Face and Bio-Metric Based Attendance and Security System using RFID and Arduino

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Abstract: We are proposing a system of employee attendance & security system using face and Biometric integrated with Smart RFID cards using Arduino. With this proposed system the drawback of existing RFID attendance system such as dual or multi entry with single card or miss use of the cards can be prevented. The existing RFID based attendance system has been enhanced with the integration of face recognition of the particular employee with his unique employee number. With integration of finger print authentication (Bio-metric) into the system, security has been enhanced. Audio welcome message on the valid Employee attendance registration has been introduced & for unauthorized entry Audio alert has been introduced along with Sound Alarm (buzzer).

Keywords: Arduino, Face Recognition, Finger Print Recognition, Smart Cards, RFID, Audio, Security.

I. INTRODUCTION

Face based recognition of the people is very helpful to ascertain their identity. Many papers have been proposed related to RFID and finger print based attendance system. We are integrating the face recognition techniques and hence proposing a prototype which will not only be helpful for attendance recording and tracking but also it will enhance security.

We are proposing a system in which the employee data is created in the company or any other institutional database. The photo will be uploaded into the database as well. First we need to detect the faces from the live video streaming from the camera. Using suitable face recognition algorithms, the face matching is done with the employee when he enters into the campus from the live video captured by the cameras. This step acts as first layer of security for the sensitive places. If match of the face does not happen then alarm gets triggered & security guards will take action.

If the face of the person entering campus matches with the available database, his Bio-metric finger print authentications is taken. If the finger prints match then an automatic attendance update is done with respect to his employee ID card number found in the database with the entry time & date details. Every time he needs to swipe his ID card both for gaining access into the campus as well as while exit.

With this kind of system we can restrict the unauthorized use of ID cards as we are using face recognition technology too in the proposed system. Dual or multi people entry with single access card too can be prevented.

With the help of the Finger print based bio metric authentication, we can add multi-layer security system to the concerned sensitive secure research establishments. Finger print based attendance is common now a days in all institutional and research establishments. In this paper we will focus on face based authentication with bio metric system.

A. Technical Background

We can refer figure-1 for the block diagram. We use Arduino UNO microcontroller here. With the help of Max 232 converters the serial communication between PC or Laptop and Arduino UNO takes place. Finger print sensor and RFID reader has been interfaced with the Arduino. RFID tags with unique tag number have been used as Smart ID cards for the employees. In this prototype the inbuilt webcam has been used. In depth details about the components used have been omitted as it is considered to have readers the technical knowledge about the same.

B. Proposed Solution

When an Employee tries to gain entry into the campus, he is asked to swipe his ID card.

Web camera captures the live video & the frames from the live video are processed for the face detection first. As face detection is the first step towards the specific employee face recognition. Once face is detected, then the face of the employee captured is matched with the face of the concerned employees face photo already present in the database which has been tagged for the particular employee ID number. Once all the parameters match then the left hand thumb finger print is taken and it is also checked for authentication. If found matched then the Attendance is marked in the file with the log in details.

II. PROPOSED SYSTEM
Now a days we come across finger print based attendance system. In the proposed system we have integrated the advantages of RFID and Bio-metric with the face recognition techniques, thus providing a three layer full proof security system for any sensitive establishments.

Fig1: Block Diagram of Proposed Face & Bio Metric Based Attendance & Security System

The block diagram has been given in figure-1. Inbuilt webcam along with speakers of the PC or laptop has been used along with other hardware components.

We have tried to minimize the hardware components by directly interfacing the Arduino with PC. For Sound we have used the inbuilt speakers.

III. IMPLEMENTATION

Whenever the employee enters the campus, he is required to swipe his/her issued Employee ID card from the company. The camera has to be placed near the entrance. When the employee swipes ID card number and ID number does not matches with the database then a voice based alert is issued through speaker & security is alerted. The warning alert message is also displayed on display devices.

When the employee swipes ID card number and ID number matches with the database then his face photo captured from the camera is checked for face recognition or face matching with the already existing face photo of the employee from the company database. If the face matches with that present in the database then face matched message is displayed on screen and the employee is asked to enter his left hand thumb impression on finger print sensor. Once the finger print matches with that present in the database which has been tagged to the particular employee ID number then an audio based voice welcome greetings is played and also welcome message displayed on the display device. We should note that finger print of valid employee trying to give attendance to his colleagues Employee ID will also trigger alarm as the finger print is tested first for valid finger print from the database & if found then its specifically tested for the tagged ID. Thus if employee tries to give proxy then also he gets caught.

As discussed above only for valid scenario, Attendance is marked for the employee with the entry time & date details & entry gate is opened for the employee entry. If the scenario is for a valid id card but the face is not matching with that of the present in the database for that particular employee number then an alert is raised via speaker & also warning message is displayed on the display device. Security is immediately alerted through this & hence intruder will be captured by the security people. Thus to record the attendance Employee needs to go through three stages of verification such as Valid Employee ID card, face matched then finger print matched. Once these parameters are passed then only the Attendance will be recorded with entry details. Welcome Audio is played and gate is opened & then closed automatically. When the employee exits then he should swipe his ID card then the exit time is recorded & exit door is opened.

Thus even if the intruder successfully gets in using the Valid Employee ID card, with the help of face recognition & then Bio-metric authentication he gets caught.

A. Hardware Implementation

Whenever an employee enters into the campus, near entry gate camera, display will ask for RFID tags (ID card) to be displayed or swiped on RFID reader. Once swiped his ID card number & other details are fetched from Arduino into PC database. From PC database his existing uploaded photo of the face is matched with his live face photo detected from the live video using web camera. Once it is established that the face matches with the one existing in database then employee will be allowed into the campus by opening entry gate. Then in the main gate he will be asked to authenticate his finger print. Once left hand thumb finger print also matches then Voice greeting heard via speaker which will welcome the employee. Employee attendance will be marked with entry time & date details.

If the person’s photo is not matching with the given ID card number, then unauthorized entry warning will be issued using speaker & display device as well.

If the Person carries another company ID card, not belonging to the establishment, then it will give out warning that card number is not found & security will be alerted if it is done by a valid employee as well.
The screenshot of the hardware implementation of the proposed systems is as shown in fig. 2.

**B. Software Implementation**

For the implementation purpose we are using languages such as C, C++ along with python. Ubuntu has been used as the operating system as its open source.

The suitable drivers are installed to make the serial communication happen between the Arduino Uno and the PC or laptop.

For serial communication python’s PySerial library has been used. Finger print sensor and RFID Reader has been interfaced with Arduino. UNIX commands have been used in terminal for execution of program.

**Flowchart**

Let’s look into the flowchart of the proposed system. Initially all the hardware components are initialized. RFID reader reads the RFID tag details. If the tag number (ID number) is not present in the database then an alert is issued. If the tag number matches with that of the database then Camera starts capturing his face photo & the system starts processing it. Once the face is recognized to be that of the valid employee, then a voice based greeting is played & entry gate is opened else security is alerted.

**IV. RESULTS DISCUSSION**

Table 1 is the list of Employee data which has been used in the project. The unique tag numbers has been used as the Employee ID number. These tag number have been tagged to the employee name. Then finger print template details has been captured along with the face photo and other details. These will be stored in the database by tagging to respective ID card numbers.

Whenever Employee ID card is swiped in the RFID reader, the tag number captured will be used to search that particular employee. His photo will be captured and then it is matched with the one available in existing database.

If the entire parameters match then the attendance is registered in the file else the alarm is triggered highlighting the entry as Intruder.

**Table 1. Employee Data Used**
We are testing the proposed system in Ubuntu. From the live video frames face capture & detection has been done using python whereas all interfacing of components with Arduino UNO has been done using C/C++.

Let us study the results one by one from the below screenshots taken while testing the prototype of the proposed system.

The above figure fig-4 depicts the Employee face detection & asks the employee to swipe the valid employee ID card. In this case we have swiped a Valid Employee ID card. Once ID card no matches with the database then the employee has been asked to give his finger print for fingerprint matching test.

Employee needs to place his left hand thumb on fingerprint sensor. Below figure fig-5 depicts the case when the fingerprint of the employee has been matched with the tagged employee IDs finger print available in the database. The Employee attendance will be recorded with entry details. A welcome message audio is played to welcome the employee into the campus & entry gate is opened.

Suppose if the fingerprint of the employee does not match with the available fingerprint tagged for his ID present in database, then Attendance will not be recorded. An Alarm will be triggered and an Audio alert informing the security about the intruder entry into the premises is done. Below figure Fig-6 depicts the case of valid employee ID card with fingerprint not matching with the database.

Consider a case where, in the initial stage itself an Employee tries to gain entry into the campus using Invalid or Expired ID card, As already the Valid Employee ID card details are available in the database, when an Invalid ID card is swiped then its detected immediately. As
shown in below figure fig-7, it will be displayed on screen & security will be alerted with Buzzer & Audio alert.

![Invalid Employee ID Card Number-Not Found In Database- Alerted.](image)

Audio Alert will be played using speakers to make security personnel take immediate action on the intruder.

V. APPLICATIONS AND ADVANTAGES

We can write plenty of applications for the proposed system, lets list a few below.

1. As Face detection is done, it acts as first layer of security and hence unauthorized use of ID cards is prevented.
2. Dual or multi people entry with single access card can be prevented.
3. Finger print authentication used acts as a Third layer security system.
4. Attendance recording will be authentic as there is no chance for proxy attendance.
5. These kinds of devices can be used in secure and sensitive places where security is of utmost importance. Ex: DRDO, ISRO etc.
6. As the proposed design is low cost, hence it can be used in Hospitals, Schools and all government or private firms & establishments.
7. The proposed Face and Biometric based attendance system can be used by the employees, workers and staff in various domains of industries such as Automobile industries, Research oriented Industries, manufacturing industries and Software development companies etc.

With the help of multi-layer security checks we can reduce the possible threats of terrorist attacks on the sensitive establishments and hence can avoid loss of lives & property and hence we can be on alert always against any possible threats from enemies.

One of the disadvantage of the proposed system is the employee needs to undergo multi-layer security checks every time which will consume some time. But for the sake of security of life & property we need to adjust and strictly adhere to rules framed for the same.

VI. CONCLUSIONS

The Proposed system has been designed based on the principle of multi-layer security. We have demonstrated successfully how Finger print sensor can be used integrated with face recognition techniques for attendance & also it’s a low cost easily affordable. These kinds of devices can be used in secure and sensitive places where security is of utmost importance.

As the proposed attendance system is based on multi-layer security, the system can not only be used for Attendance but also pre security check we are doing to establish whether the employee is authentic or not.

With the proposed system secure military and Research oriented establishments can enhance their internal security and hence can prevent possible intruder or terrorist entry into the campus. Security officials can take up immediate actions whenever such a possible intrusion into campus occurs with the help of the proposed system. Thus the proposed system not only works well as an attendance system but also as a security device.

VII. ENHANCEMENT & FUTURE WORK

We can integrate SMS and e-mail triggering feature such that an SMS & e-mail can be triggered to the Security guards mob no & email id’s and nearest Police stations upon detection of intruder into the sensitive secure establishments.

Also we can develop finger print recognition capability by using image processing techniques and hence we can use web camera itself instead of finger print sensor for finger print verification.

VIII. REFERENCES


www.ijeecs.com