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Universal authentication system for ACE

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Abstract

The Universal Authentication System for ACE is a digital permission and verification framework designed to replace traditional paper-based approval methods within ACE Engineering College. Conventional permission systems are often slow, unreliable, and lack transparency, leading to administrative inefficiencies and delayed student processing. The proposed system automates this workflow by enabling students to submit digital permission requests, which are sequentially approved by the Class Incharge and Head of Department (HOD). Upon final approval, a unique code is generated and verified by the security guard at the exit gate. Using Firebase for both authentication and database management, the system ensures secure access, real-time data updates, and seamless scalability. This survey examines prior research on digital permission management and related automation systems, identifies gaps in existing methodologies, and presents an integrated mobile-first solution leveraging Firebase and React Native to ensure transparency, security, and operational efficiency across institutional workflows.

Keywords: Universal Authentication System; Permission Management System; Firebase Authentication; React Native; Firestore Database; Role-Based Access Control; Campus Security; Digital Workflow Automation

1 Introduction

Educational institutions often face challenges in managing student permissions due to outdated manual procedures. Traditional permission systems rely heavily on handwritten applications, physical signatures, and manual verification, leading to inefficiency and lack of accountability. To address these issues, the Universal Authentication System for ACE introduces a structured digital platform that integrates student request management, hierarchical approval, and security verification. This system aims to create a seamless interaction among students, class incharges, HODs, and security staff. Each role is authenticated using Firebase Authentication, ensuring secure access control. Real-time notifications keep students informed of the status of their requests, while data is securely stored and synchronized using Firestore. The integration of mobile technology through React Native ensures accessibility across devices, making permission handling faster, more transparent, and reliable.

2 Literature review

In recent years, researchers have developed various digital management systems aimed at improving institutional operations, such as attendance automation, access control, and administrative workflow optimization. However, most systems primarily focus on attendance tracking or employee management and rarely address the hierarchical permission approval process for students

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Table 1 Comparative Analysis of Existing Systems

Author(s) & Year	System/Title	Technology Used	Scope	Limitations
B.V.R. Gowri et al., 2023	Automated Student Permission System using RFID & NodeMCU	RFID, NodeMCU	Attendance and permission tracking	No cloud or multi-level approval integration
R. Tamilkodi, 2021	Automation Software for Educational Institutes	Face Recognition, Email Notification	Attendance and fee management	Lacks hierarchical approval workflow
Xiaoquan Gao & Yuheng Wang, 2008	Leave Management Software for University Personnel	Web-Based Application	Staff leave approval and recordkeeping	Focused on employees, not students
Muhammad Talha Jahangir et al., 2024	Mobile Biometric Attendance System	Biometric Authentication, Android	Attendance tracking for employees	No student permission module
Bhattacharya et al., 2018	Smart Attendance Monitoring System	Face Recognition	Classroom attendance	No outpass or verification system
Chintalapati & Raghunadh, 2013	Automated Attendance System	Face Recognition Algorithms	Attendance automation	No hierarchical approval or authentication
Proposed System (ACE UAS)	ACE Universal Authentication System	Firebase Auth, Firestore, React Native	Digital permission with role-based verification	Combines authentication, workflow automation, and exit validation

2.1 B.V.R. Gowri et al. (2023)

Gowri et al. [1] proposed an automated student permission and attendance system using RFID technology integrated with NodeMCU microcontrollers. The method uses RFID cards assigned to each student, where the card is scanned at a reader installed at entry or exit points. The NodeMCU device reads the RFID tag and sends the data to the system for recording attendance or exit information.

The working principle of this method is based on radio frequency communication between RFID tags and readers. When a student scans the card, the system records the identification information and logs the event. This approach reduces manual effort and improves attendance tracking efficiency.

One of the major advantages of this method is its ability to automate attendance monitoring and permission tracking with minimal human intervention. RFID systems are relatively fast and reliable for identifying users. However, the system has several limitations. It lacks cloud integration, which restricts real-time monitoring and centralized data access. Additionally, the system does not support multi-level permission approval workflows, which are essential for institutional permission management. As a result, while the system improves attendance tracking, it does not fully address hierarchical permission validation.

2.2 R. Tamilkodi (2021)

Tamilkodi [2] developed an automation software system designed for educational institutions that integrates attendance monitoring, fee management, and reporting functionalities. The system employs face recognition technology and automated email notifications to streamline administrative processes.

The method works by capturing facial images of students and comparing them with stored facial data using image recognition algorithms. Once the system identifies the student, attendance is recorded automatically and notifications can be generated. The integration of reporting modules allows administrators to track student activity and generate institutional reports.

The main advantage of this approach is that face recognition eliminates the need for manual attendance tracking and reduces the possibility of proxy attendance. Additionally, automated notifications improve communication between administrators and students.

Despite these advantages, the system does not implement hierarchical permission approval mechanisms. It mainly focuses on attendance and financial management rather than permission workflows. Therefore, while the system contributes to institutional automation, it does not address the need for secure student permission verification or exit authorization.

2.3 Xiaoquan Gao and Yuheng Wang (2008)

Gao and Wang [3] proposed a web-based leave management system for university personnel aimed at simplifying administrative leave processes. The method uses a web application platform where employees can submit leave requests, which are then processed and approved by supervisors through an online interface.

The system works by allowing users to log in through a web portal and submit leave applications electronically. The request is then forwarded through predefined approval levels within the organization. Once approved, the system stores the records in a database for future reference and reporting.

The major advantage of this system is its ability to digitize administrative workflows and maintain centralized leave records, improving organizational transparency and reducing paperwork. It also allows administrators to track leave patterns and manage staff availability effectively.

However, the system is designed specifically for employee leave management and does not support student-level permissions or campus exit verification. Additionally, it does not integrate modern cloud-based authentication or mobile-based interfaces, which limits its adaptability in modern educational environments.

2.4 Muhammad Talha Jahangir et al. (2024)

Jahangir et al. [4] developed a mobile-based automated attendance system that utilizes biometric authentication techniques. The system integrates fingerprint or biometric sensors with mobile devices to securely verify user identity and record attendance.

One of the primary advantages of this method is high authentication security, as biometric features are unique to each individual. The system also enables mobile-based operation, making it convenient for real-time attendance recording.

However, the system focuses mainly on attendance tracking for employees or students and does not support permission request workflows or approval hierarchies. Additionally, biometric systems can be costly to deploy at large scale and require specialized hardware infrastructure.

2.5 Bhattacharya et al. (2018) and Chintalapati & Raghunadh (2013)

Bhattacharya et al. [5] and Chintalapati and Raghunadh [6] proposed face recognition-based automated attendance systems that utilize computer vision algorithms to detect and recognize student faces within classroom environments. These systems rely on machine learning and image processing techniques to identify students from captured images or video frames.

The method works by first capturing an image using a camera, then extracting facial features using feature detection algorithms. These features are compared with stored facial templates in a database to identify the student. Once identification is complete, the system marks attendance automatically.

The main advantage of this approach is improved accuracy in attendance monitoring and elimination of proxy attendance, which is a common issue in manual attendance systems. The use of artificial intelligence also allows the system to operate automatically without requiring physical interaction.

However, these systems primarily focus on attendance monitoring rather than permission management. They do not provide mechanisms for hierarchical approval processes or exit verification systems. Additionally, face recognition systems may face challenges such as lighting variations, camera quality limitations, and privacy concerns.

3 Proposed system

The Universal Authentication System for ACE is designed to automate and digitize the student permission management process in educational institutions. Traditional permission systems rely on handwritten applications and manual approvals, which are time-consuming and lack transparency. The proposed system replaces this process with a mobile-based digital platform that enables students to submit permission requests electronically.

In the proposed workflow, a student submits a request through the application interface. The request is securely stored in the Firestore database and forwarded to the Class Incharge for initial review. After verification, the request is sent to the Head of Department (HOD) for final approval. Once the request is approved, the system generates a unique exit verification code.

At the campus exit gate, the security guard verifies the generated code using the verification module. The system checks the request details stored in the database and confirms whether the permission has been approved. If the code is valid, the student is allowed to exit; otherwise, access is denied.

The system is implemented using React Native for mobile application development, Firebase Authentication for secure user access, and Firestore for real-time database management. By integrating cloud services with a mobile interface, the proposed system ensures secure authentication, efficient workflow automation, and transparent permission management within the institution.

4 System Architecture

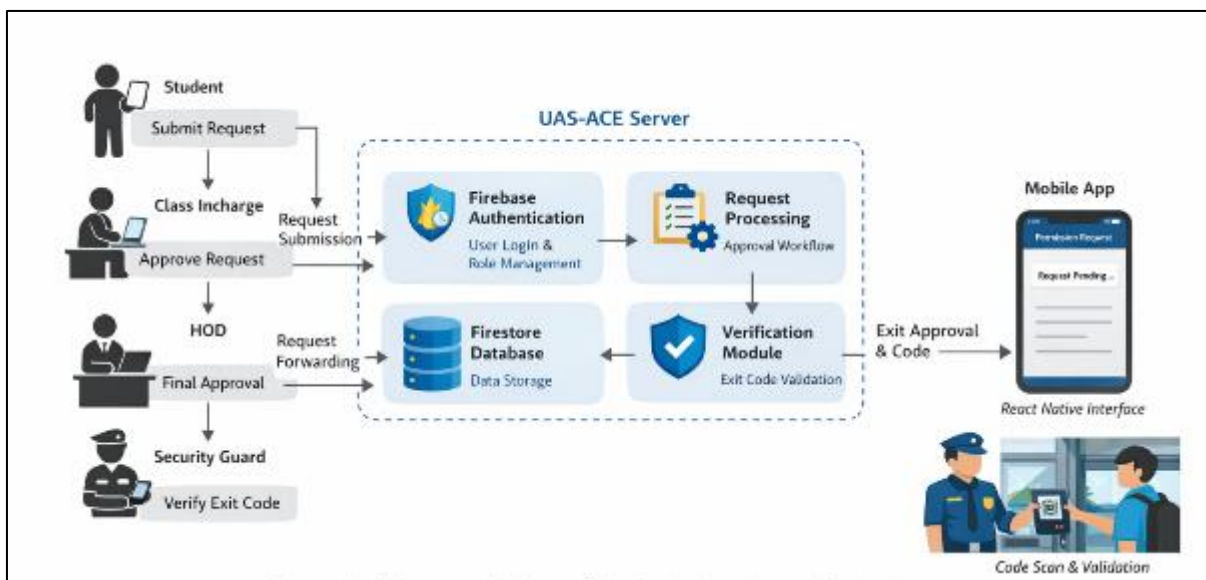


Figure 1 System Architecture of Universal Authentication System for ACE

5 Results and Discussion

The proposed Universal Authentication System for ACE demonstrates an effective solution for managing student permission requests through a digital platform. The system successfully implements a structured workflow where students submit requests, the Class Incharge reviews them, and the Head of Department provides final approval. After approval, a unique exit verification code is generated and validated at the campus gate, ensuring that only authorized students are allowed to exit.

The integration of Firebase services provides secure authentication, real-time data storage, and reliable communication between system components. The results indicate that the system improves transparency, reduces manual paperwork, and enhances institutional security compared to traditional permission management methods.

Based on the evaluation of system functionality and workflow efficiency, it can be concluded that the proposed system is a reliable and scalable solution for modernizing student permission management in educational institutions.

6 Conclusion

The **Universal Authentication System for ACE** modernizes the permission approval process in academic institutions by eliminating paper-based workflows and introducing a secure, real-time, cloud-based framework. It enhances institutional efficiency, reduces administrative workload, and ensures accountability across all approval levels.

7 Future Scope

- Integration of AI-based approval recommendations for frequent users.
- Implementation of QR code verification to replace numeric codes.
- Addition of facial recognition for enhanced identity validation.
- Offline mode support for areas with limited connectivity.
- Integration with college ERP systems for attendance and analytics.

With these improvements, ACE UAS can evolve into a comprehensive institutional automation suite, setting a benchmark for digital transformation in higher education.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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