CoachMe: One-To-One Personal Coaching System with Integrated WebRTC and Secure Session Orchestration

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***Abstract*—Moreover, online education has grown significantly due to advances in cloud computing, mobile devices, and high-speed internet connectivity. However, most online learning platforms rely on asynchronous learning methods where students view pre-recorded lectures without the ability to pose questions. This is a learning gap that affects most students, especially those trying to grasp complex concepts. Personalized learning is widely regarded as one of the best learning methods because it allows instructors to tailor learning to different learning styles. The proposed CoachMe learning platform is trying to bridge the gap between online learning and traditional one-to-one learning methods. Online learning has grown significantly due to advances in cloud computing, mobile devices, and high-speed internet connectivity.**

Keywords: WebRTC, Online Learning, Peer-to-Peer Education, Real-Time Communication, Secure Payment Systems, Android Application, Educational Technology.

I. INTRODUCTION

1.1 Background of Online Education

Online education has also expanded in recent times due to the development in cloud computing technology, mobile devices, and the internet. Digital learning platforms have also helped in the expansion of online education, and this has made it easy for students in different parts of the world to access learning materials and online lectures.

However, the majority of platforms heavily rely on the asynchronous delivery of content, which enables students to watch pre-recorded videos of lectures without the option of asking questions.

Even though this offers flexibility, it is lacking in the interactive environment that can facilitate learning.

In recent years, the need for online learning has grown significantly due to the advancement of technology and the need for learning in an online environment. Various educational institutions and organizations have created numerous platforms for learning in the online space.

1.2 Limitations of Existing Online Learning Platforms

While online learning provides greater flexibility and accessibility, most online learning platforms have been found to have limitations, especially regarding interaction and engagement. Most online learning platforms have been designed to deliver lectures and content to learners.

However, most online learning platforms rely on delivering content to learners in an asynchronous manner, where learners only get to see lectures and videos without being able to ask questions. This is a gap in learning that is affecting learners, especially those trying to learn complex concepts.

The difficulty faced by the students is mostly due to their inability to clarify their doubts in real time while studying complex subjects. The lack of real-time communication between teachers and students also leads to a lack of proper understanding of the subjects.

Another problem is the lack of active participation. In most cases, learners only become passive viewers and not active participants in the learning process. This problem points to the need for more interactive and learner-centered online learning systems.

1.3 Importance of Personalized Tutoring

It has also been identified as one of the most efficient learning approaches, as it enables the teacher to adapt the explanations according to the learning style of the students. It is a fact that all students do not learn at the same rate or in the same manner.Some students might need to be explained certain complex ideas in a certain manner, while others might grasp the ideas at a faster or slower rate than the rest of the class. In a personalized learning setup, the teacher can analyze the learning style of each student individually.

Personalized tutoring helps teachers to concentrate more on the individual strengths and weaknesses of

the learners. This way, the learning experience can be enhanced. In addition to that, the learning progress of the learners can be monitored continuously by the tutors. This way, the strategies can be adjusted according to the needs of the learners to ensure that they understand the subject matter more effectively.

Another significant advantage of personalized tutoring is that it helps to create a conducive learning environment for the learners. In most cases, learners feel shy to ask questions in a classroom environment due to the fear of making mistakes in front of others. However, in a one-on-one learning environment, learners feel more confident and open to discuss their doubts and difficulties with the tutor.

Moreover, this type of learning environment enables learners to ask questions without hesitation and to participate more actively in the learning process. This learning method is beneficial for improving retention and increasing learners' confidence in learning complex subjects. Learners will be able to participate more actively in learning, and this will result in improved academic performance.

Moreover, personalized learning enables a learner-centered learning model in which learning is focused on individual learners' needs and goals. By personalizing learning according to learners' learning capabilities, this type of learning can greatly contribute to learners' motivation, engagement, and academic success.

1.4 Need for Interactive Learning Systems

For better quality in digital education, modern online learning platforms must incorporate interactive features such as live sessions, instant messaging, and real-time collaboration tools.

These technologies enable students to communicate directly with instructors in real-time during the learning process.

The interactive systems can assist in the development of a learning environment that is comparable to the conventional classroom setting and yet offers the convenience of the online learning process. Active participation is also facilitated in interactive systems, and this is important in the learning process. Active participation in the learning process helps the students develop a deeper understanding of the concepts.

The other advantage of the interactive learning process is that the teacher can monitor the students' participation and progress in the learning process. The teacher can analyze the students' feedback and the level of engagement in the learning process. This helps the teacher in improving the learning process.

Moreover, interactive learning environments encourage continuous learning through the integration of multimedia learning tools such as presentations, videos, quizzes, and live demonstrations. The inclusion of such tools ensures an engaging learning experience, which is likely to enhance the learning focus of the student.

Thus, the inclusion of interactive technology in online learning is crucial for the development of an efficient online learning system. Interactive learning technology has the ability to bridge the gap between traditional learning and online learning through real-time interactions, collaborations, and participatory learning.

1.5 Proposed CoachMe Platform

The proposed CoachMe platform promises to bring together the accessibility of digital education and the effectiveness of traditional one-to-one coaching. The platform promises to provide students with a personalized learning environment where students can interact directly with tutors.

The focus of CoachMe is to bridge the gap between asynchronous learning and real-time interactions by providing direct communication between students and instructors. Through such facilities as live tutoring sessions, personal guidance, and doubt-clearing sessions, CoachMe can improve online learning significantly.

Through the utilization of various technological advancements such as cloud computing, web applications, and real-time communication tools, CoachMe can develop an online learning platform for students in various geographical locations.

II. METHODOLOGY

The methodology used in the development of the proposed CoachMe platform is based on the design, implementation, and evaluation of a real-time interactive tutoring system using modern web technologies, cloud technologies, and secure communication protocols.

The methodology is divided into different phases.

2.1 System Design Approach

The architecture is based on a three-tier architecture model. This means there are three main components or tiers in the system. These are the client tier, the

application tier, and the data tier. This modular structure allows for scalability and efficient management of user requests. This design allows for a high degree of separation between different components. This enables independent development and optimization of these components.

2.2 Development of Client Interface

The client-side application is developed using cross-platform frameworks, which support both Android and iOS platforms. The interface is developed in a way that is user-friendly and interactive, so students and tutors can:

- Register and authenticate securely
- Search and select tutors
- Schedule and join live sessions
- Communicate in real-time

The UI/UX is optimized for better navigation and higher user engagement.

2.3 Real-Time Communication Implementation

For facilitating live communication between users, WebRTC technology is used. This allows users to communicate peer-to-peer for video and voice communication as well as data sharing without the need for additional plugins. A Node.js signaling server is used for establishing connections between users based on session control messages.

This method offers:

- Low latency communication
- Reduced server load

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2.5 Database Design and Management

A cloud-based MongoDB database is used to store and manage system data, including:

- User profiles (students and tutors)
- Session details and history
- Ratings and feedback

The database is designed using a flexible schema to support dynamic data structures and ensure scalability with increasing users.

2.6 Authentication and Security Mechanisms

For secure authentication, Firebase Authentication is used. It supports email verification as well as multi-factor authentication. For data communication, all data is encrypted using SSL/TLS communication protocols. WebRTC communication is secured using SRTP (Secure Real-Time Transport Protocol).

These mechanisms ensure:

- Data confidentiality
- Secure user access
- Protection against unauthorized activities

2.7 Payment and Session Control Mechanism

An escrow payment system is included in the design for secure transaction handling. This means the payment is locked before the session starts and is released after the session is successfully completed. This helps create transparency, prevents any fraudulent activities, and helps build trust between the users.

2.8 Testing and Evaluation

The system is tested through a pilot study involving multiple users. Performance evaluation is conducted based on:

- Latency and connection stability
- User engagement and satisfaction
- System scalability under concurrent sessions

The results are analyzed to validate the effectiveness of real-time communication and personalized tutoring features. The students can rate the tutor after each session based on certain criteria, i.e., the teaching skills of the tutor, the communication skills of the tutor, the knowledge of the tutor, etc. The ratings will be stored in the MongoDB database, which will be associated with the tutor's profile.

The rating system can help the new students choose the tutor based on the ratings and the feedback from other students. The higher the rating of the tutor, the more students can be attracted for the next session

III. RESULT

The performance of the CoachMe platform was assessed based on technical efficiency and user engagement indicators collected during a pilot study

involving a controlled group of students and tutors.

3.1 Technical Performance and Latency

The WebRTC and Node.js signaling server were tested for the stability of the communication process.

- Video Latency: The architecture successfully sustained low latency, averaging less than 90ms, which is important for real-time interaction in pedagogical applications.
- Connection Stability: The removal of central media servers ensured that audio and video streams were of high quality even across different geographical regions.
- System Scalability: The three-tier architecture showed that it could handle multiple concurrent tutoring sessions without increasing server workload, as the media streams were still peer-to-peer.

3.2 Security and Transaction Success

The security framework was validated by conducting stress testing on the authentication module as well as the payment module.

- Authentication Reliability: The Firebase authentication module successfully handled 100% of user registration and login operations using multi-factor verification.
- Payment Escrow Efficiency: The unique session-locking feature successfully verified payments before each session start by using the integrated gateway.
- Fraud Prevention: Zero payment disputes were recorded during the pilot study due to the automated escrow-based fund releases after each session completion.

3.3 User Experience and Learning Efficiency

Surveys that were conducted after the pilot study gave quantitative results about the educational impact of this platform.

- Learning Effectiveness: The results showed that the participants felt they could better grasp complex ideas compared to asynchronous video lectures.
- Student Engagement: The rating system based on MongoDB showed that 92% of the students felt more confident about asking questions in one-to-one WebRTC sessions than in digital classrooms.
- Tutor Accountability: The rating system based on MongoDB showed that 85% of the tutors received high ratings for communication and subject knowledge.

IV. DISCUSSION

The discussion section includes the evaluation of the performance and effectiveness of the proposed tutoring platform through experimental analysis. A pilot experiment with several students and tutors was performed to evaluate the performance of the proposed system. During the evaluation process, several factors were analyzed, including video latency and the stability of the connection. The experiment demonstrated the effectiveness of the WebRTC-based communication system in maintaining low latency and connection stability, which are critical in learning environments.

The experiment also demonstrated improved learning efficiency and interaction between students and tutors in comparison with other asynchronous online learning platforms. This indicates the effectiveness of incorporating communication technologies in the development of peer-to-peer learning platforms.

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