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Next-Generation Smart Attendance System Based on RFID and Face Recognition

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ABSTRACT: Attendance is an important factor in ensuring good quality education. Hence monitoring attendance of students is an important task in any classroom. In this work, we have designed a system for efficient attendance monitoring using face recognition and RFID. The system is completely automatic. This system can be used to take attendance, store the attendance data, and provide access to the data efficiently and quickly. This simple and inexpensive system is a good candidate for academic purposes.

KEYWORDS: RFID, Face Recognition, Internet of Things, MFRC522, Raspberry Pi.

I. INTRODUCTION

The attendance of students is a parameter of prime importance in every educational systems like colleges and schools. Though many argue that a student can learn and pass examinations without attending the class just because abundant resources of knowledge are available at the fingertip due to the advancement in technology, nothing can match to physical attendance in the class. Because no technology can provide the values and knowledge that a student acquires from a teacher. Hence attendance is made as a mandatory factor in an educational institution.But, the conventional way of taking attendance has several disadvantages. Either the roll number call or passing an attendance sheet are the two common methods of taking attendance. These are definitely not effective ways of monitoring attendance. Passing of attendance sheets to a very largenumber of students is a difficult task. Also, it hinders the attention of students. Also, the students can mark the false attendance of absentees.Similarly, a roll number call method is so time-consuming. The time required to take attendance increases as the number of students in the class goes up. Also, in a crowded class, there are chances of calling false attendance intentionally to help absentees. In both the methods the data is stored as hard data. This increases the chance of the data getting tampered. Also, there is a chance of data getting lost. So, we need to develop a system which can overcome all these disadvantages. For that, the system must be automatic in the first place. Further, with the help of different technologies, we can achieve the goal of efficient attendance monitoring. The prime objective of this paper is to discuss the design of such a system.

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II. RELATED WORK

Most of the systems that are existing today for monitoring classroom attendance employs only a single technology. And this poses so many challenges for them. The cost of fingerprint reading systems is pretty high. Also, the portable fingerprint scanner can be used only by one student at a time. This makes it a time-consuming process [1]. If we fix or mount the finger recognition device at the entrance of the classroom,the students need to move from their seats towards the reader everytime the attendance needs to be taken. This needs a lot of time. The RFID based systems take attendance by reading the RFID tags [2]. So the students may indulge in fraudulent methods by reading their friend's card. The disadvantage of Bluetooth based systems is that each student should possess a Bluetooth device [3]. Also, the students who are within the Bluetooth range but not in the class can also get attendance. The QR code based system also faces a similar challenge. A student can secure his attendance using an image of the QR code sent by his friend [4]. This image can be taken when the teacher projects the QR code for the whole class to scan. When face recognition is used alone it always keeps the accuracy at risk [5]. Moreover, most of the systems do not have a cloud-based service to manage and access the data online. In this era of the Internet of Things (IoT), such a feature is a must in any system [6].

III. METHODOLOGY

The system uses three different technologies to achieve the desired result. They are Radio Frequency Identification technology (RFID), face recognition and Internet of Things (IoT). The attendance monitoring process involves detecting the RFID tags of students in the class using a long-range RFID reader and then confirming the identity using face recognition. The teacher can control the system using a GUI provided in his phone or PC. The system will generate the list of students who are present and absent in the class. This data is then uploaded to a server from which both the students and teachers can access this data anytime. All the students are given an RFID tag mounted identity card. Possession of this identity card is mandatory to secure attendance. The data regarding the id card and face data of individual students have to be stored in a database at the beginning of the academic year. It is this database that is used for comparison and awarding attendance.

A. *Radio Frequency Identification technology(RFID):*

Radio Frequency Identification technology or RFID technology is a wireless method of data capturing and transmission. It uses radio frequency. This technology can be used for both short range and long range applications. Product authentication and identity verification are examples of short-range applications. Tracing and tracking are examples of long-range applications. One of the important benefits that RFID technology provides for this system is that it does not need a line of sight alignment for working. This makes RFID technology a suitable candidate for this system. Cost-effectiveness, accuracy, and simplicity also led to the inclusion of RFID technology into the system.

An RFID system consists of a reader and a tag or a number of tags. The tags are of two types-active and passive. We are using passive tags here. Passive tags do not require a power source. The tag antenna receives the power sent by the reader and sends back the tag's id.

B. *Face Recognition:*

Face recognition technology is used to identify a person from his face. Certain features of human faces are extracted and stored. These features are used to compare different human faces and confirm their identity.
The basic steps include;

- A picture of a face is captured from a photo or video. The face might appear alone or in a crowd.
- Facial recognition software reads the geometry of the face. The key factors include the distance between the eyes and the distance from forehead to chin. The software identifies the facial landmarks that are key to distinguishing the face.

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- The facial signature (a mathematical formula) is compared to a database of the known face.
- A determination is made. The faceprint may match that of an image in a facial recognition system database.

Many tools are available to implement face detection. In this system, we use OpenCV for python for implementing face recognition.

C. *Face Detection*

The detection of face is implemented using the Haar Cascade Classifier. It is a classifier available in OpenCV for object detection. It works on the principle of Haar wavelets. The training data used for training the classifier is *haarcascade_frontalface_default.xml.*

D. *Feaature Extracton and Matching*

Scale Invarient Feature Transform or SIFT [6] algorithm is used for extracting the desired features from the images which are later used for comparing with the test image. A feature matcher is designed to compare the test images with the database. Fast Library for Approximate Nearest Neighbour (FLANN) [7] is used for this purpose. It performs fast approximate nearest neighbor searches in high dimensional spaces.It will match the features from the sample image with the test image from the webcam.

E. *Internet of Things (IoT)*

Internet of Things (IoT) is the current hot topic the world is discussing. It creates a network of devices that can process, send and receive data. It is the extension of Internet connectivity into physical devices and everyday objects. In this system, to make the attendance data available to students and teachers anytime we use the possibilities of IoT.

The architectural design of the system is given in Figure.1. A Raspberry Pi 3 board is used as the main computer that controls the system. The source codes for the different modules of the system are stored in the Pi. The Wi-Fi connectivity of the board enables the transfer of data to the server. A near field RFID reader MFRC522 is employed in the prototype we made. The reader is controlled using an Arduino Uno board. The Arduino will transfer the tag data read to the Raspberry Pi.

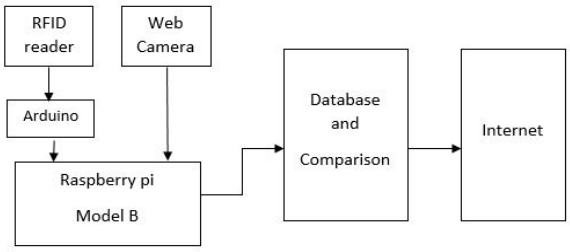

Figure 1

The pi directly runs the program for face recognition. A camera is interfaced with the pi which takes the image of the students. We use the haar-cascade classifier provided in OpenCV for face detection. It detects the faces in an image frame. The features of individual faces are extracted using the SIFT algorithm. The face region alone is cropped from every face and saved in a database. During face recognition, when a test face is detected, its features are compared with the faces stored in the database. Then if the RFID data and the face data matches, then he/she shall be marked present. Both Absentees and present students are added in separate text files with the date on which the attendance is taken. Thus attendance of each day can be analyzed faster. Then the attendance data is hosted in a local server.

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IV. IMPLEMENTATION

The seating of the students inside the class has to be designed accordingly to suit the efficient working of the system. We recommend the total seating to be divided into small blocks such that each block accomodates two students. A unit of the smart attendance system,which contains a rfid module, a face recognition module and processing unit , is mounted on the top of the desk of each block. So the students in each block can use them to scan face and tag. This saves a lot of time. Data from each units from different blocks are to be stored in a centralized server.

V. RESULTS

The prototype of the Smart Attendance System has been successfully implemented. The prototype has been designed with the capability of monitoring the attendance of two people. The system is used to update the database and also to take the attendance of the class. The GUI is shown in figure 2.

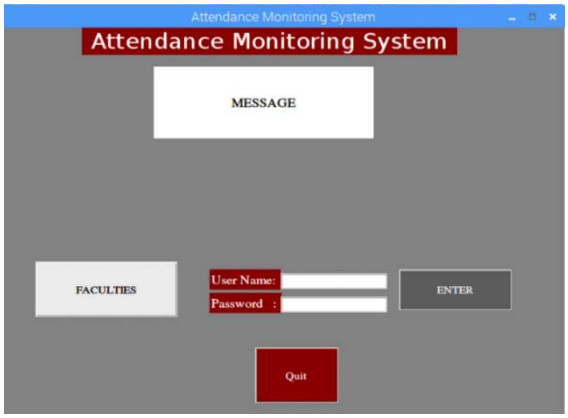

Figure 2

When we open the GUI, it asks for a username and password with which the faculty can log in, in order to update or add student details. Each faculty will have their own id and password. After logging in, it will take us to an admin mode window as shown in Figure 3.

Figure 3

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To add or change the database, type the student name at the space provided and click on 'Database'. Then the system will ask for RFID and face data. Once we provide those data, the database is done. The face data of the students will be stored in a folder called "database". To take the attendance, click the 'Faculty' button on the window shown in figure 4.1. It will then take us to a window called database. The window is shown in Figure 4.

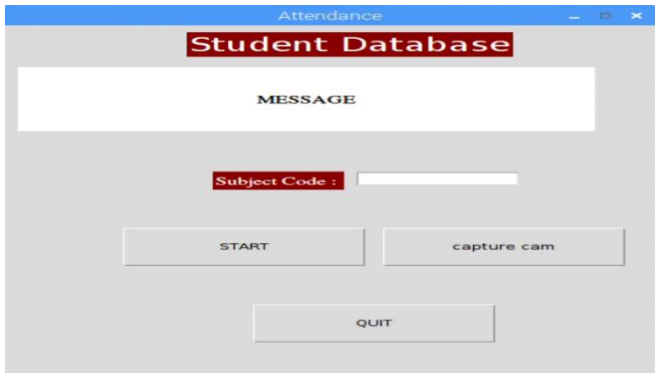

Figure 4

We need to enter the subject code and click 'start'. Then the system will start taking attendance and store the data of students who are present and absent in separate .txt files. Then the attendance data is hosted into a local server through which all connected devices can view the attendance. The concept of the local host can be extended to a webpage with more functionalities. A sample HTML page is designed and is shown in Figure 5.

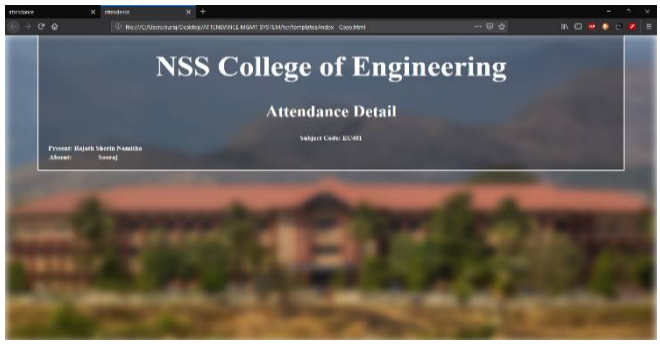

Figure 5

VI. CONCLUSION

The present paper proposes a real-time attendance monitoring system based on RFID technology and face recognition. The system takes attendance by reading the RFID tags embedded in the student ID cards and then validates the attendance through face recognition. This ensures a kind of double checking strategy that eliminates fraud attendance markings.Face recognition is implemented using haar-cascade classifiers and a matcher developed using SIFT and FLANN algorithms. This system has a user-friendly GUI which makes it easy for the user to operate the system. It also provides the attendance data in a portable format. Moreover, the data is uploaded to the server from where the teachers can access the attendance details of the students at any time from any place. Students and their parents can also know their attendance status. By using a more powerful and dedicated processor the efficiency and speed of the system can be increased. By replacing the near field RFID reader with a long range reader that can detect multiple tags, we can develop the system into a completely automatic system that does not interfere in student activities

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while taking attendance. Additionally, the face recognition mechanism can be made more reliable by using more efficient algorithms of deep learning and by using more advanced camera modules that provide more precise images.

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