortlessly found in this methodology.

#### 3.8.2 Complete Binary Tree System

A double tree is considered a complete double tree if all surfaces are filled but conceivable at the last level and all the keys within the last surface remain as much as conceivable. In Figure 7, we used a double tree for the center association at the Fog Computing technology.

Figure 6. Node association in fog layer using master slave model system

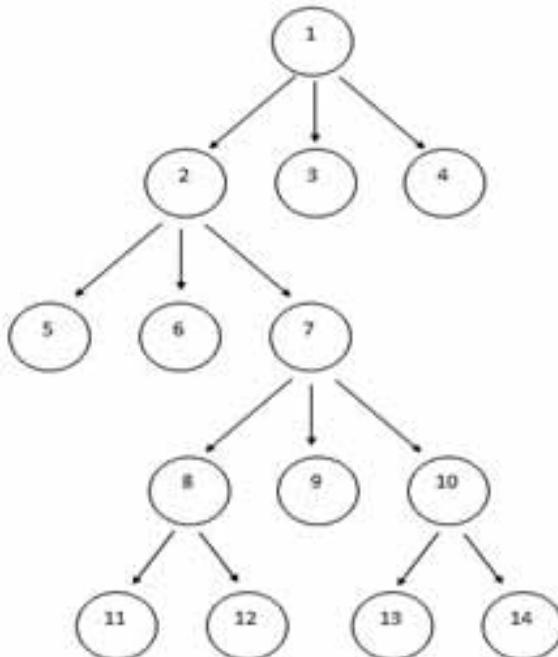
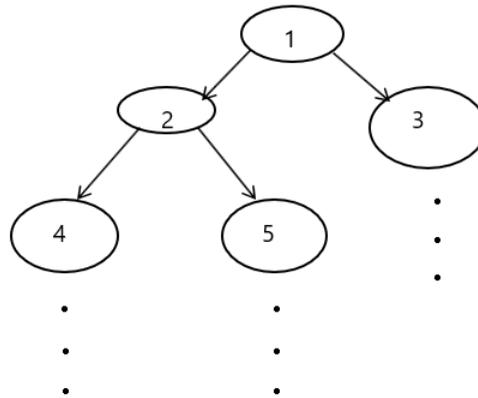


Figure 7. Node association in fog layer using complete binary tree system



### 3.8.3 Binary Tree Structure

A twofold tree is considered as a full double tree in case all surfaces are filled but conceivably at the final level and within the final level all the keys stay as much as conceivable. In Figure 7, we utilized a double tree for hub organization in mist foundation.

## 3.9 Experimental Tools

Within the case of data-centric investigation, we have utilized cloud SIM 3.0 test system and overshadow ID for reenactment. Besides, we utilized center object-oriented programming to discover the yield in cloud SIM.

### 3.9.1 Cloud SIM Simulator

Cloud SIM may be a library for the replication of cloud scenarios. It gives the vital classes to depict distinctive parts of the framework such as information centers for planning and provisioning administration, computational assets, virtual machines, applications, clients, and arrangements.

### 3.9.2 Eclipse Software

Overshadow is an coordinates advancement environment (IDE) utilized in computer programming, and the foremost utilized java is IDE. It has an extendable plug-in framework to customize a base workspace and environment (GitHub, 2018). The overshadow is for the most part composed in Java and is basically utilized to create Java applications.

### 3.9.3 Java Programming Language

Java may be a general-purpose computer programming dialect that's side by side, class-based, object-oriented, and particularly planned for greatest moo usage reliance. The purpose is to donate application designers "type in once, run (WRA), which implies that the java code compiled runs on all these stages Who back Java without the required for resynthesis (Java Community Handle (SM) Program - JSRs: Java Detail Demands - Portrayal JSR# 59, ND). Java applications are ordinarily set up on the byte code that can run on any Java Virtual Machine (JVM) in any case of computer design. For errand planning in mist hubs, we proposed a calculation. Additionally, we needed to discover as numerous data flues as possible in us organize Portage Flickr child calculation. The planning assignment makes a difference in numerous highlights within the case of expansive information. It moreover gives a real-time illustration to discover temperature-based information and new information from the Arduino Model Board and the LM35 temperature sensor utilized.

### 3.9.4 Task Scheduling

Here, Figure 8 appears that the errand chart comprises of 9 errands. As per the errand chart in Table 1, we gave entry time. Assist, keeping up line and entry time for work. Here gives each assignment to the beat need list to total the work as per entry time. On the off chance that the entry time of two assignments is the same, the most extreme line assignment number is given more need to total the work.

### 3.10 Proposed Algorithm

Input: Queue based task= qbt,  
 Arrival time= art

Output: Task priority= tpr

1. Sort the arrival time in ascending order.
2. If (Queue list is not empty)
  - 2.1 Give tpr based on art.
  - 2.2 If (finish time is equal)
    - 2.2.1 Give higher tpr based on qbt.
3. Else stop.

Figure 8. Task development into fog computing for big data processing

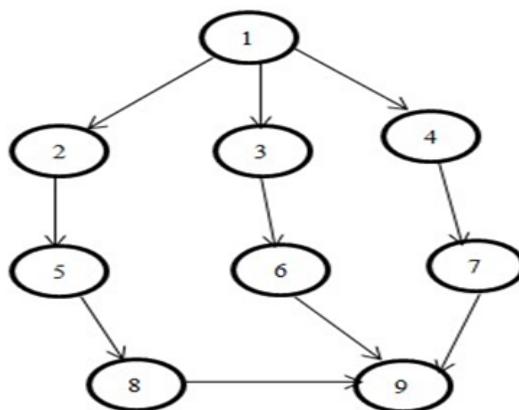


Table 1. Task priority into fog infrastructure for big data processing

S.No.	Queue (qbt)	Priority (prt)	Arrival Time Time(art)
1i	1i	P1i	5i
2i	2i	P4i	7i
3i	3i	P2i	6i
4i	4i	P8i	10i
5i	5i	P9i	12i
6i	6i	P3i	6i
7i	7i	P5i	8i
8i	8i	P6i	9i
9i	9i	P7i	9i

### 3.11 Maximum Data Flow

Here we utilized the Portage Flickr child calculation to discover greatest information stream in a organize. Passage Flickr child Calculation could be an eager calculation that counts maximum stream into the flow organize. Usually called “strategy” instead of “calculation” since the approach to finding ways to extend the remaining chart has not been completely clarified or is characterized in different requirement with diverse strolling hours. Shows gesture organization in Figure 9, the introductory design is ordinarily IOT/sensor pattern. At that point, we presented the haze edge hub or information middle code. The final is the thought for the computation information that’s produced from the IoT/ sensor serein. This last-end-level master-slave show comprises of. Passage Fulkerson calculation is utilized to degree stack capacity and add up to efficiency within the master-slave demonstrate.

Figure 10, Seen three models of master slaves. Within the master slave display, we have supplied several stacking capabilities. Based on figure, calculate different stack capacity. In the used ford-Fulkerson calculation, 4.2 master slave demonstrate. In certain master slave show-based networks. The flow capacity  $c$ , a source hub, is a parcel of Your, a Dock Yes, you may be the start of the edge and I’m the end of the rim and diverse stack capacities within the master-slave show. Calculate diverse stack capacities based on Figure 11 master-slave demonstrate within the utilized ford-Fulkerson calculation. In Some networks based on master slave show. It can be a parcel of the system {Show Method  $X = (U, I)$  Stream capacity  $U$ , a source hub hundred, i sink hub  $u$ , you can be  $S$  starting point of the edge and  $I$  have a finishing point of the edge.

Figure 9. Fog computing nodes association different layer for the cloud computing

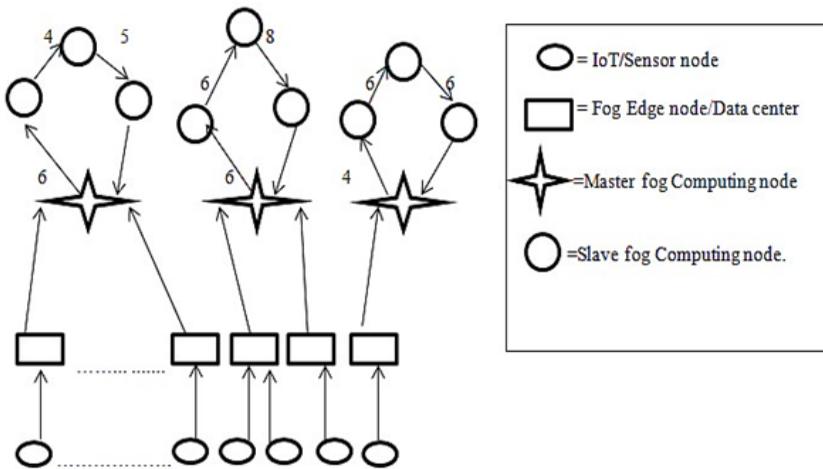


Figure 10. Master slave model system with different network capacities

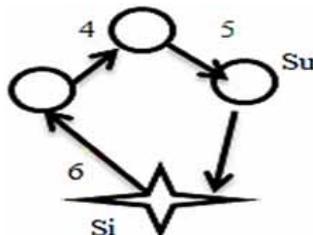
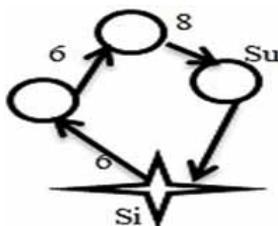


Figure 11. Fog computing using in the master slave model system model with different capacities



If the ford-Fulkerson calculation is applied, the whole arrangement and output sink hub estimation must be reported in Table 2. The organisation and the return sink value of these hubs are a difference to find out who are not assigned to the task. In addition, the capacity of the hubs which can or cannot accomplish the task. In case we apply the ford-Fulkerson calculation the full arrange capacity and yield sink hub esteem are given. The organize capacity and yield sink hub values are made a difference to discover out these hubs which are not allotted the assignment.

#### 4. RESULTS

The experimental results show latency, performance, and data-centre analysis of the community inside this part. We employ characteristics such as distance, medium speed transfer, packet size, transmission statistics and throughput to find out, for example, how long the parameters have elapsed. The experimental result in this section indicates community Latinas', throughput, and data-focused analysis. To find, community let ins use special parameters such as distance, transmission medium speed, packet size, data delivery, and exploring throughput We have used data size, time lapse parameters. In terms of providing offers from the Centre for Equal Statistics, it is time-taker, and the offers are poor. Moreover, renovation of the centre of facts is more expensive. From Table 3, we see that similar data centers work with two special tasks. When one challenge is met, another project is assigned. So, in this case, it is very challenging to offer a real time career because of this fact a project is standing on another challenge and waiting to finish the work. In this situation, fog computing paradigm plays an essential role, and storage problems can be solved without difficulty. Because we knew that fog is usually toiled as distributed processing.

##### 4.1 Data Central Analysis

In the case of supplying offerings from the equal statistics centre, it is time-consuming, and offerings are poor. In addition, it is more expensive to renovate the facts centre. Table 3 shows that two exclusive jobs are carried out by equal statistical centres. Any additional project is assigned if one challenge is completed. In this scenario, the presentation of real time operators is particularly tough since one company has a different issue and has waited for the task to be completed. The fog calculation

Table 2. Data flow into different network using ford-Fulkerson algorithm

Sources node (SU)	Slaves' node (SI)	Maximum data flowing in network
1	3	4
2	2	6
3	3	4

Table 3. To provide service from same datacenters for different task

Cloudlet Id	Data Centre	VMI Id	Time	Starting Time	Finish Time
0	2	0	80	0.1	80.1
1	2	1	160	0.1	160.1

paradigm plays a crucial role in this case, and the storage problems may be resolved without issue. We realised that fog is often worked out as a processing unloaded.

Here we want to continuously use MAAS (monitoring as a service) as a phase is set at every other stage in our architecture. Further, 5GNet facility is desired to switch through internet for facts. A variety of FDS (Fog Data Service) is further desired to speak without difficulty in a range of our proposed architecture. We can use the Lich (Low Energy Adaptive Clustering Rating) routing protocol for our smart grid node organization. Tora (Timperley Ordered Routing Algorithm) Routing protocol can be used additionally for route introduction and maintenance. Furthermore, for our construction communication, Bluetooth 4 can be used in IoT gadgets and fog nodes. Socket input output programming can be used to talk between cloud and fog nodes. Many Wi-Fi oral exchange protocols are made entirely based on IEE 802.15.4 such as Zig B for interaction between fog and IoT devices. but. We can use every other technical knowledge such as (CAAS) must be imposed as a service, (MAAS) monitoring as a provider due to the fact that layers are managed by another layers. Further, records require transmission from one bar to every other, 5G web offerings. For offering safety in IoT (internet of things), information blockchain science is useful and a less difficult way. We can use Laura properly like labra van protocol to offer long distance fact delivery. Data series from IoT units or sensors fiber optic sensors can play an additionally essential role.

#### 4.2 Fog Network Layers Transmission System

Here we wish to continuously employ MAAS (Monitoring as a service) since one stage is organised on every other level in our design. In facts are also requested on the internet. 5G network facility Additionally, in the one-off architecture ranges, several forms of FDS (Fog Data Service) are recommended without any problem. We can use LEACH for our intelligent grid node organisation (Low Energy Adaptive Clustering Hierarchy). The TORA routing protocol may be used for the implementation and management of routes as well (temporary ordered routing method). Bluetooth four may also be employed in IoT gadgets and Fog nodes for our architectural communication. Socket input-output programming may be employed between Cloud and Fog Nodes. Many wi-fi verbal interchange protocols have been developed entirely from IEEE 802.15.4, for example ZigBee for fog/IT dialogue. Moreover, we can use every other technological know-how such as it is essential to impose (CAAS) manage as a service, (MAAS) monitoring as a provider due to the fact one layer is managed by means of some other layer. In addition, records are needed for transmitting 5G web offers from the one layer to each other. Blockchain science is useful and less complicated to offer IoT safety (internet of things). We can use LORA as properly as LORA WAN protocol for offering long-distance facts transmission. Data series from IoT units or sensors fibber optic sensors additionally can play an integral role.

#### 4.3 Performance Evolution

Communication in fog and cloud layer socket input-output programming is beneficial. Performance Evolution consists of distinct stages. They are described below.

#### 4.4 Fog Network Connection System

Fog Network System is a measure of delay. In a network, latency measures the time it takes for some information to get to its vacation spot throughout the network. It is generally measured as a spherical

time out prolong - the time taken for data to get to its vacation spot and lower back again. The round-trip extend is an essential measure due to the fact a pc that makes use of a TCP/IP community sends a confined quantity of information to its vacation spot and then waits for an acknowledgment to come lower back earlier than sending any more. Thus, the round-trip lengthen has a key influence on the overall performance of the network. Latency is typically measured in Milli-Seconds (M/S).

People frequently anticipate that excessive overall performance comes from excessive bandwidth, however this is no longer the case stud.

#### 4.5 Network Latency

Latency is a latency metric. In a network, latency quantifies the time required for some information to reach its holiday location throughout the network. The time it takes to come back to and from its vacation destination is normally measured as circular time-out prolonged. The round-trip extension is an important step since a PC using a TCP/IP community transmits a limited amount of information into their holiday resort and then waits for an acknowledgement that they will return sooner than they send out. The round-trip duration hence has a major impact on the network’s total performance. Typically, latency is measured in milli-seconds (M/S) (see Table 4).

If:

$$Distance = di$$

$$Speed = sp$$

$$packet\ size = pas$$

$$Transmission\ rate = trr$$

$$Propagation\ Delay = PrD$$

$$Serialization\ Delay = SeD$$

$$Network\ Latency = NeL$$

$$PrD = di / sp$$

$$SeD = pas / trr$$

$$NeL = PrD + SeD$$

From Table 5, we take a look at how community delays are minimized when the distance is short. So, it helps in providing real-time services. Moreover, we know that fog is closer to the layers of infrastructure than the cloud’s layers.

Table 4. Network latency based on different and same speed, packet data transmission

Source to Destination (km) input1	Transmission Medium Speed (M/S) Input2	Packet size in (bytes) Input3	Data Transmission (kbps)	Network Latency (output1) (M/S)
5000	197863.022	1500	512	48.7075
4000	197863.022	1500	512	43.6535
3000	197863.022	1500	512	38.5995
2000	197863.022	1500	512	33.5455
1000	197863.022	1500	512	28.4915
500	197863.022	1500	512	25.9645

Table 5. Fog network level calculation for binary tree system

Levels No.	Fog Nodes	Nodes Numbers
00	1	1
01	2, 3	2
02	4, 5, 6, 7	4

#### 4.6 Fog Network With Binary Tree

*If, level number = l  
 then, maximum node number = 2*

If any problem takes place in one node, it can be without problems located thru the evaluation of the hassle table and additionally comprehend. If there is an issue in one node, the assessment of the whole table may be trouble-free. We further understand that the data comes solely from the guardian node, as it is a framework for management of hierarchical facts. We may thus conclude that the number of check nodes is lowered. This technique is used to check nodes using backtracking. In addition, in Table 6, we find more issue nodes, nodes to check and many nodes to detect trouble nodes.

#### 4.7 According to the Master Slave System

The node business enterprise for fog computing is explored in Figure 12. This was previously the profound arrangement of the hierarchical node. In Table 7, the range of nodes in each level has been calculated. The considered node business enterprise for fog computing. This was once the depth-based hierarchical node organization. From Table 7, we have determined the range of nodes in every level.

If any difficulties occur in a single node, the information in Table 8 can be without problems. A binary and master-slave model is the node organisation of fog computing. So, we can fix the computer problem for any issue in one node merely by identifying this master node. To detect a problem node, you need to search for a minimum of 1 node, or you wish to search for maximum nodes.

We now prefer to inform research impact, we are aware that in the present world, data is being produced in haste by building smart cities or using clever applied sciences. Processing, managing, and storing these large data is a significant problem as offering real-time from normal cloud systems is

Table 6. Fog network node for binary tree system

Problem Node	Checking Node	Total Node
1	0	0
2	1	1
3	1	1
10	5,2,1	3
11	5,2,1	3
12	6,3,1	3
13	6,3,1	3
64	32,16,8,4,2,1	6
65	32,16,8,4,2,1	6

Table 7. Fog network node calculation for master-slave model

Depth	Node	Node Number
1	1	1
2	2, 3,4	3
3	5,6,7	3
4	8,9,10	3
5	11,12,13,14	4

Table 8. Node for master-slave model

Problem Node	Checking Node(max)	Checking Node(min)	Total Node (maxi or min)
1	0	0	0
5	2,1	2	2i or 1
11	8,7,2,1	8	4i or 1

over-delayed. Moreover, giving storage at the Cloud Information Center is no longer enough for this large amount of data. So, by proposing these facts to minimize quantities and give real-time offers, we prolonged layers of fog computing and gave a strategy to provide real-time services.

Tradition Cloud Computing was not enough to deliver real-time offers for a once-latinize sensitive application. Moreover, the assessment of these large-scale records offering large statistics administrations and real-time presentations were additionally unavoidable issues. This work was once providing real-time offerings to the use of fog computing infrastructure easily. Special sublayers represented to discover glowing facts from large data, this method was suggested to delete useless data. In this work, the measuring parameter for overall performance assessment was once community Latinas', throughput.

#### 4.8 Throughput of the Cloud Network Layers

Throughput of the Cloud Network Layers are the highest speed or highest rate of creation at which something can be handled. When used in relation to correspondence organizations, for example, ethernet or parcel radio, throughput or organization throughput is the speed of effective message transportation on a correspondence channel (Ayub Khan et al., 2021; Javai Community Process (SM) Program, n.d.; Khan, Laghari, & Awan, 2021; Khan et al., n.d.; Khan & Ali, 2021; Khan, Laghari, Liu et al, 2021; Khan, Shaikh, Shaikh et al, 2022; Khan, Shaikh, Baitenova et al, 2021; Khan, Shaikh, Belinskaja et al, 2022; Laghari et al., 2021; Shaikh et al., 2022). The information with which these messages have a place can be delivered to a physical or permanent connection, or it can pass through the center of a particular organization. Throughput is usually estimated in every second (bit/s or bps) bits, and in some cases every second (P/S or PPS) in information parcels or information bundle spout per time allotment. Throughput indicates that the time required to deal with the scale of information is measured. In addition, throughput additionally means that the measure of information entered goes through the framework. If information enters a huge capacity in a framework, it converts traffic into a framework, which can be harmful to the offer of ongoing types of support.

If:

$$data\ size = ds, time\ elapsed = te,$$

$$throughput = th$$

$$then, th = ds / te$$

In Figure 12, we Implementation that the data measurement is expanded so the Throughput time is increased. Therefore, giving a real time provider is a benefit due to the fact that data processing is large data per second. Fog computing is recommended to offer real-time presentations and balance cloud computing burdens.

#### 4.9 Mobile Learning System Fog Computing Education Level

The Smart Mobile Learning System Fog Computing Education Level survey was to be taken from both genders (see Table 9). Out of the 100%, were Student participants. A graphical representation of the gender of participants. the education level of the participants. Out of 100%, 99%, holding bachelor’s degree, 88%, holding a master’s degree and 77% was the Ph.D. holder.

Figure 13 shows the education level of the participants. Out of 50, 39 were holding bachelor’s degrees, 10 were holding a master’s degree and 1 was a Ph.D. holder. The Smart Mobile Learning System Fog Computing Education Level survey.

### 5. CONCLUSION

In this research work, the Mobile Learning System model has been developed for the use of Mobile Learning System in an educational organization. Furthermore, an application has been developed in Mobile Learning System components are analysed the performance of the fog Computing. Performance

Figure 12. Throughput from volume of the data size

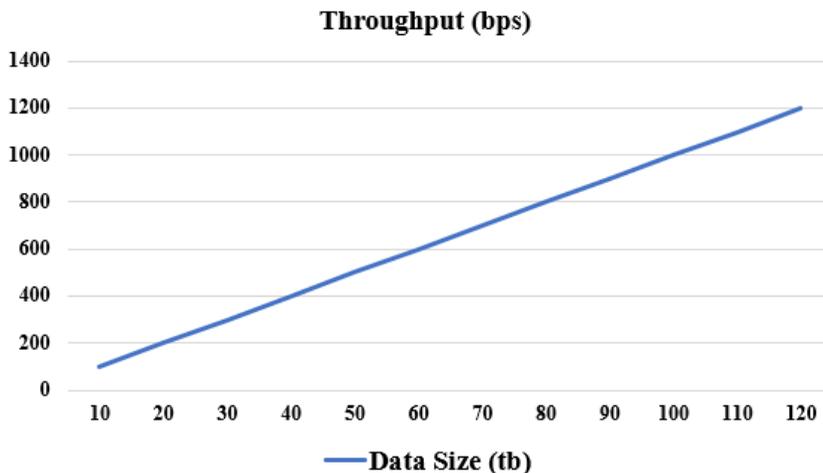
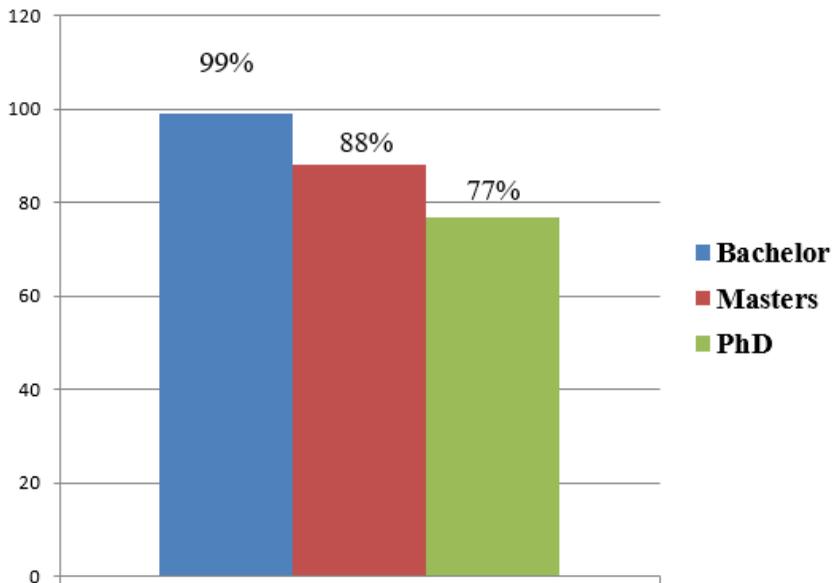


Table 9. Education levels of participants

Education Levels of Participants	10	20	30	40	50	60	70	80	90	100
Bachelor’s Degree	9	19	29	39	49	59	69	79	89	99
Master’s Degree	8	18	28	38	48	58	68	78	88	0
Ph.D.	7	17	27	37	47	57	67	77	0	0

Figure 13. Education levels of participants



of fog Computing is measured using the points assigned against the task. The performance of fog Computing is measured through the different tasks in the Cloud network. If a Cloud network completes the task within time, it means concentration in the task. Organizations may utilize the incorporation of Mobile Learning System is using fog Computing techniques to improve the atmosphere of the education system and productivity of the students. Also, the results of this research may be utilized to measure the performance of fog Computing and to make them more productive for cloud computing. To minimize the load of management information from the cloud, the mist computing standard plays an imperative part within the pre-management Versatile Learning Framework demonstrate for an instructive organization. A classified, layer shrewdly and disseminated mist computing engineering gives capacity close to the system for idleness seeing applications.

### 5.1 Future Work

This research can be further extended in education areas, in which researchers can implement Mobile Learning System techniques to enhance the performance of fog Computing to study cloud computing network edge. Also, this research can be implemented in any field like online shopping, online quizzes, and online healthcare system, etc.

## REFERENCES

- A., E.T. (2015). Use of Machine Learning Algorithms with SIEM for Attack Prediction. *Adv. Intell. Syst. Comput.*, 308(1).
- Adkins. (n.d.). *The 2012-2017 Worldwide Game-based Learning and Simulation-based Markets Key Findings from Recent Ambient*. Academic Press.
- Alhumaid, K. (2021). Developing an educational framework for using mobile learning during the era of COVID-19. *Int. J. Data Netw. Sci.*, 5(3). Advance online publication. doi:10.5267/j.ijdns.2021.6.012
- Ayub Khan, A., Laghari, A. A., Shaikh, A. A., Bourouis, S., Mamlouk, A. M., & Alshazly, H. (2021). Educational Blockchain: A Secure Degree Attestation and Verification Traceability Architecture for Higher Education Commission. *Applied Sciences (Basel, Switzerland)*, 11(22), 10917. doi:10.3390/app112210917
- Gaved, M., & Peasgood, A. (2017). Fitting in Versus Learning: A Challenge for Migrants Learning Languages Using Smartphones. *Journal of Interactive Media in Education*, 2017(1). Advance online publication. doi:10.5334/jime.436
- GitHub - JuliaComputing/JuliaDT: Julia Development Toolkit for Eclipse. (2018). Available: <https://github.com/JuliaComputing/JuliaDT>
- Javai Community Process (SM) Program - JSRs: Java Specification Requests - detail JSR# 59. (n.d.). Jcp.org.
- Khan, Laghari, & Awan. (2021). Machine learning in computer vision: A review. *EAI Transactions on Scalable Information Systems*, 4.
- Khan, Laghari, Shaikh, Shaikh, & Jumani. (n.d.). Innovation in Multimedia Using IoT Systems. *Multimedia Computing Systems and Virtual Reality*, 171-187.
- Khan, A. A., & Ali, S. A. (2021). Network forensics investigation: Behaviour analysis of distinct operating systems to detect and identify the host in IPv6 network. *International Journal of Electronic Security and Digital Forensics*, 13(6), 600–611. doi:10.1504/IJESDF.2021.118542
- Khan, A. A., Laghari, A. A., Liu, D.-S., Shaikh, A. A., Ma, D.-A., Wang, C.-Y., & Wagan, A. A. (2021). EPS-Ledger: Blockchain Hyperledger Sawtooth-Enabled Distributed Power Systems Chain of Operation and Control Node Privacy and Security. *Electronics (Basel)*, 10(19), 2395. doi:10.3390/electronics10192395
- Khan, A. A., Shaikh, A. A., Shaikh, Z. A., Laghari, A. A., & Karim, S. (2022). IPM-Model: AI and metaheuristic-enabled face recognition using image partial matching for multimedia forensics investigation with genetic algorithm. *Multimedia Tools and Applications*, 1–17. doi:10.1007/s11042-022-12398-x
- Khan, A. A., Shaikh, Z. A., Baitenova, L., Mutaliyeva, L., Moiseev, N., Mikhaylov, A., Laghari, A. A., Idris, S. A., & Alshazly, H. (2021). QoS-Ledger: Smart Contracts and Metaheuristic for Secure Quality-of-Service and Cost-Efficient Scheduling of Medical-Data Processing. *Electronics (Basel)*, 10(24), 3083. doi:10.3390/electronics10243083
- Khan, A. A., Shaikh, Z. A., Belinskaja, L., Baitenova, L., Vlasova, Y., Gerzelieva, Z., Laghari, A. A., Abro, A. A., & Barykin, S. (2022). A Blockchain and Metaheuristic-Enabled Distributed Architecture for Smart Agricultural Analysis and Ledger Preservation Solution: A Collaborative Approach. *Applied Sciences (Basel, Switzerland)*, 12(3), 1487. doi:10.3390/app12031487
- Kumar, V., Laghari, A. A., Karim, S., Shakir, M., & Anwari Brohi, A. (2019). Comparison of Fog Computing & Cloud Computing. *Int. J. Math. Sci. Comput.*, 5(1), 31–41. doi:10.5815/ijmsc.2019.01.03
- Laghari, A. A., He, H., Halepoto, I. A., Memon, M. S., & Parveen, S. (2017). Analysis of quality of experience frameworks for cloud computing. *IJCSNS*, 17(12), 228.
- Laghari, A. A., He, H., Memon, K. A., Laghari, R. A., Halepoto, I. A., & Khan, A. (2019). Quality of experience (QoE) in cloud gaming models: A review. *Multiagent Grid Syst.*, 15(3), 289–304. doi:10.3233/mgs-190313
- Laghari, A. A., He, H., Shafiq, M., & Khan, A. (2017). Impact of storage of mobile on quality of experience (QoE) at user level accessing cloud. *2017 9th IEEE International Conference on Communication Software and Networks, ICCSN 2017*. doi:10.1109/ICCSN.2017.8230340

- Laghari, A. A., Wu, K., & Laghari, R. A. (2021). A Review and State of Art of Internet of Things (IoT). *Arch Computat Methods Eng*. doi:10.1007/s11831-021-09622-6
- Laine, M., Zhang, Y., Santala, S., Jokinen, J. P. P., & Oulasvirta, A. (2021). Responsive and Personalized Web Layouts with Integer Programming. *Proc. ACM Human-Computer Interact.*, 5. doi:10.1145/3461735
- Mishra, A. S., Karthikeyan, J., Barman, B., & Veetil, R. P. (2020). Review on IoT in enhancing efficiency among higher education institutions. *Journal of Critical Reviews*, 7(1). Advance online publication. doi:10.31838/jcr.07.01.109
- Octalysis: Complete Gamification Framework - Yu-kai Chou. (n.d.). <https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/>
- Parlakkılıç, A. (2019). Responsive Mobile Learning (M-Learning) Application Design And Architecture In Fog Computing. *Int. J. Mod. Educ. Stud.*, 3(2). Advance online publication. doi:10.51383/ijonmes.2019.40
- Pecori, R. (2018). A virtual learning architecture enhanced by fog computing and big data streams. *Futur. Internet*, 10(1). Advance online publication. doi:10.3390/fi10010004
- Predictive Quality and Yield Solution, powered by process-based Artificial Intelligence. (n.d.). <https://www.seebo.com/>
- Sarkar, S., Chatterjee, S., & Misra, S. (2018). Assessment of the Suitability of Fog Computing in the Context of Internet of Things. *IEEE Trans. Cloud Comput.*, 6(1). Advance online publication. doi:10.1109/TCC.2015.2485206
- Schöbel & Söllner. (2016). *How to gamify information systems - Adapting gamification to individual preferences*. Academic Press.
- Shaikh, Z. A., Khan, A. A., Baitenova, L., Zambinova, G., Yegina, N., Ivolgina, N., Laghari, A. A., & Barykin, S. E. (2022). Blockchain Hyperledger with Non-Linear Machine Learning: A Novel and Secure Educational Accreditation Registration and Distributed Ledger Preservation Architecture. *Applied Sciences (Basel, Switzerland)*, 12(5), 2534. doi:10.3390/app12052534
- Sotirakou, Papavasiliou, Mourlas, & Van Isacker. (2016). *Gamified Mobile/Online Learning for Personal Care Givers for People with Disabilities and Older People*. doi: 10.1109/iTAG.2015.16
- Wang, Wu, Li, Li, & Li. (2017). *Fog computing based content-aware taxonomy for caching optimization in information-centric networks*. doi: 10.1109/INFCOMW.2017.8116422