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A Smart and Automated Attendance Monitoring System

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Abstract.

One of the most basic but time-consuming activities in schools is attendance management. The suggested system also includes the practical additions of time locked attendance windows, location validation via a lightweight GPS, one-photo-per-lecture enforcement, face recognition validation by confidence, background similarity check, and randomized selfie prompts, eliminating the need to use live video streams to decrease proxy attendance. The attendance data and images of the classroom are safely stored in the cloud, and this allows transparency and verification by the faculty after the fact. The experimental results conclude that the system is suitable to be deployed on a large scale in academic institutions, as it was shown to be more accurate, has lower cases of attendance fraud, and is also more time saving than the traditional ones.

Keywords. Automated Attendance, Smart Attendance System, Facial Recognition, Artificial Intelligence

1. INTRODUCTION

Attendance administration is a crucial administrative activity in educational institutions because it bears direct implications for student involvement, discipline, and schoolwork involvement. This is despite its importance because attendance is usually taken by manual roll call, which not only wastes lecture time but also is subject to error and manipulation by human beings. To eliminate these shortcomings, schools have embraced semi automatic methods like RFID cards, Biometric scanners and mobile applications of attendance. Nonetheless, these systems bring about additional problems such as high cost of infrastructure, hygiene issues, device dependency and susceptibility to proxy attendance by sharing cards or spoofing. Even face recognition systems have a way of being abused unless proper validation mechanisms are put in place. The students can also seek to provide the images that have been precaptured, to attend remotely or take advantage of system loopholes. Thus, the optimal smart attendance system should be a combination of automation and realistic limitations that will promote authenticity without losing functionality. The present paper suggests the Smart Attendance System based on the Classroom Image Recognition that would be implemented on a mobile application. When a faculty takes a single classroom photograph during a predetermined lecture break, the system will record attendance without any video detection, thus removing the possibility of live video detection. In order to enhance authenticity, the system incorporates time-locked attendance windows, lightweight GPS-based location verification, one-photo-per-lecture

enforcement, face recognition through confidence, similarity analysis of backgrounds and randomised selfie prompts. All images and attendance records of the classroom are safely placed on the cloud, which allows transparency and post-checking by faculty. The proposed Smart Attendance System provides an efficient, transparent, and robust solution to the traditional attendance systems.

2. RELATED WORK

A number of research works have been conducted on automated attendance systems based on alternative technologies to minimise manual labour and enhance precision. The RFID-based systems are quicker in payment of attendance, but they need specific hardware and are still susceptible to proxy attendance via card sharing [1]. Biometric systems (fingerprint or iris scan) are more effective in identity verification, but require a high cost of installation, hygiene issues, and cannot be expanded to large classrooms [2]. Face recognition-based attendance systems are becoming popular with the development of computer vision, since they are non-invasive. Conventional methods based on Haar Cascade and Local Binary Pattern Histogram (LBPH) are satisfactory in a controlled setting but fail in adverse lighting conditions, occlusions and pose changes [3]. Very recent deep learning approaches, such as CNNs, FaceNet and ArcFace, are more accurate and robust, but most of them use fixed camera systems or video streams, which raise their computation cost and raise privacy concerns [4], [5]. Attendance systems based on mobile phones with GPS or Wi-Fi are flexible and have fewer infrastructure demands, but can easily be spoofed by their location and abused by misusing a device [6]. In general, solutions that are in place have issues of proxy attendance, privacy and scalability. These shortcomings encourage the necessity to have a single-image, mobile-first attendance system with inherent anti proxy capabilities, which the proposed solution will assume.

3. PROBLEM DEFINITION AND MOTIVATION

3.1 Problem Statement

Attendance processes that are manual, e.g. roll calls, use up precious teaching hours and disrupt the normal teach-back process. Such techniques are also subject to the human factor, such as wrong marking and deliberate distortion. The larger the size of the classes, the less viable and easier to track attendance manually. Such challenges were met by hardware-based attendance systems such as RFID cards and biometric scanners that bring about new restrictions. RFID-based systems also involve extra infrastructure and are vulnerable to proxy attendance by sharing of cards. Biometric systems are more secure, but they are expensive to install and maintain hygienically, and they have problems of scalability, especially in large classrooms where the students are dense. The above restrictions are the reasons why a smart, reliable, and scalable attendance system is required, which reduces dependency on infrastructure but ensures accuracy, authenticity, and transparency.

3.2 Proposed System Overview

The Smart Attendance System proposed is a mobile first-based solution that can be used to automatically mark attendance by taking pictures of the classroom. The system works by enabling faculty members to take one picture of the classroom through a mobile application when a specific lecture time frame is within a preestablished period. The image acts as the key to the attendance processing, and as such, it does not require constant video monitoring or fixed cameras. After capturing the classroom image, an AI-based face detection and face recognition algorithm is applied to the picture to recognise the students attending the classroom. The recognised faces are matched with a student database that is previously registered, and attendance is automatically recorded depending on the confidence of the recognition. To improve credibility and eliminate misuse, the system will incorporate various verification functions, time limits, location checks and environment check consistency. All the registration data and other related images of classrooms are carefully saved in a cloud database. The faculty members will be given a verification dashboard where they can access attendance outcomes, deal with suspicious situations, and produce attendance reports. Faculty Dashboard of Verification and Reporting: Enables teachers to check on pending cases, fix wrong classification and produce attendance reports that can be used by the academic staff and administration.

3.3 Key Improvements and anti proxy mechanisms

The proposed system has a number of phone-based limits to curb the fraudulent practices and overcome the limitations of the current attendance systems. A. Time-Locked Attendance Window: Submission of attendance is only allowed within a preset lecture period, such as the first 10 minutes of the session. After this time window expires, the system will automatically block the marking of attendance. This system averts late submissions and remote proxy attempts to make the attendance a representation of the classroom attendance. B. Lightweight Location validation: The system confirms the position of the mobile device used by the faculty via GPS at the classroom capture image. The place must not exceed a given radius outside the classroom, or one is not permitted to attend. In order to support the principle of privacy, this strategy will maintain the physical presence despite the permanent location tracking, therefore reducing location-based fraud. C. One-Photo-Per- Lecture Rule: The system is one photo-per-lecture to deter the abuse of the system by submitting the same picture several times or swapping the image. The image of a classroom can be uploaded once per lecture session in order to have consistency and integrity in the attendance data. D. Face Recognition based on confidence: The face recognition module computes a score of similarity of each detected face, and this score is used to identify the attendance status: 90 per cent.: Automatically set to Present. 700-900: Considered as a waiting faculty review. < 70%: Marked as Absent. This hierarchical level of classification balances the position between 100 per cent automation and human analysis to enhance the overall reliability and reduce false positives. E. Background Analysis: Analysis of similarity. To make the system more realistic, background similarity checks are performed, and the visual features that can be compared include wall color, classroom boards and seating arrangements.

4. **METHODOLOGY AND EXPERIMENTAL RESULTS**

The faculty opens a session and takes a picture in a classroom during every lecture with a determination of a time period, which guarantees the availability of real time and valid attendance input without round the clock monitoring. The picture takes through the process of face detection on AI and then face recognition using deep learning, which detects all visible faces regardless of any changes in lighting or position and then compares them with the existing embeddings to produce similarity measures. With these scores attendance can be marked- high-confidence matches are marked present, borderline cases will be marked to review, and low-confidence matches will be marked absent, which further validation, such as location and background checks, will prevent proxy attendance. Lastly, all the information such as attendance records, images, and timestamps and logs are stored in a cloud-based platform allowing real-time accessibility, scalability, and automated report generation to be reviewed and integrated by the faculty with institutional systems. The system has been experimented with in the classroom setup with 20-50 students. The system has been experimented with in the classroom setup. The results indicate that under normal conditions of light, recognition is about 95 per cent. Within a few seconds, marking attendance was done. A major decrease in proxy attendance because of the combined vetting systems. Little faculty intervention was needed.

5. **CONCLUSION AND FUTURE SCOPE**

This paper has discussed a Smart Attendance System that uses classroom image recognition as a mobile app to make the process of marking attendance automatic. The system has a balance of accuracy, privacy and scalability by incorporating realistic anti-proxy technologies and evading live video processing. The positive effect of the research is confirmed by the improvement of efficiency and the decrease in attendance fraud. Future directions involve the improvement of recognition accuracy in the presence of occlusion, the incorporation of an attendance analytics dashboard, and a multi-class scheduler, as well as privacy-conserving AI methods.

6. **REFERENCES**

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Biographies



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