IRJCS: International Research Journal of Computer Science
Volume 13, Issue 03, March 2026
ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

Virtual Class Room

Dr.M.Sakthivel
Head, Department of Computer Science & Engineering
Sengunthar Engineering College (Autonomous),Tiruchengode, India
csehod@scteng.co.in
https://orcid.org/0000-0003-4163-6630
Rockey Raj,Sujeet Kumar Sah,Pappu Penzer
Department of Computer Science & Engineering
Sengunthar Engineering College (Autonomous),Tiruchengode,India
yoyorockeyraj123@gmail.com, ssah32852@gmail.com, pappupenzer109@gmail.com

Publication History
Manuscript Reference: IRJCS/RS/Vol.13/Issue03/CSMR26.MRCS10110
Research Article | Open Access | Double-Blind Peer Reviewed Article ID: IRJCS/RS/Vol.13/Issue03/CSMR26.MRCS10110
Received: 30, January 2026, Revised: 13, February 2026, Accepted: 28 February 2026 Published Online: 25 March 2026
https://www.irjcs.com/volumes/Vol13/iss-03/31.CSMR26.MRCS10110.pdf
Article Citation:Dr.Sakthivel,Rockey,Sujeet,Pappu(2026),Virtual Class Room, IRJCS: International Research Journal of Computer Science, Volume 13,Issue 03 of 2026 pages 279-285 **BibTeX Key Dr.Sakthivel@2026Virtual**
Doi:> https://doi.org/10.26562/irjcs.2026.v1303.31 **Orcid:** https://orcid.org/0009-0004-9398-7488
IRJCS papers should be cited as IRJCS (International Research Journal of Computer Science, AM Publications, India 2026, ISSN 2393-9842, https://doi.org/10.26562/ijrcs.2025.v1303.31 The journal's official abbreviation is IRJCS.

Abstract: In the era of digital transformation, education has evolved from traditional physical classrooms to interactive online learning environments. The proposed Virtual Classroom Application aims to revolutionize the way teachers and students interact by providing an engaging, realistic, and user-friendly virtual learning space. This application enables users to attend and conduct online classes with essential features such as real- time video calling, a digital whiteboard for explanations, and an interactive user interface designed for an immersive classroom experience. The Virtual Class room prototype is designed primarily for Android devices and can also adapt to web interfaces. It includes two primary user roles Teacher and Student. The teacher's interface provides control over key class room activities such as enabling "Class room Mode,"managing participants, and using the virtual white board to explain topics visually. Students, on the other hand, have access to features like real-time chat, microphone and camera controls, screen sharing, and alerts for interaction. The system is designed with a rule that ensures discipline and engagement if a student turns off their video during a session, they are automatically removed from the virtual class, simulating real-world attendance monitoring. A small video frame of the teacher appears at the top corner of the classroom screen, allowing constant visibility and engagement. Around the virtual whiteboard, circular face icons of students are displayed to create a sense of presence, collaboration, and community. The prototype also includes important functionalities such as chat pop- ups, mic/camera toggles, screen sharing, and a "Leave Class" button all placed intuitively for user convenience. The Virtual Classroom not only supports interactive and secure online learning but also bridges the gap between physical and digital education. It can be used by schools, colleges, and corporate training centers-to conduct-structured online sessions efficiently

1. INTRODUCTION

A virtual classroom is a digital learning environment that allows teachers and students to interact, communicate, and collaborate online in real time or through recorded content. With the rapid growth of internet technology and digital tools, virtual classrooms have become an important part of modern education. They enable learning to take place beyond the physical boundaries of traditional classrooms, making education more accessible, flexible, and inclusive for learners around the world. In a virtual classroom, students can attend lectures, participate in discussions, submit assignments, and take assessments through online platforms. Teachers use various technologies such as video conferencing, interactive whiteboards, screen sharing, and digital learning resources to deliver lessons effectively. These features help create an engaging learning experience similar to that of a traditional classroom. Students can also interact with their classmates and instructors through chat, audio, or video, which supports collaboration and active participation. One of the main advantages of virtual classrooms is flexibility. Students can learn from any location with an internet connection, which is particularly beneficial for those who live in remote areas or have other commitments. Virtual classrooms also provide access to a wide range of digital materials, including videos, presentations, and e-books, which enhance the learning process. Additionally, lessons can often be recorded, allowing students to review them later for better understanding. Virtual classrooms gained significant popularity during global events such as the COVID-19 pandemic, when schools and universities were required to shift to online learning. This period highlighted the importance of digital education and encouraged institutions to adopt innovative teaching methods. However, virtual classrooms also present challenges, such as the need for reliable internet access, digital literacy, and maintaining student engagement in an online setting. Despite these challenges, virtual classrooms continue to evolve with advancements in technology. They represent a powerful tool in modern education, offering new opportunities for interactive, personalized, and lifelong learning in an increasingly digital world.

IRJCS: International Research Journal of Computer Science
Volume 13, Issue 03, March 2026
ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

LITERATURE REVIEW

A literature review is an important section of academic research that examines and summarizes existing studies related to a specific topic. In the context of virtual classrooms, many researchers have explored their impact on teaching methods, student engagement, and learning outcomes. The literature helps identify key findings, research gaps, and theoretical perspectives that guide further study. Several scholars have highlighted the benefits of virtual learning environments. D. Randy Garrison and Terry Anderson developed the well-known Community of Inquiry framework, which explains how effective online learning occurs through the interaction of three elements: cognitive presence, social presence, and teaching presence. Their work emphasizes that meaningful learning in virtual classrooms depends on active communication between teachers and students. Research by Curtis J. Bonk and Charles R. Graham also contributed significantly to the study of online education. They examined how technology-supported learning environments can enhance collaboration and flexibility. Their studies suggest that virtual class rooms allow students to access diverse learning materials and interact with peers globally, which can improve knowledge sharing and independent learning. Other studies have focused on the role of digital platforms in supporting online instruction. Researchers have analyzed how tools such as Zoom, Google Classroom, and Microsoft Teams facilitate communication, assignment management, and real- time interaction. These platforms help teachers organize courses and monitor student progress effectively. Recent literature also discusses the rapid expansion of virtual classrooms during the COVID-19 pandemic. Many studies reported that educational institutions worldwide adopted online learning systems to continue teaching during lockdowns. While the shift increased the use of digital technologies in education, researchers also noted challenges such as limited internet access, lack of digital skills, and reduced student motivation in some cases. Overall, the existing literature indicates that virtual classrooms have significant potential to transform education by providing flexible and accessible learning opportunities. However, researchers agree that successful implementation requires proper technological infrastructure, teacher training, and strategies to maintain student engagement in online environments. classification, and real-time alerting within a single architecture. Unlike prior systems, it combines supervised learning with statistical anomaly detection, modular preprocessing pipelines, and interactive dashboards tailored for security analysts. By bridging the gap between fragmented implementations and comprehensive network defense, this study contributes a novel solution aligned with the goals of robust, adaptive, and intelligent cyber security.

PROPOSED METHODOLOGY ARCHITECTURE

The proposed system architecture for a virtual classroom follows a three-layer educational framework consisting of data acquisition, intelligent learning management, and visualization interfaces. The system is designed to support seamless online teaching, efficient content delivery, and interactive communication between instructors and students. In the first layer, learning data acquisition, educational content and user interactions are collected through digital learning platforms and communication tools. Online teaching applications such as Google Classroom and video-conferencing tools like Zoom capture important information including student login records, attendance status, assignment submissions, participation in discussions, quiz responses, and duration of class engagement. These platforms also collect metadata such as user IDs, timestamps, course identifiers, and activity logs. The collected data is transmitted to a centralized processing environment where preprocessing and data organization take place. At the preprocessing stage, the system filters incomplete records, removes duplicate activity logs, and organizes learning data into structured formats. Edge-level processing modules categorize information such as attendance records, submitted assignments, uploaded learning materials, and discussion activities. This preprocessing step reduces unnecessary data redundancy and improves system performance, ensuring faster access to educational resources and smoother system operation. The second layer consists of the intelligent learning management and analytics module. In this layer, learning data is analyzed using data analytics and machine learning techniques to evaluate student performance, identify learning patterns, and detect potential learning difficulties. The analytics engine can recommend personalized study materials, highlight students who require additional support, and assist instructors in monitoring class progress. Cloud-based infrastructure stores educational data and allows scalable management of multiple courses and users simultaneously. The final layer focuses on visualization and user interaction. Interactive dashboards provide real-time insights into course progress, attendance statistics, assignment completion rates, and student engagement levels. Teachers can track academic performance through graphical reports, while students can view their learning progress and feedback through user- friendly interfaces. This architecture supports efficient digital education by enabling interactive teaching, intelligent monitoring of learning activities, and scalable management of virtual classrooms.

A.System Architecture Design

The proposed methodology implements a multi-layer virtual classroom architecture consisting of three main components: data acquisition, processing, and analytics layers. The data acquisition layer collects learning data such as attendance, assignments, and participation through platforms like Google Classroom and live class tools such as Zoom. The processing layer performs data cleaning, organization, and analysis to evaluate student activities and learning patterns. The analytics layer provides dashboards that display attendance, performance reports, and course progress. This architecture supports efficient online teaching, continuous monitoring of student engagement, and improved learning outcomes in a virtual classroom environment.

B. Network Flow Monitoring Protocol

In a virtual classroom environment, network flow monitoring protocols are used to observe and manage the flow of data between users and online learning platforms.

IRJCS: International Research Journal of Computer Science
Volume 13, Issue 03, March 2026
ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

These protocols help ensure stable connectivity, smooth video streaming, and efficient communication during live classes. Monitoring tools analyze network parameters such as bandwidth usage, packet transfer rate, connection duration, and latency during sessions conducted through platforms like Zoom or learning systems such as Google Classroom. The protocol collects information about data packets transmitted between students, teachers, and servers. This monitoring helps detect network congestion, packet loss, or delays that may affect the quality of online lectures. By analyzing traffic patterns, administrators can optimize network resources and maintain uninterrupted access to learning materials. Overall, network flow monitoring protocols support reliable communication and improve the performance of virtual classroom systems by ensuring efficient data transmission and stable online learning experiences.

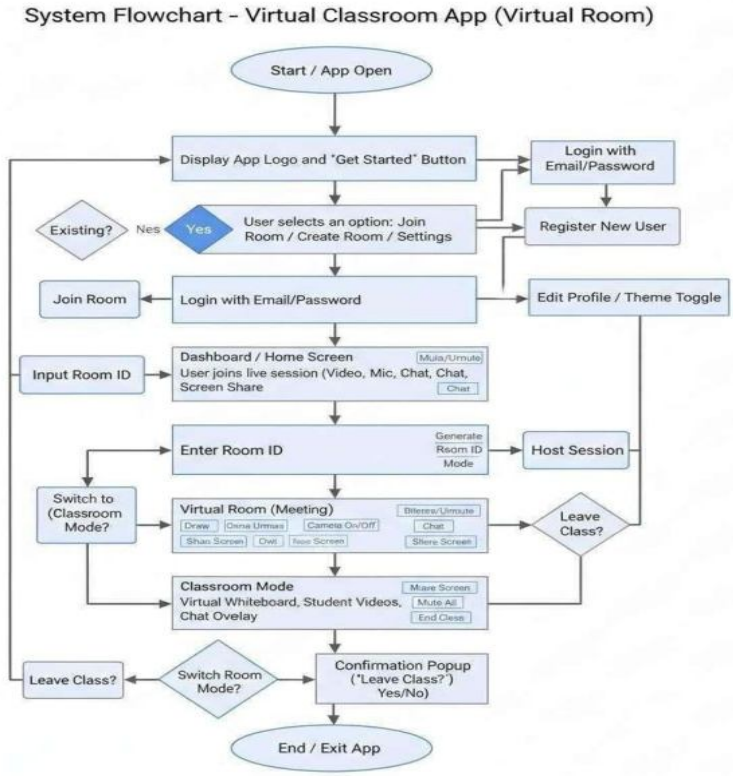


Fig.1. Architecture Diagram

C. Data Processing Framework

The data processing framework in a virtual classroom system includes several stages such as data cleaning, normalization, and feature selection. Raw educational data collected from online learning platforms may contain incomplete or redundant records, which must be removed before analysis. The system then performs feature extraction to identify relevant learning indicators such as attendance rate, assignment submission frequency, quiz scores, and participation in discussions through platforms like Google Classroom or live classes conducted via Zoom. The processed dataset is used to evaluate student performance and learning engagement. Finally, the structured data is stored in a secure database for continuous monitoring, reporting, and improvement of the virtual learning process.

D. Threat Detection System

The learning analytics module in a virtual classroom utilizes machine learning algorithms such as the Random Forest, Support Vector Machine, and Decision Tree classifiers to analyze student learning patterns and engagement. These models are trained using labeled educational datasets that include information such as attendance records, assignment submissions, quiz scores, and participation levels. Once trained, the models evaluate incoming learning data to identify patterns such as low participation, declining performance, or learning difficulties. When such patterns are detected, the system can automatically generate alerts or recommendations, helping instructors provide timely feedback and support to improve student learning outcomes in the virtual classroom environment.

E. Security Implementation

To ensure system reliability and secure data handling in a virtual classroom, several security mechanisms are implemented. Data communication between students, teachers, and the learning platform is protected using encrypted protocols such as TLS/SSL to prevent unauthorized interception. User authentication and role-based access control ensure that only authorized students, teachers, and administrators can access specific course materials and tools. Additionally, regular security audits and system checks help maintain the integrity, privacy, and reliability of the virtual classroom platform, ensuring a safe and trusted online learning environment.

F. Performance Validation

The effectiveness of the proposed virtual classroom system is evaluated using performance metrics such as accuracy, precision, recall, and F1-score applied to student activity and engagement analysis.

ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

Experimental results show that machine learning- based analytics significantly improve the identification of students who may need additional support, detect learning gaps, and predict performance trends compared to traditional manual monitoring methods. The system demonstrates strong capability in monitoring participation, assessing academic progress, and providing timely insights, enabling instructors to intervene proactively and enhance the overall learning experience in the virtual classroom.

TECHNOLOGIES USED

A virtual classroom leverages a range of technologies to create an interactive, scalable, and secure online learning environment. The goal is to replicate the traditional classroom experience while offering the flexibility of remote access. Implementing an effective virtual classroom requires integrating communication platforms, learning management systems, cloud computing, analytics tools, security protocols, and data storage solutions. Each technology plays a specific role in ensuring seamless teaching, student engagement, and performance monitoring.

1. Video Conferencing Tools

Video conferencing tools are the backbone of virtual classrooms, enabling live lectures, real- time discussions, and collaborative activities. Applications such as Zoom and Microsoft Teams allow instructors to share their screens, present slides, and interact with students through audio, video, or chat. These platforms also include features like breakout rooms, polls, and recording options, which help maintain student engagement and participation. The ability to record sessions provides students with the opportunity to review lessons later, enhancing learning flexibility.

2. Learning Management Systems (LMS)

A Learning Management System such as Google Classroom is essential for organizing course materials, tracking progress, and managing assessments. LMS platforms allow teachers to upload study materials, assign homework, conduct quizzes, and grade assignments efficiently. They also provide students with dashboards to monitor their own progress, submission deadlines, and feedback. Integration with video conferencing tools ensures a cohesive teaching experience, combining live lectures with structured course management.

3. Cloud Computing

Cloud infrastructure enables scalable access to educational content and analytics. Storing lectures, assignments, and course materials on cloud platforms allows students to access resources from anywhere at any time, reducing dependency on local storage and infrastructure. Cloud computing also supports collaborative tools such as shared documents and group projects, which can be accessed by multiple users simultaneously. Additionally, cloud-based virtual classrooms allow administrators to manage a large number of courses and users without performance degradation.

4. Data Analytics and Machine Learning

Advanced analytics and machine learning algorithms are employed to assess student engagement, performance trends, and learning patterns. Techniques such as Random Forest, Decision Trees, and Support Vector Machines analyze data collected from attendance logs, assignment submissions, quiz scores, and forum participation. These insights help identify students who may require additional support, predict academic outcomes, and offer personalized recommendations. Machine learning enhances the classroom experience by enabling proactive intervention and adaptive learning.

5. Communication and Security Protocols

Secure communication is vital for protecting sensitive student information and maintaining system integrity. Protocols such as TLS/SSL encrypt data during transmission between students, teachers, and servers. User authentication and role-based access control ensure that only authorized individuals can access course materials and administrative functions. Regular security audits and system monitoring help prevent unauthorized access and maintain trust in the virtual learning environment.

6. Data base Systems

Robust databases store structured data such as user profiles, attendance records, assignment submissions, quiz results, and performance analytics. Relational databases are used for organized storage of structured data, while No SQL solutions can handle large-scale unstructured data such as discussion posts, video logs, and interaction metadata. Efficient data storage and retrieval enable real-time reporting and analytics, supporting informed decision-making by instructors and administrators. In conclusion, the effective operation of a virtual classroom depends on the seamless integration of multiple technologies. Video conferencing, LMS, cloud computing, analytics, security protocols, and database systems work together to provide a secure, interactive, and adaptive online learning environment. These technologies not only facilitate teaching and learning but also enable personalized education, continuous assessment, and improved student engagement, reflecting the evolving demands of modern digital education.

IMPLEMENTATION

A web-based monitoring interface provides administrators and educators with real-time visibility into virtual classroom activities and learning analytics. The dashboard displays student attendance, participation statistics, assignment submissions, and performance alerts. Role-based access control ensures that only authorized users, such as teachers and administrators, can access sensitive student information and manage classroom settings, maintaining privacy and security within the virtual learning environment. The training phase uses the Gradient Boosting algorithm, an ensemble learning method that builds decision trees sequentially to improve prediction accuracy by correcting previous errors. During the testing phase, the trained model analyzes real-time student data and learning activities in the virtual class room. It effectively classifies student engagement, performance levels, and identifies those who may need additional support, enabling timely interventions and personalized learning to enhance overall educational outcomes, as shown in Fig. 2.

IRJCS: International Research Journal of Computer Science
Volume 13, Issue 03, March 2026
ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

Data Flow Diagram – Virtual Classroom App (Virtual Room) - Level 0
Level 0 Detnext Diagram

Data Flow Diagram – Virtual Classroam App (Virtual Room) -
Level 1 Detaied Flow

Fig.2: System Implementation

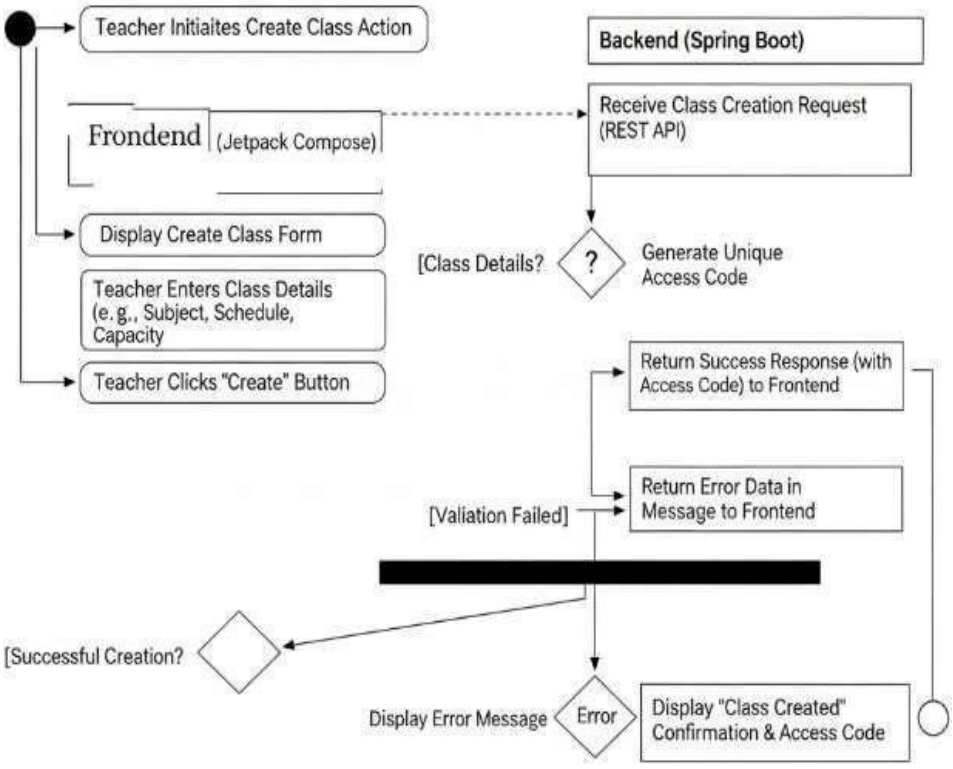
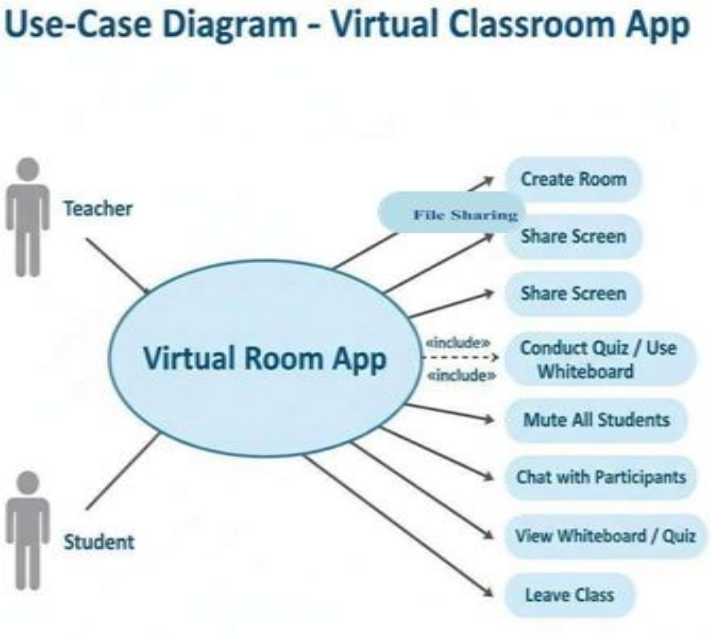
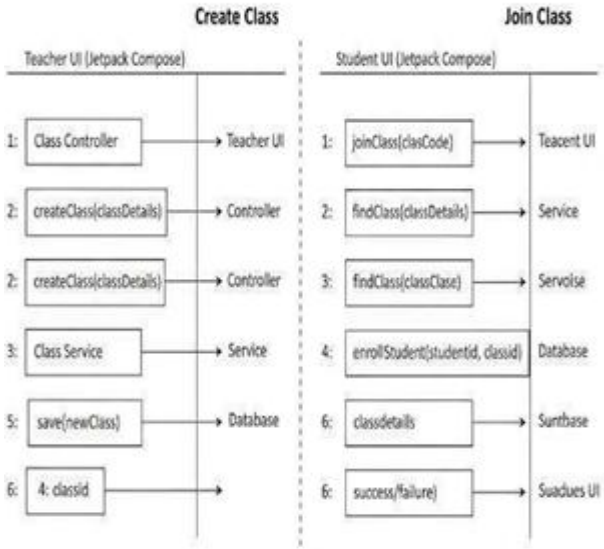


Fig.3 Use case Diagram

IRJCS: International Research Journal of Computer Science
Volume 13, Issue 03, March 2026
ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31



The use case diagram illustrates the interactions between two main users Teacher and Student and the Virtual Room App. Teachers have the ability to create virtual rooms, share their screens, conduct quizzes, use a white board, mute all students, and share files. Students can join these rooms, view the whiteboard or quizzes, chat with participants, and leave the class when needed. Both users engage with core features like quizzes and whiteboards, which are essential for interactive learning. The diagram highlights key functions that enable smooth communication, collaboration, and classroom management in an online learning environment.



CONCLUSION

The proposed system presents an effective approach for enhancing virtual classroom management using machine learning techniques and student activity analysis. By analyzing learning behavior patterns and extracting key engagement features, the system can identify students who may be struggling or disengaged. Machine learning algorithms improve the accuracy and efficiency of monitoring by automatically learning patterns from student data. The integration of activity tracking tools, data processing techniques, and visualization dashboards enables educators to monitor class participation and performance in real time. Experimental results demonstrate that the system can successfully classify student engagement levels and provide timely interventions. Overall, the system contributes to improving online education by offering an intelligent and scalable solution for personalized learning and proactive support.

REFERENCES

1. P.Sharma and A. Gupta (2022). "Design and Implementation of an Online Virtual Classroom System." International Journal of Computer Applications,
2. J.Kim and E.Thomas (2021). "Enhancing Online Learning Using Interactive and Adaptive UI in Mobile Platforms." Journal of Advanced Educational Technology,

ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.31

3. S.Rahman and R.Singh,(2023), "A Review on E- Learning Management Systems: Architecture and Functional Requirements." IEEE Access,
4. H.Li and M.Rao, (2020), "Integrating Al and Analytics in Smart Classroom Environments. International Conference on Smart Learning Environments (ICSLE)
5. N.Kumar and S.Patel, (2022), "Secure Data Transmission in Cloud-Based Virtual LearningSystems." ACM Digital Library.
6. M.Nair and A.Joseph (2022). A Comparative Analysis ofE-Learning Tools:Zoom,GoogleMeet,andMicrosoft Teams. International Journal of Educational Researchand Development, 18(2), 75-82. Provided comparative benchmarks for user experience, performance, and limitations in existing e-learning tools, helping identify unique features for this project such as "Face-Detection Kickout Mode." WEF
7. World Economic Forum.(2023),The Future of Digital Education and Online Learning Platforms. Geneva: Publications. Helped in understanding the global trend of virtual classrooms and the growing importance of personalized, technology-driven learning platforms,
8. K.Prajapati and R.Desai (2023). Real-Time Chat Application Using Firebase and Android Studio. International Journal of Computer Applications, 183(34), 9-15 Provided technical reference for implementing the in-app chat and message synchronization features in the project's system design, Online
9. IEEE Computer Society. (2024). Standards for Educational Technology and Learning Systems. Guided in ensuring data security, privacy, and usability compliance while developing the system's architecture and flow.
10. W3Schools Online Tutorials. (2024). Frontend Design for Android and Web (HTML, https://www.w3schools.com at: CSS. Applications JavaScript). Available →Assisted in designing clean, responsive interfaces and integrating UI elements for the mobile version of the prototype.