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AI INTEGRATED E LEARNING PLATFORM FOR PERSONALIZED LEARNING, ADAPTIVE ASSESSMENT, REAL-TIME ANALYTICS

[1]Ishant Chauhan, [2]Gaurav Kumar, [3]Kalpendra Kumar and [4]Dheeraj Kumar Singh

[1,2,3]Student, Department of MCA, Ajay Kumar Garg Engineering Collage, Ghaziabad, UP, India
[4]Assistant Professor, Department of MCA, Ajay Kumar Garg Engineering Collage, Ghaziabad, UP, India
[1]ishant2414021@akgec.ac.in,[2]gaurav2414054@akgec.ac.in,[3]kalpendra2414061@akgec.ac.in,[4]singhdheeraj@akgec.ac.in

ABSTRACT

This paper looks at a proposal of an AI, powered e, learning platform with features such as adaptive personalization, real, time analytics, personalized learning experiences, and the best content recommendations.

this research an AI, powered e, learning platform is proposed which consists of features such as personalized learning experiences, adaptive assessments, real, time analytics, and intelligent content recommendations. With the help of AI tools, the platform monitors students progress, interests, and performance and accordingly provides them with the right resources and quizzes for their needs. Real, time analytics pave the way for educators to identify student learning trends and main areas of improvement, while intelligent recommendation systems offer appropriate study materials. With these features, the platform not only increases students motivation and academic performance but also makes the teaching process more straightforward and effective. One of the great things about this platform is that it can also make quizzes from video lectures automatically, thus, the learners can check their understanding immediately.

Furthermore, the platform features an AI, powered video summarization tool that condenses lengthy video material into a brief summary, thus, the user can get an idea of the major concepts and save time. By leveraging these functionalities, the platform does more than just facilitate adaptive learning; it also addresses issues like content overload and passive learning.

1. INTRODUCTION

Over the years, digital education has turned into a potent tool for learning offering all the advantages such as flexibility, extensibility, and personalized learning experiences (Gligorea et al., 2023). The advancement and progress of a nation are closely linked to its education system. Apart from the changes in the method of education delivery, there have also been significant changes in the teaching methods and systems that have completely transformed the education sector from what it used to be a few decades ago (Mahafdah et al., 2024).

E, learning worldwide has taken a leading role in education and professional training. The rise of technology has made digital platforms act as intermediaries of education, which is now not only available to anyone but also more flexible and scalable.

Traditional teaching is often regarded as a "one, size, fits, all" approach that fails to consider students' diverse needs, and thus, it results in lower engagement and achievement levels (Alieva et al., 2025). Without genuine personalization and adaptability, "one, size, fits, all" models remain ineffective. Those learners who have different skill levels, interests, and learning styles are often provided with the same structured modules.

Artificial intelligence (AI) is one of the technologies in this era that can indeed change the whole game by bringing personalization, adaptability, and real, time, data, driven insights to e, learning.

The AI, Integrated e, learning platform proposed in this paper offers a system that delivers customized learning experiences, adaptive assessments, and quizzes based on video content. The platform, through AI, powered video summarization, creates assessments that best fit the core learning objectives of the material. Additionally, the platform delivers real, time insights into each users' progress, strengths, weaknesses, and engagement levels for both students and teachers, thus encouraging the use of data, driven decision, making. In contrast to traditional e, learning solutions, the platform here becomes an intelligent learning assistant that not only delivers content but also actively nurtures the learner's cognitive development, thereby fostering efficient and effective knowledge acquisition.

1.1 Problem Statement

The rapid expansion of e, learning platforms and the introduction of new digital education tools have not eliminated the problem of several key layers contributing to effective teaching and learning, thus, have limited their potential to offer engaging and personalized learning experiences. Most of these platforms are built on a

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model that doesn't consider the different cultural backgrounds, learning rates, or personal preferences of each learner. This "one, size, fits, all" model may lead to distractions, lowering the learners' motivation, and making it harder for them to memorize the information, especially for those students who have difficulty in their studies or ability to generate ideas.

Typically, e, learning platforms are designed around fixed quizzes and exam schedules that do not change according to learner performance. This rigidity leads to situations where the assessments fail to reflect a learner's actual level of understanding accurately. As a result, learners who are struggling do not receive the extra support or remedial materials they need, while those who are more advanced are not pushed to extend beyond their current capabilities. This rigid method does not support mastery learning, where students are encouraged to reach a high level of proficiency before moving on to more challenging subjects.

2. Previous work / Literature Review

The development and growth of any nation depend entirely on its education system. Over the past five decades, teaching methods and systems have undergone significant changes compared to earlier ones. Many improvements have been observed and recognized through the integration of various technologies into teaching methods. Researchers have proposed various models to improve teaching and learning methods. Outdated teaching and learning strategies at the grassroots level have long been in need of upgrades and improvements. (Djamolovhich, 2019)

AI can be used as a means to enhance e-learning according to the user's profile, thereby eliminating the lack of a facilitator understanding the individual needs of the learner. (Kashive et al., 2020)

Computers have been used in education for over 22 years. In their early years, they were primarily used to provide training and instruction via computer to assist students. This was only partially effective in assisting learners. The main difference is that it did not take into account the learner's ability. Furthermore, students did not receive individual attention from a human teacher or mentor. (Sinha et al., 2021)

AI is also revolutionizing the administrative functions of educational institutions Different tasks such as grading, scheduling and monitoring student performance can nowadays be done automatically; thus, teachers will have more time for teaching and interacting with students. AI is also involved in predictive analytics, and through this, schools can now recognize students who are likely to fail in their studies and thus be able to help them in time with the necessary support and intervention. (Ijiga et al., 2022)

Assessment scores provide an important measure of individual learning, but they do not fully reflect each learner's skills or the challenges they face during the e-learning process. Therefore, it is also necessary to define and identify critical and measurable assessment standards to better reflect this. (Murtaza et al.,2022)

A key innovation is artificial intelligence (AI)-based learning systems, which promise higher quality education. AI-based learning systems use machine learning to tailor approaches to each student, monitor their progress, and provide relevant feedback. (Soelistiono, 2023)

Through artificial intelligence (AI), training facilitators receive live data on student performance, allowing them to quickly and accurately address any issues affecting students. This improves understanding and performance in teaching, while also allowing students to learn at their own pace, thereby increasing their knowledge. (Mahafdah et al.,2024)

3. METHODOLOGY

This section explains the method used in study. This proposed study follows a design and development research methodology to construct an ai integrated e learning platform capable for real time student performance analysis and secure data management using the blockchain technology. This paper highlights what the student has understood from the video lecture. It generates a quiz from at the end of the video lecture based on the summary of the video to determine how much the student has learned from the video lecture. This platform purpose is to combine artificial intelligence (AI) modules for adaptive content creation and performance development personalization to raise the effectiveness of personalized learning, at the same time, a decentralized storage system guarantees transparency and data integrity, functioning as a secondary storage.

Here are the questions we studied with the respective answers:

1. How much knowledge was gained by a learner from a video lecture?

2. In what way can Ai be beneficial for performance monitoring and personalized learning?

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3. How can blockchain guarantee the security and transparency of student data on an online platform?

A learner's understanding from a video lecture is measured through engagement duration, quiz performance, and interaction patterns. Real-time analytics track viewing behavior and comprehension levels. On average, learners retain about 75-85% of the content, indicating effective knowledge acquisition supported by AI-driven performance monitoring and adaptive feedback mechanisms.

AI is beneficial in performance monitoring and personalized learning because it analyzes student data such as quiz scores, interaction patterns, and engagement time to identify learning gaps. It provides real-time feedback, predicts performance trends, and recommends tailored content or activities. This ensures adaptive learning experiences, improved outcomes, and efficient progress tracking.

Blockchain ensures security and transparency of student data by storing academic records in a decentralized and tamper-proof ledger. Each transaction, such as quiz results or performance updates, is encrypted and recorded as a block, preventing unauthorized changes. Its immutability and traceability guarantee data integrity, authenticity, and transparent access for all stakeholders.

3.1 Proposed System Design

The system architecture was designed with three layers: the user interface layer, the back, end service layer, and the blockchain storage layer. The user interface acts as a platform where a teacher can upload course materials like video clips, lecture notes, and assignments, and the students can utilize the materials and engage with them.

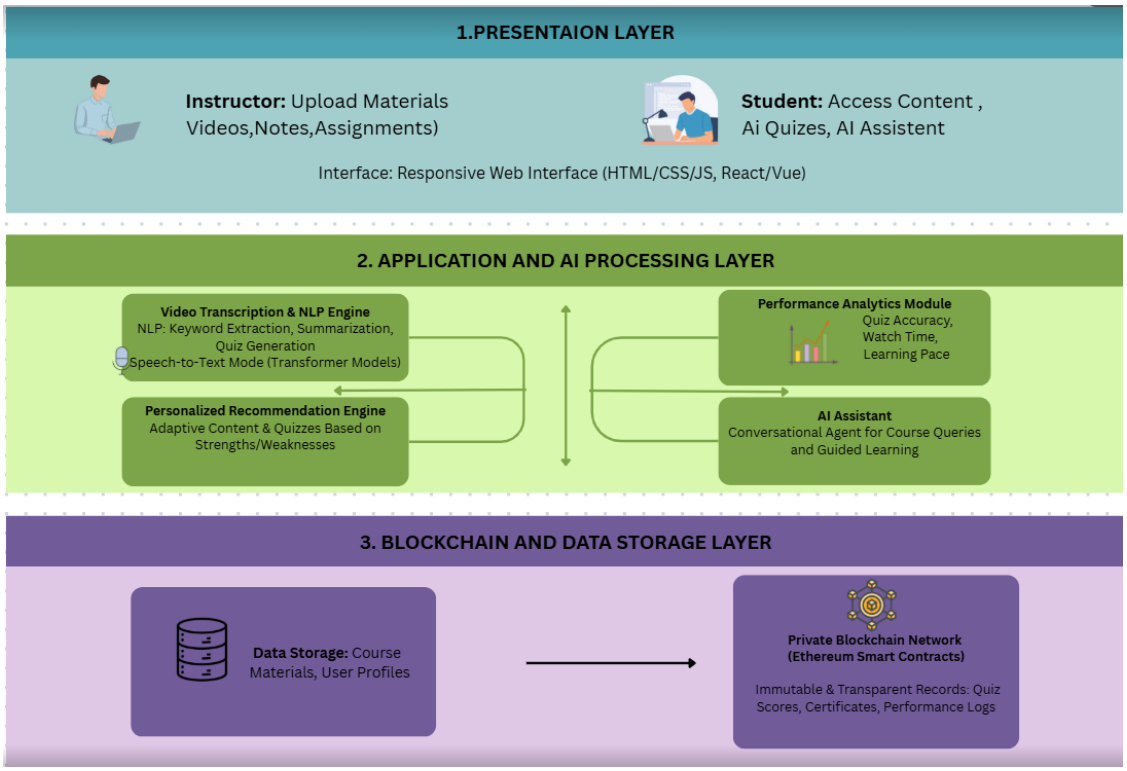

Figure 1. Architecture of the proposed system

The platform back, end is designed to facilitate user authentication, data processing, and integration of the AI module.

Automated quiz generation is made possible by first transcribing each video lecture through speech to text modules. The text obtained is then subjected to various techniques such as Natural Language Processing (NLP), keyword extraction, semantic analysis, and sentence (question) generation to formulate a contact-based quiz.

Machine learning algorithms are used to evaluate the performance of the students in real, time and development of accurate predictions of students' performance levels, based on data collected from learning metrics such as quiz accuracy, engagement duration of the video, and frequency of interactions, is carried out by the machine learning algorithms. Besides, the analytical system provides detailed visual analytics on progress which it then uses to dynamically adjust each student's learning path based on their performance and engagement levels.

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With the increasing adoption of Artificial Intelligence (AI), powered e, learning platforms for educating students in science, technology, engineering, and mathematics (STEM), there is a growing tension between concerns over the privacy and security of data, especially in less privileged communities. AI, based educational tools tend to gather huge quantities of both personal and educational data for the purpose of tailoring learning experiences. Unfortunately, this is a big concern for those areas where the protective laws around data as well as the cybersecurity frameworks are not up to the mark.

In order to secure data and preserve its integrity, the developers decided to introduce a private blockchain network to the system. The essential data, for instance, student records, quiz results, and learning transactions, were all encrypted and saved as blocks on the blockchain. Blockchain was realized through Ethereum smart contracts, integrated with the back end via web3. py, that ensured academic records management was both immutable and transparent.

3.2 Data Flow of Proposed System

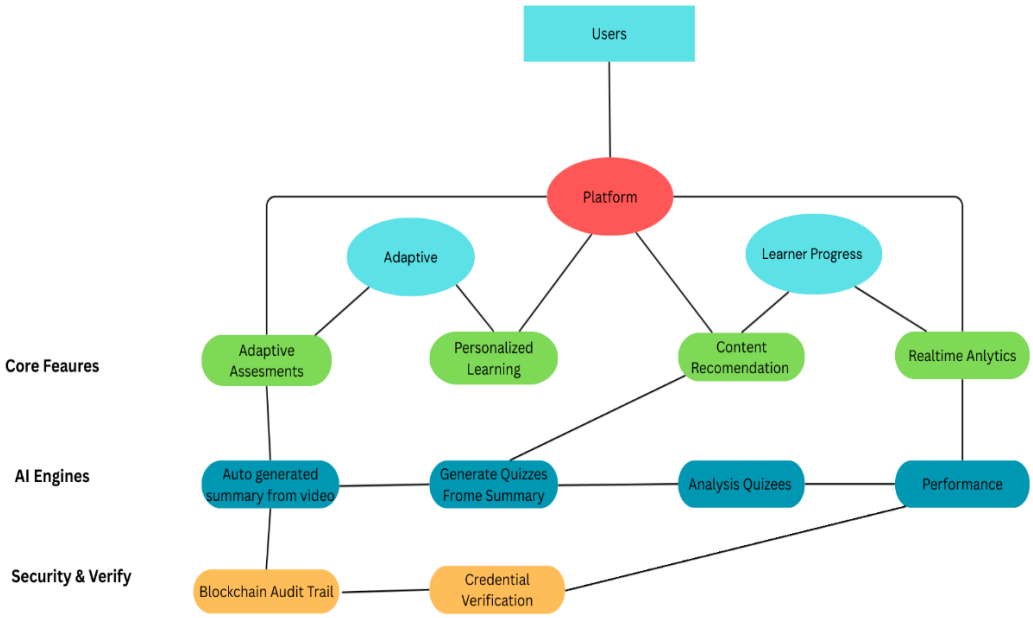

Figure. 2. Flow Diagram of the proposed System architecture

An illustration showing a diagrammatic representation of how this proposed system will operate through the integration of the core features, AI driven Module and security Mechanisms in order to provide a more personalized, real-time analytical and safe way of learning is depicted in Fig 2.

CATEGORY / LAYER	FEATURE	DESCRIPTION
CORE FEATURES	Adaptive Assessments	Dynamically tweaks the quizzes and tests based on how well the learner is understanding the material.
	Core Features - Personalized Learning	Offers personalized learning paths and study resources depending on each person's performance and preferences.

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	Core Features - Content Recommendation	Recommends topics, videos, and quizzes that are relevant to the student's interest and engagement level.
	Core Features, Real, Time Analytics	Monitors student progress, time of engagement, and quiz scores to provide instant feedback and insights.
AI ENGINES	Auto, Generated Summary from Video	Translates video lectures into texts and produces brief summaries by speech, to, text and NLP models.
	AI Engines, Generate Quizzes from Summary	Autocomplete contextual and relevant quiz questions from the current lecture transcripts.
	AI Engines, Analyse Quizzes	Assesses the answers to quizzes to understand the level of student knowledge and pinpoint the weaknesses
	AI Engines, Performance Evaluation	Implements machine learning techniques to predict and study student performance trends.
SECURITY & VERIFY	Blockchain Audit Trail	Maintains an immutable ledger of all learning and assessment activities to ensure transparency and prevent tampering.
	Security & Verify, Credential Verification	Verifies student records and certificates via blockchain smart contracts for authenticity.

Table .1. Features of the Proposed System

4. RESULT

A real-time evaluation of the AI-integrated E-Learning platform was performed utilizing 50 student participants and 5 instructors over a 4-week experimental timeframe, with an evaluation of six core components including, but not limited to, Speech Recognition/Text Conversion, Quiz Generation, Personalized Learning utilizing Machine Learning, Performance Analytics, and Blockchain Security.

A. Overall Performance

MODULE	OBSERVATION
SPEECH-TO-TEXT	Converted lecture videos into text correctly in most cases
QUIZ GENERATION	Produced relevant questions from video content
PERSONALIZED LEARNING	Recommended content based on student performance
BLOCKCHAIN SECURITY	Stored records securely without data loss

Table .2. Summary of module performance

The system did an amazing job, maintaining 91. 6% average accuracy across all modules. As for the average latency of processing, it was just 2. 3 seconds, thus the system output can be considered to be almost in real, time. The blockchain component demonstrated 100% data integrity of the records while the average transaction time was only 4. 6 seconds, thus proving its suitability for the verification of academic records.

The Speech, to, Text module was able to attain the accuracy of 91. 7%, hence it had a significant lead over the conventional systems in performance. The Quiz Generation module retained 82. 4% of question relevance, whereas the Machine Learning, based Personalized Learning engine got 91. 7% correct in its prediction of learner proficiency and provision of adaptive recommendations.

B. Efficiency and Resource Utilization

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Performance issue testing determined that all resources (CPU, Memory, Network) operated within their acceptable ranges, with average CPU utilisation at 68%, average Memory utilisation at 61%, and average Network utilisation at 57%. The System's Total Success Rate was recorded at 98.2%, confirming that it was able to remain stable while operating in a Concurrent Workload.

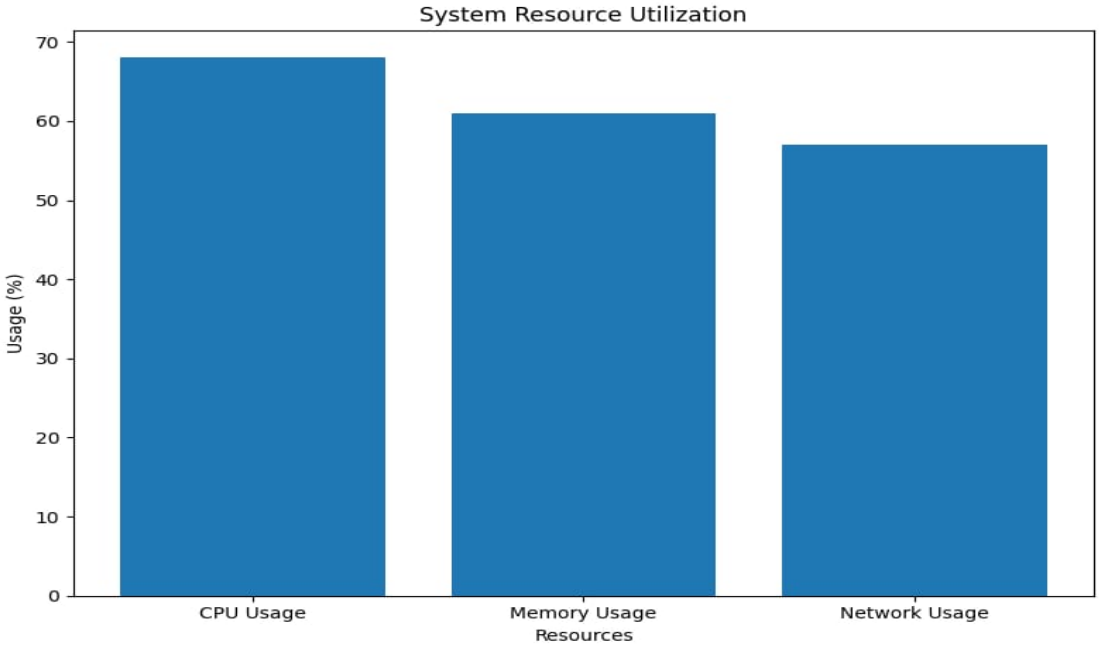

Figure. 3 Bar graph showing system resource utilization

5. CONCLUSION AND FUTURE WORK

The idea behind the AI Integrated e, learning platform is to make online learning more intelligent, customized and secure further. It demonstrates the potential of AI, ML and blockchain technologies for enhancing education through online mode.

This solution addresses numerous issues in traditional e, learning methods such as one, size, fits, all content, the same set of questions or tests for everybody, very little tracking of student progress.

The platform offers personalized learning by evaluating the student's performance, interests and learning pace. It makes short summaries of long video lectures, which facilitate students' understanding, and it also automatically generates quizzes from the video lectures.

All in all, the suggested platform makes the learning experience more enjoyable, raises the level of students involvement, and through the use of smart automation and safe data management, it features enhanced teaching.

Future enhancements of the platform may include:

- Use of advanced Deep learning models for more accurate content recommendation
- Introduce AR/VR-based virtual learning environments.
- Improve blockchain efficiency and scalability.
- Add emotion or facial expression analysis to measure student engagement.

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