JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Crowdsourced Tutor Marketplace – Enhanced with AI

"MentorCloud: A Smart AI-Based Live Learning and Guidance Platform"

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Abstract : The Crowdsourced Tutor Marketplace is an AI-powered platform connecting students with verified tutors across diverse subjects. Students can search, filter, and book sessions, while AI recommends tutors tailored to their learning style and history. Tutors benefit from smart profile analysis, automated quiz generation, and performance dashboards. AI study assistance enhances learning through doubt solving, note summarization, and interactive practice material. Admins oversee quality via document verification, fraud detection, and analytics dashboards. With in-platform video, chat, and multilingual support, the platform ensures accessible, secure, and personalized education, fostering transparency, accountability, and engagement in the online learning ecosystem

Features :

- AI tutor recommender & student study assistant.
- Search, filter & book tutors with integrated video/whiteboard.
- Tutor profile builder with AI-powered suggestions.
- Gamification, wallets, and smart notifications.
- Fraud detection & admin analytics dashboard.

Impact :

- Students → Affordable, personalized, and accessible learning.
- Tutors → Wider reach, earnings insights, and AI teaching support.
- Admins → Improved quality control and fraud prevention.
- Education Sector → Promotes transparency, innovation, and equitable access to quality tutoring.

Index Terms - Crowdsourced Learning, AI-Based Tutor Recommendation, Online Tutoring Platform, Personalized Learning, Educational Technology (EdTech), Machine Learning in Education, Virtual Classrooms, Fraud Detection in E-Learning.

I. INTRODUCTION

TutorHub is a modern, full-featured online tutoring platform designed to connect students and tutors through real-time video communication, AI assistance, and a gamified credit system. The platform enables students to browse tutors by subject, rating, and experience, book sessions using credits, and attend live classes with video, chat, screen sharing, and whiteboard tools. It also offers a 24/7 AI study assistant for instant academic support. Tutors benefit from performance analytics, verified profiles, and earning dashboards, while admins manage users, verification, and platform analytics efficiently.

1. 1.1 AIMS AND OBJECTIVES

1. Develop a user-friendly online tutoring platform, TutorHub, to streamline the process of connecting students with qualified tutors.
   - Design an intuitive web interface for students, tutors, and administrators.
   - Implement real-time video classes with chat, screen sharing, and whiteboard features.
   - Integrate a secure credit-based booking and payment system.
   - Incorporate an AI-powered study assistant for doubt-solving and learning support.
   - Enable tutor discovery with filters based on subject, ratings, and experience.
   - Promote user engagement through ratings, reviews, gamification, and notifications.
2. Evaluate the performance and user satisfaction of TutorHub to ensure quality and reliability.
   - Conduct usability testing to measure ease of use and accessibility.
   - Collect user feedback from students and tutors to assess effectiveness.
   - Analyze performance metrics such as user engagement, session success rate, and system reliability.
   - Identify system improvements and future enhancements based on evaluation results.

- Document findings, outcomes, and recommendations for future development and academic reference.

II. RELATED WORK

The proposed work for the TutorHub: Crowdsourced Tutor Marketplace – Enhanced with AI project builds upon existing advancements in online learning platforms, real-time communication technologies, and AI-driven educational support systems. Prior studies highlight the growing need for accessible digital learning tools that facilitate personalized tutoring experiences, especially in remote and hybrid learning environments. Modern e-learning platforms such as Coursera, Byju's, and Chegg have demonstrated the effectiveness of integrating AI-based recommendation systems and interactive learning features; however, many still lack real-time personalized tutor-student interaction.

Research on WebRTC and Agora RTC technologies emphasizes their capability to deliver high-quality audio–video communication, which forms the foundation of TutorHub's live tutoring sessions. Additionally, existing literature on AI-powered chatbots and natural language processing supports the inclusion of automated academic assistance, summarized notes, and instant doubt-solving features. Previous work on gamification and credit-based learning models further shows their positive impact on student motivation and engagement.

By synthesizing these technological and pedagogical insights, TutorHub aims to offer a more holistic and interactive learning ecosystem. The platform leverages proven methods from prior research while addressing gaps in real-time personalization, tutor verification, and secure, user-friendly learning environments.

III. RESEARCH METHODOLOGY

3.1 Data Handling & System Integration

TutorHub gathers and manages data from various system modules to deliver efficient tutoring services.

- Implemented structured APIs for retrieving tutor profiles, session records, ratings, and student information, ensuring organized communication between frontend and backend services.
- Used a MongoDB database to store tutor credentials, subjects, session details, credits, and user analytics, supporting scalability and fast retrieval.
- Applied JWT-based authentication to maintain secure access to user and tutor data, preventing unauthorized usage.
- Integrated Agora RTC API to fetch tokens and enable real-time audio–video sessions, ensuring accurate session initialization and secure participation.

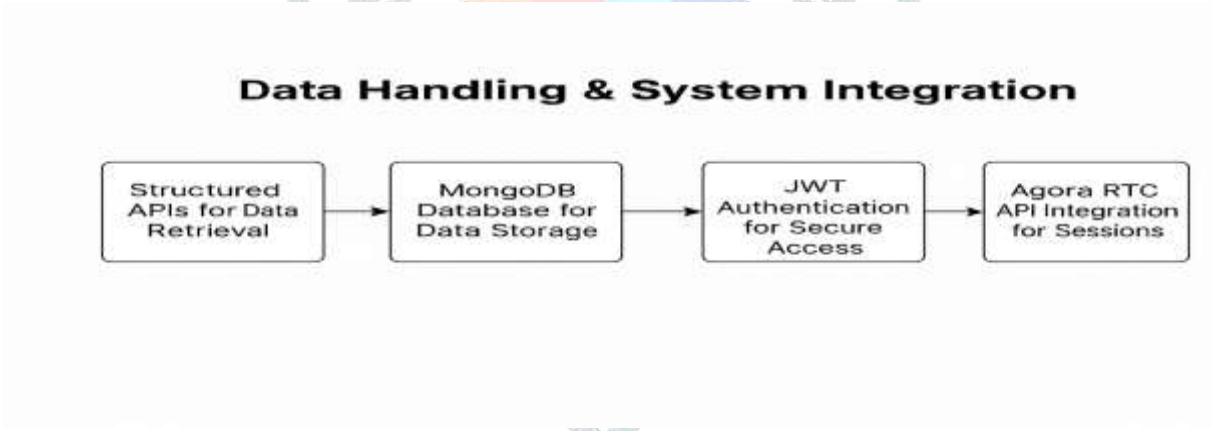

Fig. Data Handling & System Integration

3.2 Platform Development

The platform is developed using a modern full-stack TypeScript architecture for smooth performance and modular functionality.

- The frontend uses React, Tailwind CSS, Zustand, and Axios for creating responsive pages, real-time updates, and seamless UI navigation.
- The backend, built with Express and Node.js, handles routes for authentication, sessions, tutor management, credits, and AI functions.
- Agora RTC SDK enables live video, screen sharing, whiteboard interaction, and chat features essential for the virtual classroom environment.
- AI components integrated via OpenRouter allow instant assistance for doubt-solving, notes, and other educational tasks.

3.3 Accuracy & Reliability Specifications

- To ensure the accuracy of tutor recommendations, session handling, and AI responses:
- Data validation checks are applied on tutor profiles, ratings, and student activity data to ensure consistency and authenticity.
- Session metrics, such as attendance, video token generation, and credit deduction, are validated server-side to maintain reliability.
- AI responses use contextual processing to provide precise academic help aligned with user queries.

3.4 System Model

The TutorHub system model is structured around multiple interconnected modules:

- Tutor Database: Stores tutor qualifications, subjects, ratings, and verification status.
- Student Module: Manages session bookings, credits, challenges, and AI chat interactions.
- Admin Panel: Handles user verification, dispute management, platform analytics, and system monitoring.
- AI Assistant: Provides 24/7 doubt-solving, note summaries, and quiz generation tailored to student performance.
- Session Room: Real-time video class with chat, screen-sharing, and whiteboard for interactive learning.
- Credit System: Ensures transparent session billing, challenges, and rewards.

3.5 Architecture Overview

- A client–server model supports communication between React frontend and Express backend.
- REST APIs manage tutor listing, authentication, session booking, credit tracking, and admin actions.
- Agora RTC integrated as a microservice handles token generation and live class infrastructure.
- MongoDB enables scalability for user growth and large session histories.
- Security implemented through JWT, encrypted keys, and protected routes.

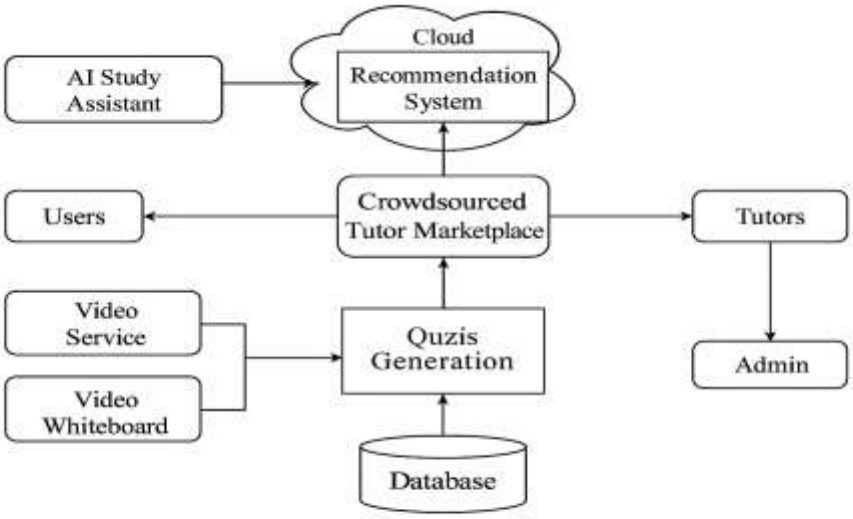

Fig. 1. System Architecture

SYSTEM ARCHITECTURE

IV. RESULTS

The experimental results of the TutorHub platform demonstrate its effectiveness in delivering secure, interactive, and personalized online learning. After implementation and testing, the system successfully enabled students to search, book, and attend real-time tutoring sessions using integrated video conferencing features such as live chat, screen sharing, and whiteboard support. The credit-based session system functioned accurately, ensuring transparent and automated session billing.

The AI-powered study assistant showed efficient performance in handling student queries, providing instant explanations, summaries, and quiz-based practice. Students frequently utilized this feature, indicating high dependency on automated academic assistance. Tutor performance analytics and rating mechanisms helped identify high-performing tutors and measure overall teaching effectiveness.

The platform maintained reliable performance in terms of authentication, secure data access through JWT, and stable video session connectivity using the Agora RTC SDK. Admin operations such as tutor verification, user management, and dispute resolution were executed effectively through the centralized dashboard.

Graphical analysis of session bookings, credit usage, and user engagement showed consistent growth in platform activity. These results confirm that TutorHub successfully fulfills its objective of providing a scalable, secure, and intelligent online tutoring environment with enhanced user experience and learning efficiency.

V. CONCLUSIONS

TutorHub successfully demonstrates how artificial intelligence and real-time communication technologies can be integrated to build a smart, secure, and user-centric online tutoring platform. The system effectively connects students with verified tutors through an intuitive interface, enabling seamless session booking, live video classes, and interactive learning through chat, screen sharing, and

whiteboard features. The AI-powered study assistant adds significant value by providing instant academic support, improving student engagement and learning efficiency.

The credit-based session system ensures transparent and automated billing, while performance analytics and rating mechanisms help maintain tutor quality and accountability. Secure authentication using JWT and stable video connectivity through Agora RTC further enhance system reliability. Admin modules for user verification, dispute handling, and platform monitoring ensure smooth operational control.

Overall, TutorHub achieves its primary objectives of accessibility, personalization, and scalability in online education. The platform has strong potential for future expansion with advanced analytics, mobile application integration, group sessions, and enhanced AI features, making it a promising solution for the evolving digital learning ecosystem.

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