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NEED OF SECURITY AND PERFORMANCE ENHANCEMENT IN CLOUD ENVIRONMENT FOR DISTANCE LEARNING: A REVIEW

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Abstract

The need for cloud-based remote learning is increasing every day. There has been a variety of studies in the area of online education systems for distant learning in cloud computing. These studies, however, have certain drawbacks. Some of the cloud-based education solutions for remote learning that have been previously described have poor security. However, some researchers have chosen to enhance security, but there is still a performance problem since securing the data carries along. This study aims to look at problems like performance & security in a cloud-based education system for remote learning. There is a need for a system to protect educational material without compromising performance. The Cloud system and the necessity for an online education system are discussed in this article and past research on cloud-based online education systems, including methods and constraints. The necessity for improvements in current research is to preserve security, performance, and the breadth of such a system is discussed.

Keywords: *Cloud Environment, Performance, Security, Distance Learning*.

1 Introduction

The usage and demand for remote education is rapidly increasing. With the help of distance-education programs, various courses and degrees are accessible. Distance learning programs must continuously develop and improve their IT infrastructures in order to offer greater assistance to instructors and students. Cloud computing, a relatively new IT paradigm, has potential to enable the use and consumption of IT resources in education sector.

Cloud computing is an critical component in achieving this goal. Thanks to networking design, access to a variable pool of shared computing resources are made on-demand and straightforward. These resources include networks, storage, services, servers, & applications. With little managerial effort, these resources may be allocated. As a result, cloud computing and remote education are often combined. The importance of the cloud in

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remote learning has been discussed in given section. To have better understanding of benefits & drawbacks of incorporating cloud computing into distant learning, a review of the relevant literature was done.

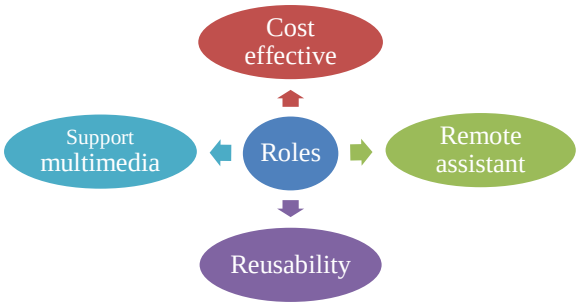

Fig 1. Role of cloud in distant learning

1.1 Benefits of Cloud Computing in Distance Learning

It has a number of advantages for dealing with issues that have been linked with prior IT systems. The advantages are following:

- Cloud computing facilitates the deployment of dependable access networks and servers during online distance learning.
- Cloud computing aids in the administration of data, software, and services necessary for an online education programme.
- It is a service provider with no downtime.
- The cloud environment allows for easy access to instructional materials across a variety of hardware platforms.
- Cloud computing enables access to educational materials through private, public, and hybrid modes, allowing both public and authentic access.
- The cloud environment allows for more flexibility, scalability, and efficiency in the learning environment.

1.2 Challenges to Cloud Computing in Distance Learning

In a cloud-based education system, there have been many problems such as deployment, performance, and security, in addition to several advantages. The following sections go through some of the problems:

- Cloud service management has been proven to be complicated and difficult. To create a cloud-based remote learning environment, highly trained and competent personnel are needed.
- The protocols, transmission medium, hardware, and software employed all have an impact on the cloud system's functioning.
- The transmission of educational material via the network has been limited on many occasions due to poor performance. These problems may arise as a result of the transmission medium or the content's size.
- Another problem that arises in a cloud-based learning environment is the management of large amounts of instructional material because moving large quantities of data from one place to another is difficult.

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- Another problem is the security of educational material due to the danger of attackers and hackers on the network. There are many security measures available, but their implementation has an impact on the performance of a cloud-based education system.

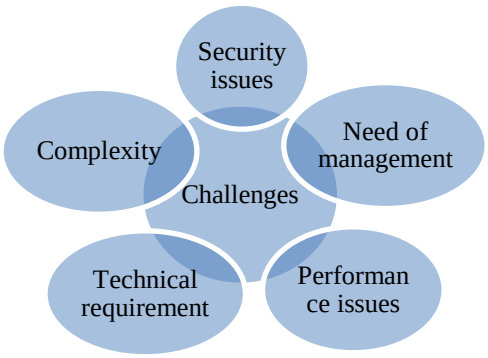

Fig 2. Challenges to Cloud learning

1.3 Influencing factors

Several factors are influencing performance & security of education system.

Security Factors

There have been Security Treats from viruses & external assaults in a cloud environment. There are risks of hacking instructional information across a network. Hackers are accountable for the access of data without any authentication. On other hand, cracker is accountable to crack encrypted material. The encryption methods $ & firewalls are widely employed to offer security. But there have been various attempts that might effect security like as

- Brute force attack
- Trojan horse attack
- Man, in Middle
- Denial of services
- SQL Injection

Performance Factors

The encryption systems used near strengthen the system's security are time-consuming & have an influence on the system's overall performance. performance may be affected by several factors, including the cloud environment itself.

Transmission medium: There is an influence on the system's performance depending on the type of transmission media used. In comparison to wired media, wireless networks tend to be slower. Wireless and wired systems are also many.

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Bandwidth: Quantity of data that may be sent in a given length of time is known as bandwidth. Having greater bandwidth means that more data may be transmitted in a shorter period of time.

The data transmission protocol: It's the collection of rules that control how data is sent over the network. User datagram protocol, which is connectionless and does not require acknowledgment, is faster than transmission control protocol, which requires acknowledgment.

Security mechanism: A security mechanism can slow down cloud network performance since it takes a lot of time to determine whether or not the message is authentic.

Distance: Distance between transmitter and receiver nodes determines how well it works. Transmission time and performance decrease when distance between the transmitter and receiver is higher than distance between transmitter and re-ceiver. When transmission durations are shortened and the distance between transmitter & receiver is reduced, better performance is attained.

Attenuation: Energy is lost as a signal moves from one location to another. Transmission medium and distance have an effect on attenuation. Attenuation-related issues must still be addressed by a signal regenerator.

Compression method: A compression method is recommended to reduce amount of content used in online learning system. The problem of data loss remains, despite the availability of many compression technologies. Words with high frequency must be replaced with words of lesser size in replacement table. When big words are substituted with short ones, the size of a packet decreases. In turn, this reduces packet's transmission time. It is also less likely for packets to be lost since packets are smaller. As a result, with this compression method, an online learning system might see a reduction in packet transmission time.

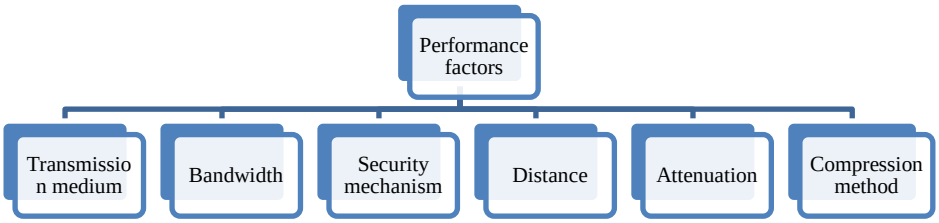

Fig 3. Performance factors

2 MOTIVATION

The incorporation of electron-ic learning into the cloud computing environment has resulted in a wide range of studies. Several academics are debating whether cloud computing is necessary in the educational system. It has been discovered that web technologies make it easier to get information and resources for distance learning. The dynamic web technique, in addition, has demonstrated the most recent technology for transferring information and applications through the Internet. Existing research has shown that education aids in a country's economic growth. Education has the capability of eradicating poverty in a nation. Complicated educational goals and ever-evolving technology have generated a variety of challenges throughout the years. Higher education has focused

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on newest technologies & tools to explore learning in the present age of exploration and experimentation. A worldwide obsession has been sparked by low-cost technology, the Internet, and a variety of educational resources. Using the power of ICTs, this phenomena is contributing in the modernization of educational institutions. Academic data processing is made easier with the inclusion of several application tools including word processors and spreadsheets. It has been discovered that the allocation of educational resources is not equal among countries. There is a pressing need to offer low-cost online education to disadvantaged students in developing nations. Cloud computing provides platforms for implementing new educational methods. There is requirement to develop a conducive atmosphere for administration of instruction & formation of teaching materials. There are a few security models that have been developed in prior studies. To safeguard cloud-based data, the RSA, AES, and DES techniques, DNA security, and numerous security protocols have been described. These research have spurred an interest in safeguarding instructional content in the cloud. It's been discovered that just a few research have focused on cloud performance. As a result, there is need to boost speed of educational material transfer over the cloud while ensuring security.

Literature Review

There have been several types of research in field of cloud-based [1]distance learning, cryptography [2]and data compression. However, the study did a lot of work in this area. But still, there is need to do more work to introduce a mechanism that could provide distance learning features over the cloud in more secure manner without affecting the performance.

2.1 RESEARCHES AREA OF CLOUD COMPUTING IN EDUCATION SYSTEM

Characteristics of today's E-learning system for remote learning have been studied by several scholars. The incorporation of Electronic Learning has been used to explain the architecture of cloud computing environments [3, 4]. Some of the studies looked at the need for cloud computing in online education, and they discovered that cloud computing [5–7][8] is a dynamically scalable and secure system thanks to encryption. It has the ability to provide internet-based services. Virtual technologies are becoming more important in online education as a result of technological advancements. The significance of online training has been addressed by researchers. The study looked at the utilization of a cloud computing-based online education system. During the study, it was discovered that as technology advances, the variety and significance of data utilized in education is growing. The research discussed the importance of web technologies in remote learning and their contributions.

Cloud Computing ramifications and problems in the area of academia have been addressed. There are dangers involved with utilizing the cloud to store and conduct confidential results. Researchers have explained the security loopholes in cloud computing and the prevention mechanism to restrict the attack over the cloud environment. Cloud computing is also being used in research to offer E-learning methods. An e-learning platform with cloud computing Two technologies are employed in online education: systems and software. To better serve e-learners, this study examines how cloud infrastructure services can be used. An investigation was conducted into five areas, including conceptual and pedagogical aspects of the subject matter; educational applications; data and resource management; cloud computing in education's benefits and drawbacks; and DBMS incorporation to cloud-based services.

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There are a number of cloud computing models in distant learning that focus on providing cost-effective web-based solutions at any time& any location. When assessing use of CC in the education sector, fresh findings are provided. Underprivileged children from developing nations are expected to get online cloud-based education. For creative practice teaching, teaching tools to conduct teaching management have been developed.

2.2 Research Fields of Cryptographic Security

Many researchers have implemented DNA Cryptography for Cloud Computing [9]. Such researches have also made use of Huffman Algorithm to perform data compression. These researches have also used socket programming to build a new mechanism for securing data over the cloud.RSA mechanism has been frequently used for cryptography to secure data in cloud environments. The issue with such a mechanism is its time consumption during encryption operations. Several other researchers have also used different cyber security to protect the E-learning environment on a cloud platform. They also analyzed security issues in cloud-based E-learning. Many researchers have discussed the need, scope, issues, and challenges in the cloud environment considering cost and security. Secure storage & data access in cloud computing have been provided in existing research. Some authors used digital signature with exponential key exchange, while others used AES encryption algorithm to boost data protection in cloud storage.

2.3 RESEARCHES IN FIELD OF DATA COMRPESSION

There is a need to introduce the concept of data compression to increase performance. Compressed content is frequently transferred over the network, and the probability of error and packet dropping gets reduced. However, the Huffman algorithm has been used in many types of research to reduce the size of content because it provides loss-less data compression, but the Huffman algorithm's time consumption is high. Data security model for cloud computing has been introduced, considering data compression requirements. In addition, recent literature has addressed the success review of Cloud-based web platforms for interactive learning platform Systems Integration.

2.4 LITERATURE SURVEY

The following table shows the results of a comparative study of cloud-based distant learning research.

Table 1 Comparison of Benefits & limitation of Cloud-based distance learning system

Sno	Author name / year	Title	Objective	Limitation
1	Marston et al. /2011 [10]	"Cloud computing from business perspective"	Work has presented commercial p erspective of cloud computing.	Lack of technical work
2	Kumar et al. / 2011 [11]	"E-learning security issues in the cloud are examined."	To address security concerns in a cloud-based e-learning system.	Lack of technical solution
3	Venters et al. /2012 [12]	"Critical Review of Cloud Computing"	Research focused to review the pros and cons of	No technical solution provided

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			cloud	
4	Garrison et al. /2012 [13]	"Success Factors for Deploying Cloud Computing"	Research considers the elements that are influencing the working of cloud	Did not considered application areas of cloud
5	Yang et al. /2012 [14]	"Cloud computing research: a descriptive literature review and categorization"	Research has focused on different type of cloud environment.	Need to consider the application area
6	Arjun Kumar /2012 [15]	"Cloud computing data storage and access must be secure"	Access level and storage security is considered.	Ignored the performance factor
7	Herhalt et al. /2012 [16]	"Global Study of Governments" Adoption of Cloud"	Considers the factor to make cloud globally acceptable	Need to do work for security
8	Meslhy et al. / 2013 [17]	"Cloud Computing Security Model "	Increasing the performance of cloud environment along with security	Need to improve performance.
9	Nirmala et al. /2013 [18]	"In the cloud, data security and integrity are verified via a user authenticator method."	Research considered data security and user authenticity.	There is need to improve the
10	Xu et al. / 2013 [19]	"By constructing a general education cloud, you may broaden the meaning of remote education."	To perform teaching management	Need to improve performance.
11	Ying et al. / 2014 [20]	"Cloud Computing in Education: Trends"	Considering the upcoming trends in cloud-based educational system.	Only theoretical discussion has been made.
12	Sudhir et al. / 2014 [21]	"E-learning System and Cloud Computing for distance education"	Implement distance education by integration of eLearning and cloud.	Lack of technical feasibility
13	Bandara et al. / 2014 [22]	"Concerns about cyber security in e-learning"	Considering the role of cyber security for online education system.	Theoretical work
14	Arshad et al.	"E-learning in Distance	To increase availability in	Neither security

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	/ 2015 [23]	Education Using Cloud Computing"	E-learning environment.	nor performance factors are considered.
15	Sanjay et al. / 2015 [24]	"Cloud computing as a distant learning paradigm"	Providing a low-cost web-based solution	Ignored the concept of security.
16	Atun et al. / 2016 [25]	"Cloud Systems Used in Education"	To focus on the feature of educational clouds	Research has limited scope
17	Patil et al. / 2016 [26]	"Cloud Computing is being used to research e-learning in distance education."	Considering role of e learning in distance education.	Research is not providing security to content.
18	Balobaidet al. / 2016 [27]	"A Novel Cloud-Based Distance Education Model Proposal"	To assist disadvantaged students and children in developing countries with online cloud-based education.	Lack of security
19	Singhet.al. / 2016 [28]	"Security of data by RSA Algorithm"	To provide security to data by RSA mechanism.	Need to improve security and performance
20	Suresh et al. / 2016 [29]	"The RSA technique is used to secure the cloud environment."	To secure cloud using encryption mechanism.	The RSA takes time to encrypt data
21	Osman, Saife et. al. / 2016 [30]	"VLE Performance Analysis in the Case of Cloud-Based Web Services"	To analyze factors influencing performance of cloud-based web services.	Ignored the security.
22	Pandey and G. P et al. / 2019 [31]	"Cloud Computing DNA Cryptography and the Huffman Algorithm"	To make use of DNA encryption for security and applying Huffman for compression.	Need to do more work on security.
23	Prakash et al. / 2019 [32]	"Cloud Computing in Education: A New Perspective"	To investigate which educational sectors are using Cloud inverment as a service?	Limited scope of work.
24	Ananthi et al. / 2019 [33]	"11Cloud Computing Risks and Challenges in the Academic Field"	To focus on issues in cloud computing when it is used in educational	Lack of technical work

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			sector.	
25	Tadapaneni et. al./2020 [34]	Considering cloud computing as emerging technology	Recent enhancement of cloud computing is discussed.	Ignored the use of the cloud for distance learning.
26	Rahman et. al. / 2016 [35]	Online e-learning, the dangers of cloud computing, and how to protect yourself from them	Research focus on cloud computing and security	Limited scope of work.
27	M. Durairaj et al. / 2015 [36]	A Research Project on Cloud-Based E-Learning Security Concerns	To focus on cloud computing security issues	Need to improve in performance
28	Riahi and Ghazal / 2015 [37]	A look at a cloud-based e-learning platform	Introduce eLearning process on cloud computing	Need to do more work on security.

2.5 RESEARCH GAP

Vouk et al. [1]have addressed the cloud computing in 2008, including the idea, problems it attempts to solve, associated research areas, and a current cloud implementation. The name "cloud computing" may be new, but it's based on decades of distributed computing, utility computing, & study in virtualization. less overhead for users, increased flexibility, cheaper total ownership costs, and Service-oriented architecture are just some of the benefits it offers.In 2021, Duha et. al. [38] presented the educational process idea, which included various cloud inputs & outputs, and described how education problem might be addressed in all of its institutions by using the electronic cloud in remote education. This research looked at all of characteristics of that setting, as well as the potential of using them in universities and educational institutions. Cloud, Distance education, Database is some of the terms that come to mind while thinking about this project.Timothy et al.[39] gave overview of remote education from policy, human, & technological perspectives in 2003. A number of commonly asked questions in distance learning panel discussions are given, along with authors' recommended responses. Survey provided in this article covers distant education communication, intelligence, and instructional technology.Distance education students' well-being and effectiveness as learners were examined in 2012 by Kutluk et. al. [40]. Gathering data is done by employing the first-degree method. The data includes students enrolled in two Turkish colleges' online accounting programmes. Assertions are tested using t-tests and One-Way ANOVA to determine frequency and standard deviations.Discussion focused on how Preethi Sheba [41] talked about the use of animated graphics and digital collaboration with peers as well as the availability of student version software and a conducive home setting for learning. Because online classes place PowerPoints in front of each student, students are able to hear lectures at their preferred volume level, and students don't have to walk or drive to class in order to see these advantages, online courses are more effective.Vijay et al.[42] demonstrated the usage of the cloud provider's storage solution in 2016. In the cloud, data is not safe since an unauthorized user may attempt to access sensitive information. As a result, in order to ensure data security, it employs a variety of encryption tech-

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niques. As a result, multilayer encryption method is used in the suggested research. Multilevel encryption uses two distinct methods to provide a higher level of protection. In a survey study on cloud computing, researchers looked at several sorts of attacks and probable risks to this developing technology, as well as the defence techniques and existing solutions to these attacks.Lubnaet al.[43] performed a cloud computing survey research in 2019 that covered various kinds of assaults and potential risks to this growing technology, as well as security techniques and current solutions. Cloud computing security is a significant issue since it is dependent on Internet connection, making it susceptible to variety of assaults.Abdul Rahman's goal is to find out why cloud-based E-learning services are so popular & why they're plagued by security challenges despite their many advantages, & to identify feasible remedies.With the goal of proposing a solution for cloud-based e-learning security measures, Durairaj and discovered many security vulnerabilities in model. Various attacks on e-learning service delivery methods offered by different researchers are discussed. It was Ghazal's goal to provide a service over the internet that could be easily scaled. With advent of Cloud computing & its effective scalability mechanism, it is now possible to delegate the development of e-learning systems to third parties, opening up a new delivery method for online education.

3 Problem Statement

In the education sector, existing research has looked at problems with cloud computing for professors, staff, & students. Researchers have looked at security concerns & risk classifications. The impact of cloud inverment on teaching is studied. Important problem in emerging nations is security management and the difficulties that the education sector faces. Intruders' hacking and cracking operations are a security concern. Another problem is accessibility 24 hours in day, seven days week. It is imperative that users may entree critical data at any time & from any location via cloud storage. Some of studies looked at how to lower the cost of remote learning. It is considered to be a difficult job to provide online cloud-based education to disadvantaged kids and youngsters in a developing nation. However, several previous studies used RSA, DNA Cryptography, and other security methods to secure the cloud system. However, there is still the problem of performance. Existing studies have shown that providing security reduces overall performance by 7% to 20%. The size of the packets, the time it takes to encrypt data, time it takes to filter data via a firewall, and the time it takes to identify malware are all variables that affect cloud performance. As a result, a method that can improve security while also improving speed is required.

4 Security Enhancements Techniques

Cloud applications using the RSA method have many data security mechanisms. RSA Algorithm has been implemented and the author has evaluated the algorithm's performance based on three different parameters. Space Difficulty, Time Complexity, Throughput are all important considerations when building a computer system from the ground up. The RSA method was employed by the author in this study to encrypt data and ensure that only authorized individuals could access it. Before being stored in the cloud, all data is encrypted. When a user

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requests data from the Cloud, the provider authenticates the user and permits the transmission of the data. encrypting data has increased the amount of time it takes by 15%.

Private Key Length(bits)	Time in (ms)
64	86.00
128	91.33
256	110.33
512	142.67
1024	363.67
2048	2748.67

Table 2 Complexity of Time

Private Key Length(bits)	Run Time Memory
128	345128
256	347224
512	347320
1024	348040
2048	348608
4096	349488
8192	351048

Table 3 Complexity of Space

Data Bits	128 bits key length	256 bits key length	512 bits key length	1024 bits key length	2048 bits key length
32	205.13	186.04	136.75	102.56	48.854
64	457.14	372.09	256	205.13	71.99
128	914.28	684.49	514.056	315.27	182.33
256	1641.02	1361.70	1094.02	684.49	443.67

Table 4 Throughput

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Integration of Compression and encryption mechanism in cloud

In order to increase performance & security data is initially compressed on cloud side then this compress information is encrypted using encryption algorithm as shown in figure 4. After transmission content is decrypted on receiver end and finally it is decompressed to plain text that would be easily understandable to user.

The large size content took a lot of time to travel over the network. Moreover, there always remain chances of packet dropping and hijacking. Thus, in the proposed work the content has been compressed before sending. The suggested method uses a replacement mechanism to minimise data size, which should result in reduced data loss during compression. It's possible to substitute big string lengths with smaller string lengths, as shown in this table. There is a replacement table for each string with its equivalent smaller string. Data packet strings are replaced with their equivalents only if the matching strings are available to replace them in the replacement table.

For example, if data packet is consisting of a “Computer” string & small string in replacement table is “_c1_” corresponding “computer” then “Computer” word in data packet would be replaced by “_c1_”. All of the strings in data packet would be changed in this manner. As a result, less data is sent in each packet. In addition, the data is not same as original data, which may be referred to as "first-level encryption."This would help in reducing the time consumption and packet dropping ratio.

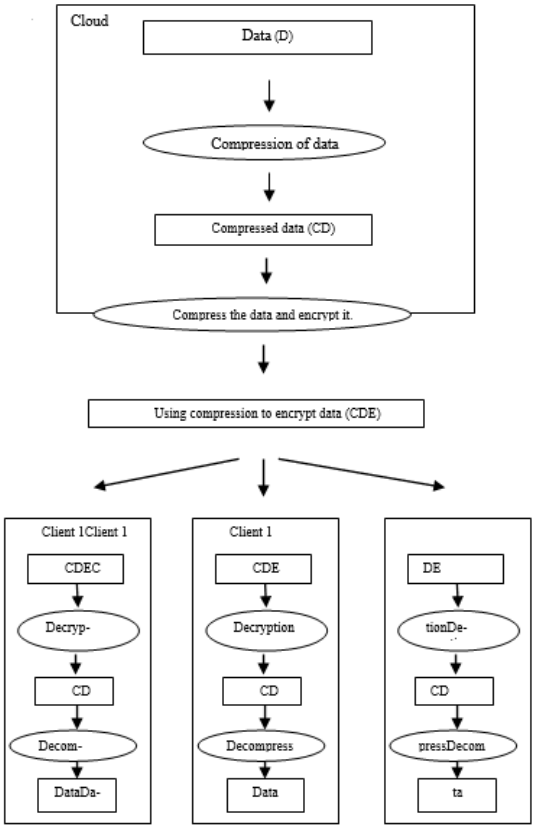

Fig 4. Integration of Compression and encryption mechanism in cloud

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5 Scope of Research

Clouds computing and e-learning are both gaining popularity these days. It is very important and influential in the field of education and learning. These enable Smartphone users to carry out tasks more efficiently and at a lower cost. Cloud-based apps from a variety of cloud service providers are used in these systems. Future research should be able to offer critical technologies for cloud application security in remote education. Furthermore, it should be capable of improving service quality and be suitable for teaching resource management. Future research should also be capable of delivering intelligent service management.

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