Automated Group Attendance System Using NFC and Facial Recognition for Enhanced Identity Verification

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Abstract
This paper presents an innovative attendance management system based on Near Field Communication (NFC) technology integrated with deep learning–based facial recognition. The proposed system enhances the security and accuracy of attendance recording by ensuring that only physically present individuals with verified identities are marked present. Facial features captured in real time are matched against identity information stored in an NFC tag embedded in the user's identification card, thereby preventing proxy attendance and identity misuse. By tightly coupling facial verification with NFC-based authentication, the system significantly reduces attendance-related fraud in educational institutions and workplaces. Experimental results demonstrate that the proposed solution is efficient, reliable, and achieves high accuracy under real-world conditions, making it suitable for large-scale deployment.

Keywords— NFC, Facial Recognition, Attendance System, YOLO, ID Verification, Sustainable Cities and Communities, Decent Work and Economic Growth, Industry, Innovation and Infrastructure.

1. Introduction

The accuracy and integrity of attendance management are critical concerns in educational and organizational environments, where traditional manual and standalone biometric methods are often inefficient, time-consuming, and vulnerable to fraud such as proxy attendance and identity misuse. To address these limitations, this paper proposes a robust and technologically advanced attendance system that integrates Near Field Communication (NFC) with deep learning–based facial recognition to achieve dual-layer authentication. In the proposed approach, an individual first authenticates using an NFC-enabled identification card, a technology widely adopted for secure access and rapid verification, and this authentication is then reinforced by real-time facial recognition, where the captured facial features are cross-verified against the identity data stored within the NFC tag. This combined verification ensures that the correct individual is physically present and eliminates risks associated with card sharing or unauthorized usage. By coupling biometric validation with NFC-based identification, the system significantly enhances security, improves accuracy, and accelerates the attendance marking process, even in environments with large user volumes. Moreover, the solution reduces administrative overhead, prevents attendance-related fraud, and offers scalability and adaptability across diverse settings such as schools, universities, workplaces, and other secure facilities. Experimental evaluation under real-world conditions demonstrates that the proposed system operates efficiently and reliably, validating its potential for practical deployment and establishing it as a modern, fraud-resistant, and highly accurate attendance

2. Literature Survey

Recent studies indicate that existing attendance management systems based on single-factor authentication suffer from significant limitations in terms of accuracy and fraud resistance. Biometric-only attendance systems, such as fingerprint and facial recognition, have become popular due to their contactless operation and ease of deployment; however, they remain vulnerable to spoofing attacks using photographs or artificial biometric samples, and the lack of dual authentication makes them susceptible to proxy attendance, as highlighted in [2]. Near Field Communication (NFC) technology has been extensively adopted in access control, payment, and identification systems because of its short-range secure communication and operational efficiency [3]. While prior work has demonstrated the effectiveness of NFC in multi-factor authentication frameworks [4], its application as a standalone solution in attendance systems is limited by issues such as card sharing, loss or theft, and the inability to ensure the physical presence of the authenticated user. In parallel, advances in face recognition powered by deep learning techniques, including convolutional neural networks, transfer learning, and lightweight detection frameworks, have significantly improved recognition accuracy and processing speed in controlled and semi-controlled environments [5].

Recent hybrid approaches combine facial recognition with NFC-based identification to achieve multilayer verification, where identity is confirmed through both biometric matching and NFC data validation, as explored in [6]. These dual-factor systems typically perform sequential or integrated authentication, striking a balance between the speed of card-based methods and the security of biometric verification, and have demonstrated improved resistance to attendance fraud and reliable performance in classroom-scale deployments. Collectively, the literature emphasizes the necessity of integrating NFC and face recognition technologies to overcome the inherent weaknesses of single-factor attendance systems and to develop more secure, efficient, and scalable solutions.

3. Methodology

The proposed attendance system is designed as a dual-verification framework that integrates **Near Field Communication (NFC)**–based identification with **machine learning–driven facial recognition** to ensure secure and accurate attendance marking. Each student is issued an NFC-enabled ID card containing a unique identifier, such as name and registration number, which is read using an NFC-capable smartphone acting as the reader. Upon tapping the card, the NFC module transmits the stored credentials to the backend server for validation. Simultaneously, a webcam captures the student's facial image, which is processed by a deep learning–based face recognition pipeline. A custom dataset was created by collecting student images, annotating facial bounding boxes using Roboflow, applying preprocessing and extensive data augmentation, and exporting the dataset in YOLOv8 format. A lightweight **YOLOv8n** model was then fine-tuned on this dataset to enable fast and accurate real-time face detection suitable for classroom environments. The system cross-verifies the unique ID obtained from the NFC tag with the identity predicted by the face recognition model, and attendance is marked as present only when both outputs match; otherwise, the student is marked absent. The implementation leverages the **Web NFC API** for NFC interactions, real-time video

capture for face detection, and **Firebase** for secure authentication (email/password and OAuth 2.0) and cloud-based storage of attendance records. The integrated system provides faculty-facing dashboards for login, monitoring, and attendance management. Experimental evaluation was conducted in a real classroom setting with approximately ten students over a two-week period, and system accuracy was assessed based on successful matches between NFC data and facial recognition results, demonstrating reliable performance and practical feasibility for institutional deployment.

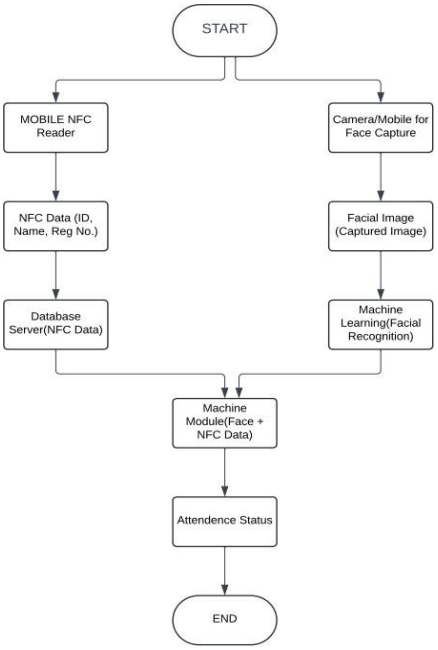

Fig1. Architecture Flow Diagram

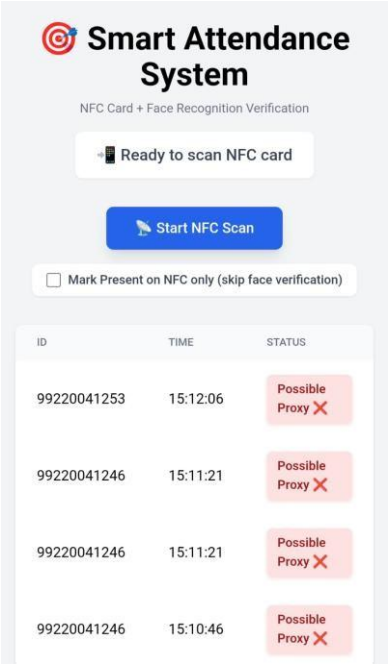

Fig2. Attendance system Working

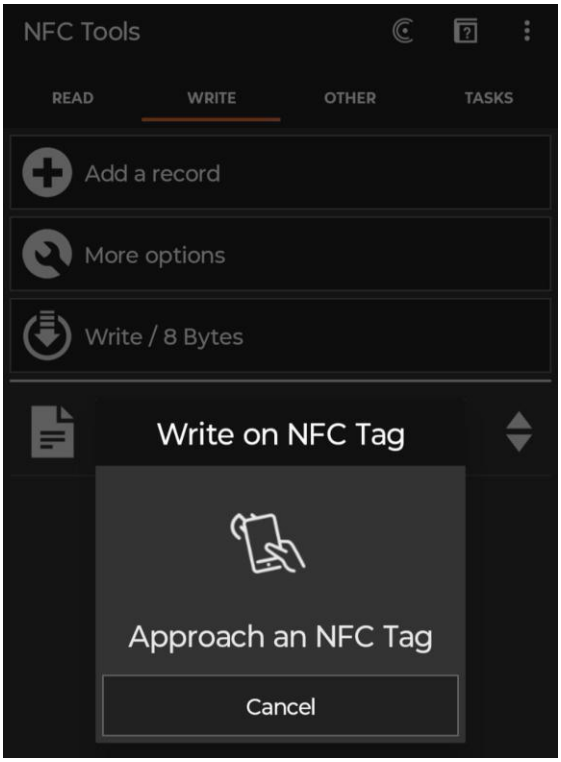

Fig 3. Writing in NFC Tag

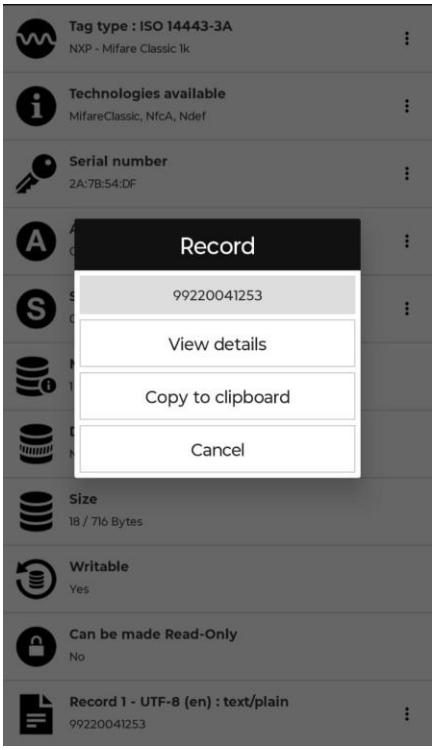

Fig 4. Reading the NFC tag

Analytics:

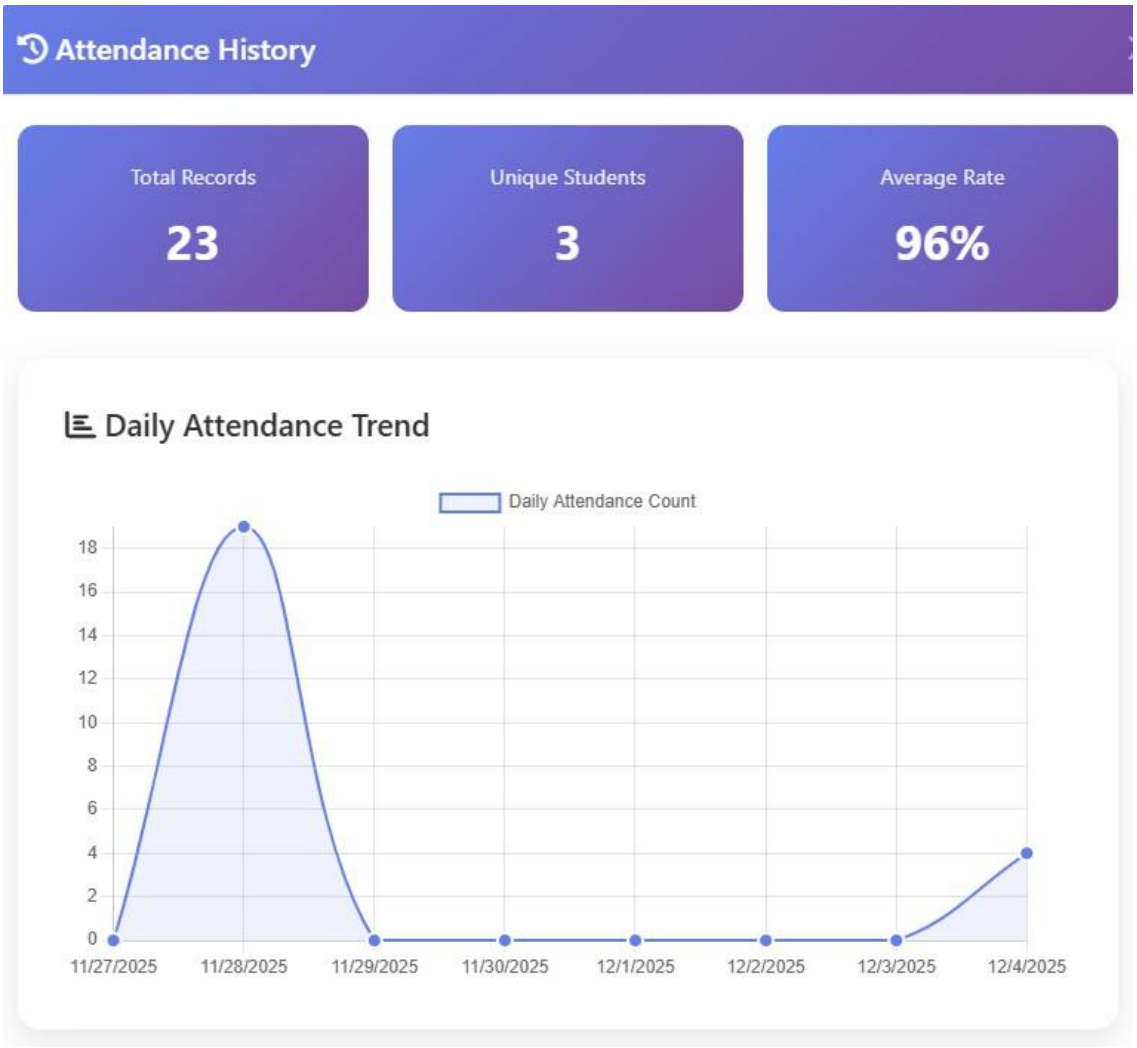

Fig 5. Analytics of attendance over the days

4. Conclusion

The integration of NFC with facial recognition further enhances both the security and accuracy of attendance systems. The proposed system prevents students from marking each other's attendance, which is a common phenomenon in academic institutions because two different factors, namely, NFC and facial features, are used for attendance marking. The drawbacks of the system, such as high setup costs and requirement of a clear view of face, have been considered, and further enhancement opportunities have been brainstormed and presented. This paper presented a novel NFC-based attendance system that combined the techniques of machine learning-based facial recognition with ID verification via NFC to record attendance. The system proposed in this paper has been satisfactorily observed to be very accurate and efficient; therefore, it can be used as a feasible option for the educational institutes of the modern days.

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