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An agent-based framework for providing security in a cloud-based E-learning system

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ABSTRACT

The application of E-learning is increased nowadays for various academic purposes. The combination of cloud computing, along with the E-learning, has emerged recently as a novel technique for managing and delivering the E-learning services. Sharing of data in between the cloud storage and the E-learning platform is mandatory in order to make sure that the user's needs are satisfied and also to enhance the standard of the services provided by this learning platform. Though, various researches have been done in the past for improving the security and privacy of this cloud-based Learning method, and complete accuracy is not achieved. In this paper, a novel framework for providing the security and privacy of the cloud-based E-learning platform is provided. The main objective of this work is to use intelligent agent-based systems for providing data security and privacy. The aim of our work is to identify an architecture that will be using Cloud Computing within higher education. The proposed framework comprises of various agents such as the user interface agent and the authentication agent with intelligent and distinct working features. These agents make effective communication between users, E-service providers, and the cloud-based system. This system monitors the data flow between the user, the E-learning platform, and the cloud-based systems focus on various security and privacy concerns that the E-healthcare environment is facing.

1. Introduction

With the spread of modern means of communication spread, the concept of E-learning uses the internet for teaching and E-learning activities, which takes advantage of modern educational technology. It provides a new mechanism of communication, and it also allows them to access a broader spectrum of learning materials in accordance with their individual competencies and situation without the limitations of space and time (Bibi and Ahmed, 2017). E-learning can significantly reduce the time learners spend on learning. E-learning is an efficient and fast way to spread knowledge to learners in different parts of the world (Alshwaier et al., 2012). The main difference between an E-learning platform and a traditional classroom is the way in which instruction is transmitted. In an E-learning situation, the learning provider is separated from the learner by cyberspace and has less visibility of the way the learner is interacting with the educational environment. The ability to adapt, realign, or change the environment is reduced due to this limited visibility. It also makes the educational content very important as the content is now the only differentiating factor between competing E-learning initiatives, assuming there is a level playing field in infrastructure for the provision of service over the internet.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal effort and cloud computing can be defined as "a new style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet." The National Institute of Standards and Technology (NIST) defined cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks,

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servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. The cloud can be seen as a large group of interconnected computers. These computers can be personal computers or network servers inside public or private organizations. Therefore, a wide range of end-users has access to the applications and data served by the cloud. Access is through the internet, and it crosses over different enterprises and platforms. Cloud computing can be connecting to different types of devices, such as access from maximum telecommunication devices like desktops, laptops, tablets, mobiles, etc.

In this work, a detailed analysis is done for identifying the security and privacy threats present in the maintenance of EHR. Then, a novel agent-based system for providing security and privacy for EHR data is also proposed. The agent-based system consists of various intelligent agents such as the user interface agent, authentication agent, connection establishment agent, and the connection management agent with distinct and expedient working features.

These intelligent agents make ease of use, effective communication between patients/users, and E-service providers. Various functions, such as interface framing, user registration, user authentication, connection establishment, and connection maintenance, were carried out by the agent-based system.

2. Literature review

In recent decades, the importance and application of cloud computing had increased. Various researches have been done based on the applications of this cloud-based E-learning technique and technology. In general, cloud-based E-learning is defined as the distance study of various subjects in cloud-based systems remotely and securely. This cloud-based E-learning system had vast applications in today's education field. This technology incorporates the IoT based technology, its devices, and its applications. This paper depicts the various applications, technologies, and applications of the IoT based E-Learning based on cloud-based computing.

Gamundani et al. (2013) proposed a cloud E-learning system design system architecture based on distributed resources which Provided by PC users the proposed architecture although the elastic characteristics of the specific features of cloud computing architecture will provide another characteristic feature is the high scalability of the architecture of the type is not supported in other words the coordination of distributed resources of the node to the central computer system which is the bottleneck of the system.

According to Pocatilu et al. (2009), a specific plan to implement an E-learning system based on the Cloud computing architecture is given, and only the advantages and positive effects of using Cloud computing technology in the field of E-learning is discussed. Jain and Chawla (2013) proposed a novel methodology after considering the advantages of Cloud computing services in E-learning systems, providing architectural design concept of the system based on Cloud computing models have been studied, but their performance has been implemented according to plan the proposed architecture has been evaluated.

Giotopoulos et al. (2007) developed an E-learning environment that incorporates Intelligent Agents and Computational Intelligence Techniques. This E-learning environment consists of the E-learning platform Front-End, the Student Questioner Reasoning, and the Student Model Agent. These parts were distributed geographically in dispersed computer servers, with the main focus on the design and development of these subsystems through the use of new and emerging technologies. These parts were interconnected in an interoperable way, which used web services for the integration of the subsystems, to enhance the user modeling procedure and achieve the goals of the learning process.

Christos et al. (2006) presented an innovative platform that integrates intelligent agents in legacy E-learning environments. It introduced the design and development of a scalable and interoperable integration platform supporting various assessment agents for E-learning environments. They introduced a scalable implementation architecture that is based on an agent platform. This platform is used in order to manage the execution of the various intelligent agents for supporting legacy E-learning systems.

Capuano et al. (2000) proposed an agent-based Intelligent Tutoring System for Distance Learning (ABITS) that would be useful for several knowledge domains. The architecture of ABITS was composed of three different kinds of Agents. Evaluation Agents are interested in evaluating and updating the cognitive States and whole Student Models (remember the "Update All" use case); to do this, they interact with the Metadata Base, the ABITS Database, the Affective Agent and the Pedagogical Agent. Affective agents are interested in evaluating and updating Learning Preferences; to do this, they interact with the Metadata Base, and the ABITS Database and Pedagogical agents are interested of evaluating and updating Curriculums; to do this, they interact with the Metadata Base, the ABITS Database and the Courses Database.

This paper presents a novel agent-based Architecture for E-learning utilizing cloud computing, which contains the integration of different agent-based systems. Section 2 depicts the literature review carried on by the proposed framework. Section 3 presents the general architecture of intelligent agents. Section 4 shows the general definition of a cloud-based E-learning system. Section 5 presents the proposed methodology with various subsystems present in it. Section 6 concludes the work and future enhancement.

2.1. Motivation of the proposed methodology

Challenges faced by traditional learning techniques are as follows:

- Various methods were proposed earlier for improving the security and safety of E-learning systems. The majority of the E-learning systems are still in process, but with poor accuracy.
- Methods based on Artificial Intelligence (AI) were used earlier for improving the accuracy of the E-learning System. Though it was highly scalable, the performance was poor in terms of accuracy.
- The methods based on fuzzy systems were proposed later on for the E-learning system. The method was more efficient and robust but resulted in poor accuracy.

Hence, this framework is proposed in order to rectify the drawbacks present in the existing methodologies.

3. Intelligent agents

An agent is an autonomous computer-based system that is flexible in nature that can receive input and output from the environment. There are many other advantages to the agents. For example, agents can be given the knowledge to do a specific task, collaborate with each other, and extendible, which are very useful when developing secure systems. An agent can represent a user and do tasks on behalf of the user. Moreover, agent systems are extendible in nature. A new agent can be created instantly and added to the existing system in order to represent a new user, such as a network monitoring agent, without changing the entire system. The Architecture of an agent-based system is shown in Fig. 1.

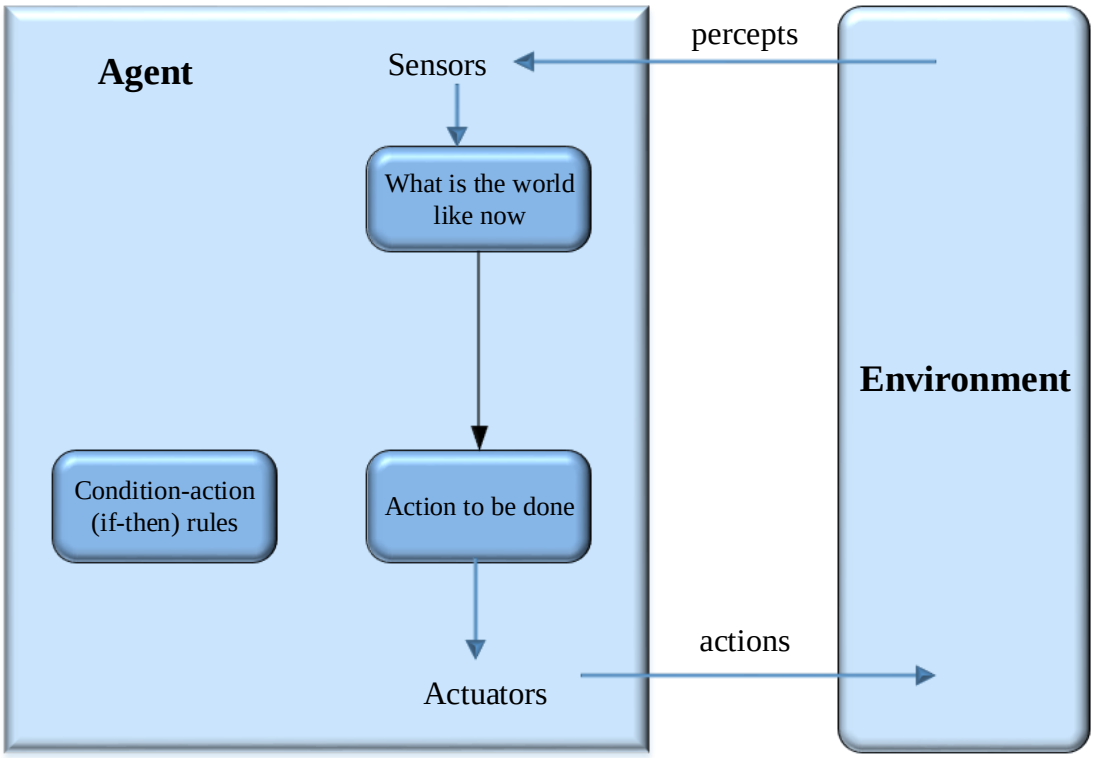

Fig. 1: Architecture of an agent-based system

4. Cloud-based E-learning system

In recent years, cloud computing as a new kind of advanced technology accelerates the innovation for the computer industry. Cloud computing is a computing model based on networks, especially based on the Internet, whose task is to ensure that users can simply use the computing resources on-demand and pay money according to their usage by a metering pattern similar to water and electricity consumption. Therefore, it brings a new business model, where the services it provides are becoming computing resources (Riahi, 2015). Cloud computing is highly scalable and creates virtualized resources that can be made available to users. Users do not require any special knowledge about the concept of Cloud computing to connect their computers to the server where applications have been installed and use them. Users can communicate through the Internet with remote servers. These servers can exchange their computing slots themselves (Subramanian et al., 2014). Cloud computing is one of the new technology trends likely to have a significant impact on the teaching and learning environment (Paul and Das, 2016). The general architecture of the cloud-based E-learning system is shown in Fig. 2. The main features of this service include:

- Access and manage your software via a network
- Activities run by the center and not at the location of each of our customers can remotely and applications through web access.

Software updates and upgrades are managed centrally and need to download patches, or promotion fixes it. With these clouds, students and researchers can make good use of the resources available on computer networks and the efficiency of solving scientific Problems as well, so to run applications in the cloud infrastructure, the need for a framework that can successfully exploit the Cloud resources to pay. In this paper, we introduce a framework for the E-learning system in cloud computing SaaS layer.

E-learning cloud architecture is divided into five main layers (10-15), hardware resource layer, and software resource layer, resource management layer, server layer, and business application layer.

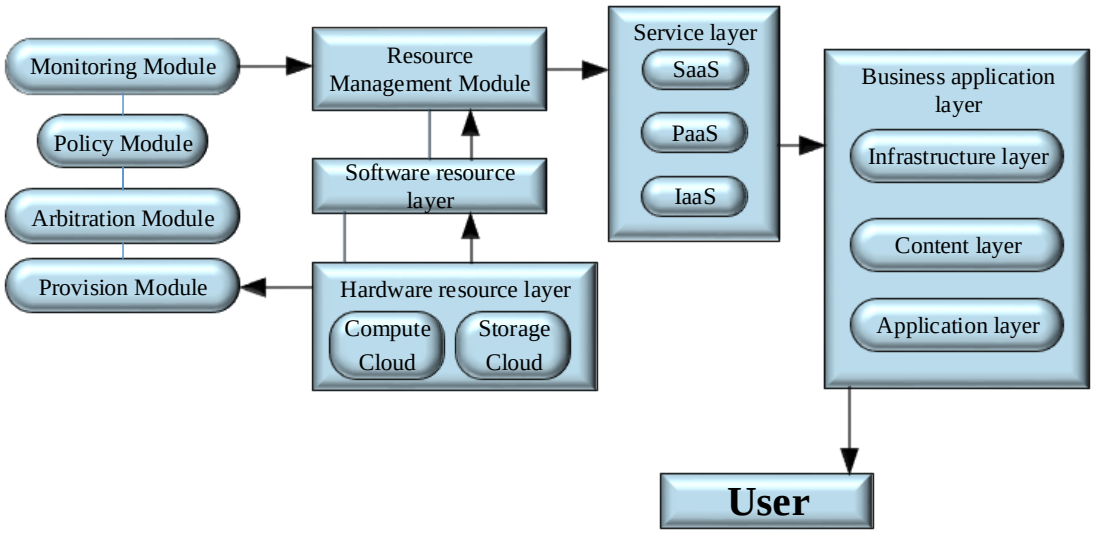

Fig. 2: General Architecture of cloud-based E-learning system

1. **Hardware resource:** it is located at the lowest level of the cold middleware services, the basic computing power, such as physical memory, CPU, memory layer is provided by the layer. This emphasis is placed on the construction of infrastructure. Because of the use of virtualization technology, physical server, storage and network from virtualization group for being called by upper software platform. The physical host pool is dynamic and scalable, and the new physical host can be used to increase the physical computing power for cloud middleware services.
2. **Software resource layer:** This layer mainly is combined with operating system and middleware Because of middleware technology a variety of software resources are integrated to provide a unified interface for software developers then can easily develop a lot of applications based on software resources and embed them in the cloud making them an available for cloud computing users.
3. **Resource management layer:** This layer is the key to achieve loose coupling of software and hardware resources. Because of the integration of virtualization and cloud computing scheduling strategy, no demand for free flow and distribution of software over various hardware resources can be achieved.
4. **Service layer:** There are three levels of services in cloud computing are SaaS software as a service PaaS platform as a service) laas (infrastructure as a service ln SaaS cloud computing service is provided to customers as is different from traditional software users use the software via the internet not to need a one-time purchase for software and hardware and not to maintain and upgrade simply paying a monthly fee. ln PaaS Secondary development skill is offered for users, and location-based interface developed can be used by third parties. In LaaS, products offer via this mode include the remote delivery (through the Internet) of full computer infrastructure.
5. **Business application layer:** The E-learning key is different from other cloud is located in the E-learning application layer, which represents the major E-learning business logic composed of expanded upon a group of E-learning components.

5. Proposed framework

The proposed system consists of two phases and four modules, such as 1) User Management; 2) Authentication Management; 3) Connection and its establishment Management. The first phase is the user. In this phase, the users, such as the instructor, students, and the administrator, were managed. This is explained in section 5.3. The second phase is the Authentication Management. This system was designed using AI logic-based methods logically to get the suitable intelligent cloud-based E-learning system. The overall architecture of the proposed methodology is shown in Fig. 3.

5.1. Working principle

The proposed framework accepts the user request through a user interface agent-based system. The user interface agent is directly connected with the users who are using this E-learning based system. It accepts the user credentials such as the username and password from the respective users. Users such as the students, teachers, and administrators can access the system using the required credentials. The User interface agent is connected through an online based application. The protocols are defined for the users who are using the proposed system. All the policies are then parsed in the form of constraints and further stored in a cloud database. The database consists of users, roles, and permissions.

Three different types of fields were present in the cloud, such as the student field, teacher information field, and the admin Information field. The student field consists of all the information about the student, such as the user Id, Password, University Id, subjects written, pass percentage, passed or failed subjects, etc. The teacher information field consists of name, user Id, password, subjects, marks awarded, etc. and finally, the admin field consists of all the usernames and passwords, access history, etc.

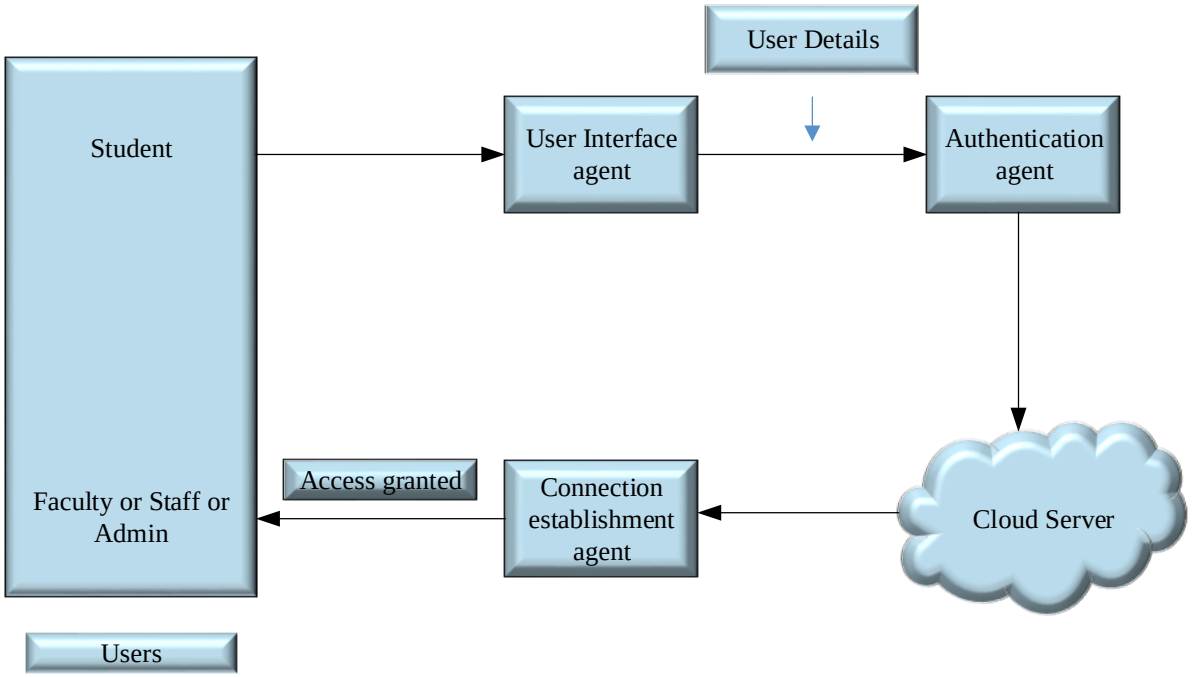

Fig. 3: Architecture of the proposed system

5.2. User management

The role of user management is to monitor the functions such as login, editing the profile, and setting permission for the users to access the system. The login function monitors the users who were accessing the system. It also maintains the correct username, password, and sign up function before login to the system. Also, users can edit their profiles by changing the password, email, and profile picture, etc. It manages the setting permission to a different type of user, such as the student, teacher, or administrator.

The proposed system consists of three types of users, such as instructors, students, and administrators. Each user has different responsibilities. The types of users and their responsibilities are shown in Table 1.

5.3. Authentication management

The authentication system validates the username and password of the user. It sends the authenticated information to the examination /evaluation system. Roles were created by the authentication system for various operations, including the permissions for particular functions. Roles are assigned to particular users, and the assignments for those roles give the permissions to do particular functions. The algorithm for accessing the system by a correct user and authenticating whether it is the authenticated person is as follows:

#Algorithm for Authentication#
for every user U in the User Set
if (User ∈ User _Set) and
Access=<User, Mode, Action>
then,
Access Granted;
else
Invalid User;
End if,
End for

5.4. Connection and its establishment management

The role of connection management is to establish and maintains the connection between E-

learning and the cloud database. Various functions such as creating a connection with the cloud, maintaining the connection with the cloud, and monitoring the established connection within the cloud are maintained by the connection and its establishment agent. Users can set privileges based on their role, and they can access the data present in the cloud through this agent. It also manages the setting permission to a different type of user for accessing the data present in the cloud database. By this agent, un-authorized users are not allowed to access or modify the data present in the cloud database.

Table 1: Users and their role in the proposed system

NO	Users	Role
1	Instructors	• Maintain the overall system
2	Students	• Perform online learning • Verify the result
3	AI Agents	• Make the complete process of the E-learning system.

5.5. Findings of this research

- The proposed methodology based on agent-based systems can provide effective services for E-learning based on Cloud computing.
- This framework is controlled by the intelligent AI-based systems which are considered a major part of the proposed system
- Different types of intelligent agents such as the user interface agent, authentication agent, and connection establishment agent which make ease of use, effective communication between users, the E-learning system, and the cloud provider.
- The User interface agent is connected through a website or a mobile-based application so that it will be easy to handle for the users.

6. Conclusion and future work

E-learning has become a part of education in recent times. The advancement in technology and communication has made teaching and training possible anywhere and anytime. The rise of cloud computing is a rapidly changing landscape of Information technology and ultimately turning to the long-held promise of utility computing into a reality. Cloud computing can help communities and nations, can transform education. The aim of our work is to identify an architecture that will be using Cloud Computing within higher education. Mainly, we have considered the benefits of cloud architecture. This paper provided an Artificial Intelligence guided agent-based architecture for E-learning that provides features like intelligence, distributed, adaptive, interactive, extensible, and collaborative in a single architecture, and it is considered to be an efficient one, especially while adopting in the cloud-based systems. In the future, much concentration will give to agent-Based E-learning for Distributed/Heterogeneous environments.

Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

References

Alshwaier A, Youssef A, and Emam A (2012). A new trend for e-learning in KSA using educational clouds. Advanced Computing, 3(1): 81-97. https://doi.org/10.5121/acij.2012.3107

Bibi G and Ahmed IS (2017). A comprehensive survey on e-learning system in cloud computing environment. Engineering Science and Technology International Research Journal, 1(1): 43-50.

Capuano N, Marsella M, and Salerno S (2000). ABITS: An agent based intelligent tutoring system for distance learning. In the International Workshop on Adaptive and Intelligent Web-Based Education Systems, ITS, Montreal, Canada: 17-20.

Christos AE, Konstantinos GC, Eleni TJ, Grigorios BN, and Spiridon LD (2006). Integrating E-learning environments with computational intelligence assessment agents. Journal of Engineering Technology, 13: 117–122.

Gamundani A, Rupere T, and Nyambo B (2013). A cloud computing architecture for E-learning platform supporting multimedia content. International Journal of Computer Science and Information Security, 11: 92-99.

Giotopoulos KC, Alexakos CE, Beligiannis GN, and Likothanassis SD (2007). Integrating agents and computational intelligence techniques in E-learning environments. International Journal of Educational and Pedagogical Sciences, 1(7): 330-337.

Jain A and Chawla S (2013). E-learning in the cloud. International Journal of latest Research in Science and Technology, 2(1): 478-481.

Paul M and Das A (2016). SLA based E-learning service provisioning in cloud. In: Satapathy S, Mandal J, Udgata S, and Bhateja V (Eds.), Information systems design and intelligent applications: 49-57. Volume 435, Springer, New Delhi, India. https://doi.org/10.1007/978-81-322-2757-1_6

Pocatilu P, Alecu F, and Vetrici M (2009). Using cloud computing for E-learning systems. In the 8th WSEAS International Conference on Data Networks, Communications, Computers, World Scientific and Engineering Academy and Society (WSEAS), 9(1): 54-59.

Riahi G (2015). E-learning systems based on cloud computing: A review. Procedia Computer Science, 100(62): 352-359. https://doi.org/10.1016/j.procs.2015.08.415

Subramanian P, Zainuddin N, Alatawi S, Javabdeh T, and Hussin ARC (2014). A study of comparison between Moodle and Blackboard based on case studies for better LMS. Journal of Information Systems Research and Innovation, 6: 26-33.