A Low-Cost Portable Smart Card Based Attendance System

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Abstract. Managing attendance may be a vital record-keeping activity in any institution. There are different methods of maintaining the attendance from manual system where attendance is marked in sheets to automated attendance on the likes of biometrics. The combination of frequency Identification (RFID) with fingerprint biometric technology was to enhance the safety level and integrity of the records. The designed system not only makes the system design simpler but also enhances the productivity of the institution both in terms of man power and time. The system doesn't only simplify the method of taking attendance but reduces error and allows for faster verification of student attendance, all with minimal human interaction. This technique will help the authorities manage the attendance system in a more organized, efficient and time saving manner. The planning of the system is straightforward and portable making it an honest candidate for commercial and academic purpose. A GUI based version and app-based version has been designed to make the system both PC and mobile friendly. The system is built with various levels of access permissions and security. The system was tested for a small group of 100 students and was found to provide accurate marking of attendance for all users.

Keywords: Biometric, RFID Tags, Fingerprint, Smart card, Autonomous system.

1. Introduction

Attendance is a very significant criterion in many organizations, and it is used for different reasons. The reasons are varied as ranging from maintaining of records, assessing grades to promoting adequate and reliable school attendance. In the majority of schools, a minimum percentage of attendance for a class is required before students can sit for an examination. But due to the lacunae in the existing schemes of manual attendance monitoring, this requirement is many a times flown in air. The conventional way of monitoring attendance envisages to mark signature manually each and every time a test or a class is conducted. System like the one discussed is lagging in its functionality and hence leads to multiple causes of failures. Excessive time needs to be spent by each student in locating their names in the attendance sheet and then signing. The system also leads to increased rate of impersonation. A foolproof system capable of eliminating all these above-mentioned issues is the need of the hour.
RFID ensures a wireless medium of communication between a reader and a tag or multiple tags making use of EM waves. Multiple systems [21 - 28] are available in literature that makes use of RFID based card systems for attendance entry to keep the process simple and hassle free but all fails on a single front wherein impersonation cannot be eliminated.

The problem of impersonation has created a new dimensionality to the process of automated attendance management. This has led to the conception of a hybridization of techniques. An additional level of access scheme employing biometrics will play out an enhanced security measure. The process of hybridization ensures that the advantages of both schemes are leveraged effectively towards the better design of the system. The combination of frequency Identification (RFID) with fingerprint biometric technology was to enhance the safety level and integrity of the records.

The proposed system is aimed at designing and implementing a new hybrid approach in automating the attendance management process. The design is built around RFID and fingerprint-based access schemes. RFIS ensures easy hassle-free access whereas fingerprint ensures that impersonation is kept at minimum. The proposed design had been utilized for automating attendance management in an examination hall. The attendance details are collected through the portable device and then transferred through the server, thereby updating those attendance details to the website that we had created.

1.1. Fingerprint based technology

A portable attendance system was introduced using the GSM Network with Fingerprint Technique to control and monitor student attendance and to send a list to student parents [1]. Talaviya et al., have proposed hybrid structure involving Zigbee and fingerprint to monitor and record student attendance at a university [2]. Yadav et al., presented and introduced a compact attendance system for fingerprint detection [3]. Kamaraju et al., also introduced time sensitive and cost-effective solution for workers’ attendance in an industrial plant using Zigbee and biometrics [4]. Zainal et al., showed that design and development of the attendance monitoring and management framework using fingerprint technology and Arduino microcontrollers provided a safe and compact solution method [5]. Potadar et al., have proposed to register, control and report student attendance using a fingerprint technique to minimize the likelihood of error-related attendance tracking for academic sectors [6].

1.2 QR Code based Technology

Rakhi Joshi et al., have proposed a smart learning and attendance system by implementing a QR code-based access to a central server built with .Net and visual studio technologies. An android based app is also created which allowed students to access contents from anywhere and anytime. The system also provided for attendance report generation both to parents and individuals as messages [8]. Nath & Mukhopadhyay have proposed a mobile-enabled on-line attendance system [9]. Noor et al., have proposed Android-based application to take, handle student attendance records by using camera system as sensor [10]. Buddhwant, have presented Android based and GPS application for attendance monitoring of students [11]. Dinesh Kumar et al., have proposed smart phone-based attendance system for employees in which the QR Code is used as an identification proof. In Future this method may implement in academic for proper maintaining of the attendance recording management [12]. Emmanuel C et al., have presented an offline Identity Card authentication System using QR code, Smartphone is presented as solution to authenticate the bonafide student of tertiary institutions which results in faster authentication [13]. Jacob et al., using NFC mobile attendance system, launched an attendance control system for university students [14].

1.3. Barcode Based Technology

Y. K. Saheed et al have proposed an attendance management system using barcode which is to be printed on the student’s identity card. By scanning their card in the device, the attendance of the student is updated, which results in reducing effort on paper work and it saves the valuable time [7]. K. Lakshmi Sudha et al., had developed an attendance management for the students while entering lab
using barcode scanner which helps the teacher to maintain a registry book [5]. P Rahmah Al Sheikh et al., have proposed barcode-based attendance management using a unified modeling language which then helps in maintaining the details of the students [15].

1.4 Bluetooth based Technology
Vishal Bhalla et. al., have presented a Bluetooth based attendance system which is a method of taking attendance using instructor's mobile telephone. It is paperless, quick, and the student entries can be confirmed [16]. Kumar & Kumar have developed a system to track, track and locate students on campus using a novel Bluetooth Face Recognition feature [17]. Tiwari et al., have a student attendance system based on GPRS which the lecturers can easily access through the internet to verify and track attendance tracking for their students [18]. Idachaba F.E et al., have designed a system which identifies the user using his fingerprint and the data is sent to a database using the Bluetooth for large halls and auditorium [19]. Riya Lodhaa et al., have designed a system utilizing radio frequency and microchip-based techniques to create a secure environment for inventory management. The advantages incorporated in the system are low power consumption and high data transfer rate [20].

1.5 RFID based Technology
Patel et. al., proposed an intelligent system to record students’ attendance in real time which results in low time consumption [21]. Singhal et al., proposed a design using RFID tag identification along with a SMS capability [22]. Arulogun O. T et al., proposed a solution to attendance monitoring of lecture hours by a coordinated approach involving handshake between RFID tag and reader with a central PC [23]. Chiagozie, & Nwaji, proposed a door system based on RFID technologies to handle time-attendance [24]. Arbiain et al., proposed an attendance system for automatically tracking/managing pupil attendance in laboratory settings using RFDUINO method [25]. Kurniali, built a student attendance management system using RFID to control student engagement in an Indonesian university with a web-based approach [26]. Yuru et al., created a participant inspection system based on ARM and RFID technologies has been developed [27]. Yadav et al., presented to students and teachers an automated attendance management system that sends alerts to parents via GSM. [28].

1.6 Face Recognition based Technology
Mekala et al. implemented a face recognition-based class attendance monitoring system that relies on Principal Component Analysis technique of classification [29]. A detailed comprehensive survey on the attendance systems in literature classified based on the techniques is presented by Vinod V.M. et al.,[30]. A face-recognition based attendance system is introduced by using DIP and a Euclidean distances filtering system by A. Cathrine Joe Silvia et al., [31]. Wang et al., developed an Automatic attendance method with two Faster Face Detection and SeetaFace face recognition algorithms built into the deep learning algorithm. [32]. Khatun et al., have an educator implemented and introduce an Iris recognition method for tracking and handling participants and have submitted a report in the programming environment to the predefined e-mail address [33]. Eigen face and Principal Component Analysis is found to improve face recognition rate and accuracy as is evident form the work proposed by Wagh et al., [32]. Sayanekar et al., have an NFC technology and face recognition technique developed for the biometric attendance control system introduced for student monitoring and recording at different campus locations [34].

2. Methodology
The proposed system uses the RFID Tag and Fingerprint sensor for marking the attendance of the students. In the proposed system, a database of all the students admitted is collected from the admission details and another biometric database is also appended to it. The students’ attendance in the examination hall is taken by either scanning the tag or by using fingerprint of the student using the portable device designed for attendance management. The components of hardware, such as RFID
Tags, RFID Scanners, fingerprint scanner, Raspberry pi and LCD Displays, used to simplify the assistance device for students to monitor their attendance and for exam marking. If the student’s RFID Tag or fingerprint is read by the system, automated attendance marking will be performed on the local host. As and when the entire attendance of the hall/class is noted, the report is uploaded to the server from the host by the concerned administrator. Bulk upload of report is advisable as it reduces the data transmission as well as improves security. At the server end, the report can be accessed for storage and retrieval by the competent authorities.

Figure 1. below represents the block diagram of the attendance system in which the raspberry pi is interfaced with RFID Reader and Fingerprint sensor and LCD. After scanning their tag or fingerprint in the device, the attendance of the students will be updated in the website by the authenticated person.

Figure 1. Block Diagram of the Proposed Attendance Device

Figure 2. below represents the flow diagram of the attendance system. After scanning their tag or fingerprint in the device, the students tag number and fingerprint is compared with stored value. The students will be marked as present when the stored value is matched with the scanning value or else it will be marked as absent. Finally, the attendance of the students will be updated in the website.
Figure 2. Flow diagram of the proposed attendance management system

The process flow of the designed device setup is given below as vivid steps:

- The RFID Reader is fixed in the device which is used to scan the RFID Tag of the students.
- In Addition, Fingerprint sensor is available in the device which is used to scan the fingerprint of the student.
- Either scanning their Tag to the Reader or scanning their fingerprint to the fingerprint module, the attendance of the students is marked as present.
- After the scanning process is completed, the request is sent to the server to update the results to the corresponding website which is under the control of the admin.
- The attendance of the students is updated on the website with corresponding date and time.
- The attendance report of the student can be exported as a spreadsheet.

The designed system can switch over between two modes – RFID and fingerprint seamlessly and hence provide a fail proof authentic attendance system as compared to the existing models. Raspberry pi can double as a hosting platform for the web UI.
Figure 3. Hardware prototype

3. Results

Webpage creation and Online hosting is performed on https://somee.com. As a free .NET Hosting. It provides a storage capacity of 150Mb and the monthly transfer of 5Gb. Figure 4, shows the designed login page for the attendance portal. On successful login, the user is navigated to the registration page as shown in Figure 5. The basic details of the student may be fed in this page. The option is also made available to make bulk registration of students by the competent authority.

Figure 4. Login Page.
Registration page allows each student to update his basic details. Provision for biometric storage and cloud access is built into the system.

The administrator is provided with the privileges to view and edit the details of each user as shown in Fig. 6. Varying levels of access is provided depending on the user or administrator privileges. Interactive GUI enables updation of user account with ease. Bulk upload of data feature is also provided.
As and when a fingerprint scan or an RFID tag is read, attendance field for the particular student gets updated in the central server. This updation is made semi-autonomous with the faculty concerned having to authenticate the process. This provides a two-level authentication keeping the issue of malpractices to a minimum.

As discussed earlier, the designed system is a hybrid structure with two authentication modes namely RFID tag and a biometric scan (fingerprint). This hybrid nature of authentication ensures that the right student takes up the exam and there is very little space for forgery. Moreover, the provision of authentication/ approval by the faculty ensures impersonation is kept to the minimum or null. Fig 8 shows the two modes of access from the designed system.
Finally, for documentation and such purposes, the attendance details can be exported as a sheet in .xls format. Facility to include multiple formats is also being worked out. Report generation of any day and any session can be accessed with ease by the administrator.

4. Conclusions

The designed system offers many advantages as against the existing manual attendance system seen in exam halls. Though various authentication schemes are proposed in literature, they remain as papers and no tangible product/solution is seen in real world. Our design is portable and a cost-effective solution. The system helps in avoiding the human errors and proxy punching. It provides persistent and protected storage. It has put an end to the tedious process of maintaining a log book for attendance and at the same time it has saved 10 to 15 minutes of time that is been previously spent on taking attendance during the exam time. This system can be implemented instead of traditional attendance system. It can be implemented in both schools and colleges as an effective means of taking attendance which leads to less time consumption and cost effective.

Improvements on the GUI and android based app are to be carried out to make the system attractive and acceptable to the user. Application of security protocols also needs to be worked out.

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