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Design and Implementation of an Automated Multi-Functional Attendance System with Real Time Web Visualization

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Abstract*— In the recent times the security crisis is on the rise, safety and security of not only humans but also confidential information has become a big concern for everyone. An automated web based multifunctional attendance system is built to keep track of people getting in and out of an institution, it is an attendance system which ensures that unexpected people do not have access to important information. This system has RFID entry, finger print scanning and real time facial recognition all together to ensure full security, the data of attendance is available on the website for a better visualization. It eliminates the flaw of the traditional attendance system which can ensure neither proper security nor proper attendance. This system mitigates the present security concerns.

***Keywords*— Web Application, Microcontroller, RFID, Fingerprint, Sensors, mysql, php, html, CSS, opencv, Image processing, Machine learning, Python, Facial Recognition, Database.**

I. INTRODUCTION

Attendance has been a part of security field for a long time, it is a way to keep track about the people coming in and out of a particular premises. But the traditional or the most commonly used manual attendance system is not an efficient one, which makes it hard to ensure security. A lot of efforts were made to ensure a better attendance for security purpose.

Now the attendance system has taken an electronic approach; RFID scanners, finger print scanners, DNA recognition, iris recognition etc. are being used to maintain the attendance. Many systems were made using these electronic devices individually; but it was found that these systems were flawed. RFID is one of the oldest and most implemented concepts to maintain proper attendance and security [1 2]. One of the attendance systems comprises of web -based development and system integration with the RFID-ARDUINO technology. The hardware platform is developed over the famous Arduino microcontroller where the web design is developed in Adobe Dreamweaver and Adobe Fireworks and is hosted in XAMPP application server. Visual Basic scripting is use to integrate between hardware and SQL database. The system also has features such as evaluation and a key-in manager for student marks [2]. Although this makes the attendance system computerized and helps maintain a proper database, the drawback of this system is anyone can pretend to be anyone else using others' card. This makes it hard to ensure security in this system. There are systems designed using fingerprint scanners [3 4] which employs finger print scanner and SQLserver for database management. But they fail to ensure an efficient attendance system; instead of making it easier and efficient it creates huge queues and wastes a lot of time as students input their fingerprint one by one. A more futuristic technology for digital attendance is by using facial recognition [5]. A system is developed using Viola-Jones algorithm for face detection. For recognition the system uses PCA (Principal Component Analysis). The system functions by projecting face image onto a feature space that spans the significant variations among known face images. The significant features are known as Eigen faces, because they are the eigenvectors (Principal Component) of the set of faces that do not necessarily correspond to the features such as eyes, ears, and noses. The projection operation characterize an individual face by a weighted sum of the Eigen faces features and so to recognize a particular face it is necessary only to compare. Each of the faces fall under a specific class which are pre-defined [5]. Although this system ensures security, the data collected here might have error in case of detecting faces. Moreover, most of these systems lack visualization capabilities.

All these systems have their positives and negatives so an effort was made to mitigate the flaws of these systems and design an efficient attendance system. After studying the existing systems, a new system was designed and tested. This system is designed combining all the three techniques: RFID, Fingerprint and Facial recognition with web visualization. When all these are used together one or the other is able to mitigate the flaws of other techniques. This system uses RFID scanner, fingerprint scanner and webcam (Facial recognition) for taking the attendance input which makes it automated and reduced amount of error which exists in the present manual attendance. This system takes the input from all these systems and checks with the pre-defined database to ensure security. This system makes sure that no one enters or leaves the unnoticed; it also acts as a surveillance system for an institution. With its web based visualization makes it more convenient.

Present day security and safety crisis is a huge concern for everyone; An Automated Web-based Multi Functional Attendance System is designed to lessen the security threat by ensuring well checked attendance system.

II. OBJECTIVE

In the present context of the world security has become a huge issue. Data theft is a common security issue for business institutions; recent attacks on the schools are also a huge security issue. So to eliminate these issues to some extent a Web-based Multi Functional Attendance System was designed. The objective of this system is provide surveillance and simultaneously ensure security by maintaining a proper database. Hence, keeping a proper workflow in the system.

III. SYSTEM DESIGN

A. System Architecture

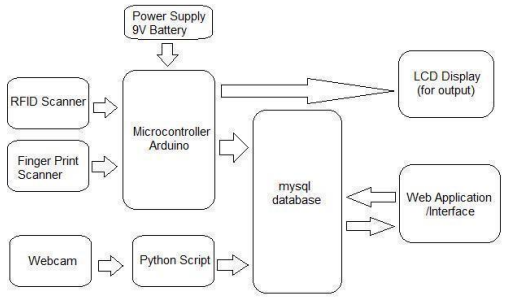

Fig 1: System Architecture

Fig.1 portrays the architecture of the system. The inputs being the RFID and finger print scanner and also the webcam. The different input data being sent the microcontroller and the python script, which are then sent to the mysql database. The output is shown in an LCD display in real time and also in the web application. The communication between the web app and database is bidirectional since it always sends a query to the database, as a result, always being updated by new data if any.

B. Flow Chart

Upon giving the power supply the systems turns on, it takes reading from the RFID, finger print scanners and also from the webcam. The readings are then compared with the pre defined data. If the data matches then it is stored in the database and hence an entry is logged otherwise it prints "No Data" on the LCD. This data is then displayed on the web application and on the LCD screens in the hardware output.

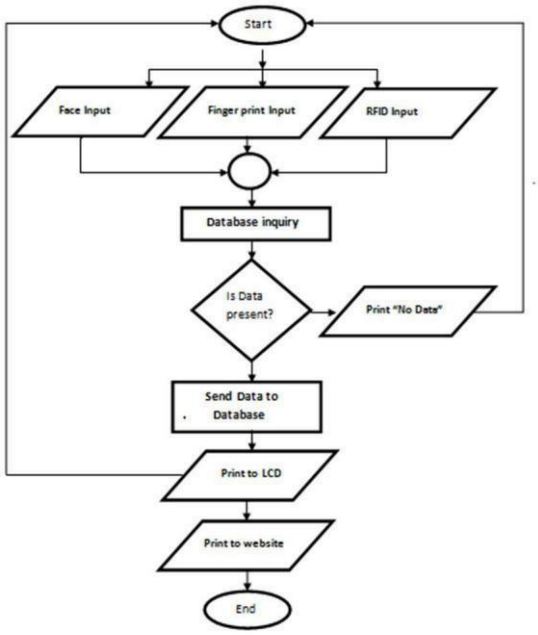

Fig 2: Flow Chart

C. RFID Scanner

This system uses features RFID based data collection. When someone with registered RFID card logs in or punches the card in the system the data are collected, this data can be further used for attendance and security purpose. RFID RC522 is used for recording the RFID inputs from the people. This module is connected to the ATmega328 based 16Mhz microcontroller (Arduino Uno) which helps to communicate with the database; the collected data is directly sent to the database via and established communication between the microcontroller and the database. It is then compared with the pre-defined data to see if the data is present or not, if the data is matched it is recorded in the database and absence of data prints no data on the LCD screen. UUID values of the card are read by the RFID scanner according to the program written on the microcontroller this recorded data passes through matching algorithm to compare the data and then the result is shown. For security purposes the system is kept static that is the cards can be registered only from the server end not from the user end. An instance of the RFID reader device is shown below.

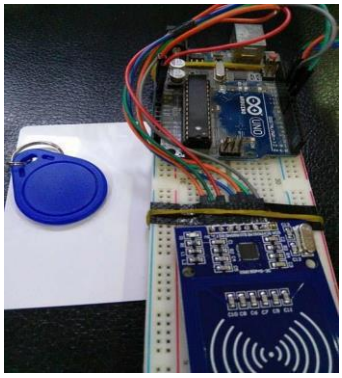

Fig 3: RFID reader

Fig.3 shows the RFID connected to the microcontroller.

D. Finger Print Scanner

For the finger print input the system uses GT-511C3 which does all the work of reading and matching of the finger print with its 32bit on board CPU. It works in the 3.3V range so a regulator circuit in the figure below had to be constructed to switch between the logic levels from 5V to 3.3V.

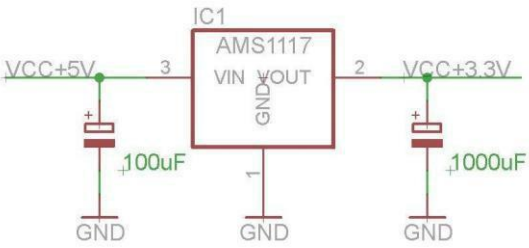

Fig 4: Voltage regulator

This module is connected to the ATmega328 based 16MHz microcontroller (Arduino Uno) which helps it function according to the user. First the finger prints are recorded in the database as a pre-defined data and then when a finger print entry is found the system checks with the pre-defined data and notifies if there is a match and records it; it also notifies if there is no match. An instance of the finger print device is shown below.

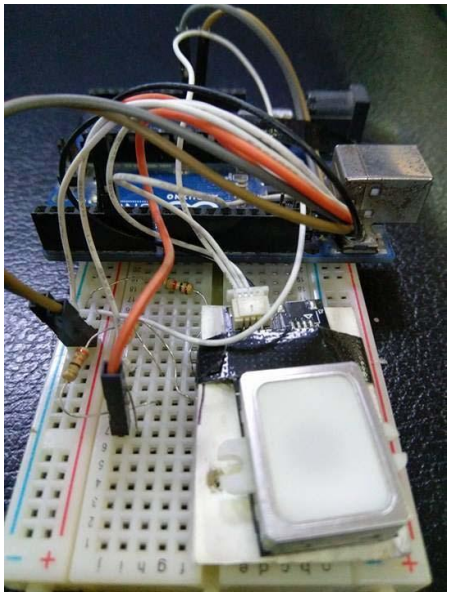

Fig 5: Finger print scanner

Fig.5 shows the fingerprint scanner connected to the microcontroller. In the final hardware prototype a voltage regulator and a switch module – to toggle between functions- is added to make the device more intuitive.

E. Face recognition

Lastly, face recognition feature which makes this system more secure and safe; even if someone forgets to entry their RFID card or finger print camera is always recording who is coming in and getting out. The camera present in the premise will record every moment and detect faces and register the data in the system. A python based real time facial recognition system was developed and used to detect the entry of a person. It is one of the most secure methods to log an entry since it can only be copied if there are twins. The method itself comprised of two main aspects: training and recognition. A webcam was used to take the input of faces in real time and the training and recognition algorithms were running in Python 3 using Virtual Environment. The python packages that were used are:

- opencv
- numpy
- virtualenv

The method used for training the system was using haar based cascade classifiers. This includes the process of saving the images into numeric vectors. Later, these values will be used to identify the faces. First, the application reads the two destinations, the one for negative images, and the one for positive images. Both the destinations will be read throughout the training process, and final values will be exported to an XML file called training.xml. During this process the application reads grayscale images, which are later formatted to be used for face recognition. After they are formatted, vectors are set based on X and Y coordinates. After that process, the application continues to save the images in numeric values, and in the end, it will send a message telling that the savings have been successful. All images will be saved in three models, medium, positive, and negative.

Fig 6: Training data set

Fig. 6 shows the training dataset for a single class. One hundred pictures were used to train the system for specific class.

The recognition algorithm simply checks the training.xml file for any known class, if matched then entry is logged. The output is also shown in the video feed from the webcam upon the person's face with a square on the face and also simultaneously it is updated to the mysql database.

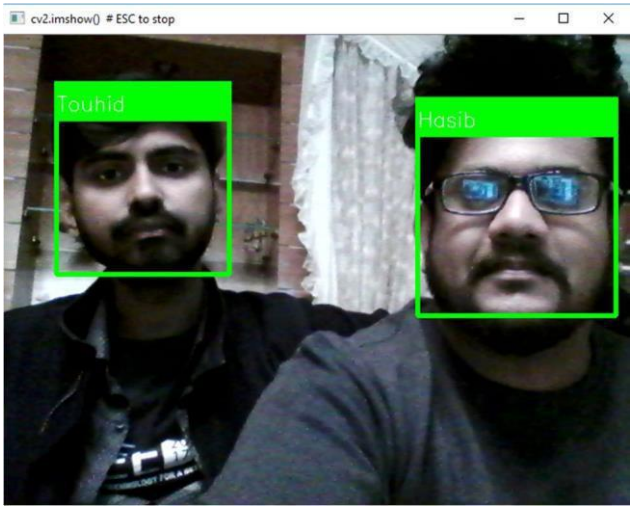

Fig 7: Real time face recognition

Fig. 7 shows the output where the system recognizes multiple faces in real time.

F. Web Application and Interface

This system comes with a website which features all the data collected from all three inputs. Any user can always check their data entry. The web application and interface consists of a front and back end. The front end is developed using html, css and bootstrap. Initially the admin has to login to the page using a pre-defined username and pass which is integrated with the web application when constructed. After logging in, the admin can view the current state of the attendees. An instance of the web application admin login is shown in the figure below.

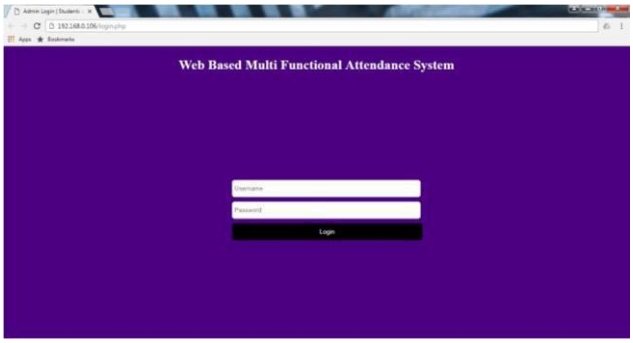

Fig 8: Web interface admin login page

In the back end, php was used which was then connected to a mysql database running on apache local server. The database consisted of models which are:

- Serial number
- Name
- Attendance
- Time

Here, amongst the four models, the time is always updated and save in 24 hour intervals. Depending upon the three different inputs, the attendance is taken and the time is updated in the database and hence displayed on the website.

IV. HARDWARE IMPLEMENTATION

For it to be a complete system, a hardware device was constructed to show real time display of the datas. A 12V Lithium Polymer battery was used to power the whole device. An instance of the prototype is shown below.

Fig 9: Hardware prototype

For the face recognition, a standard A4 tech webcam was used to take the inputs, and the processing was done in python scripts.

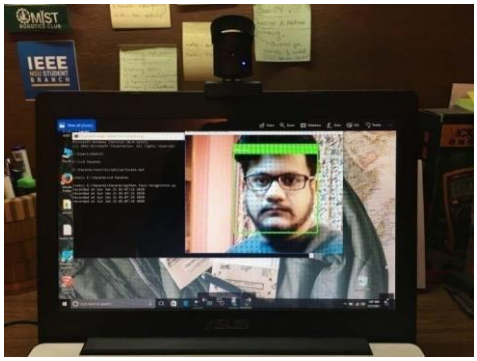

Fig 10: Webcam

Fig. 10 shows the hardware required.

V. Data Collection and Visualization

The prototype was tested and worked successfully. This section will portray and explain the results from the inputs of RFID, finger print scanner and the webcam which are then shown on the web application.

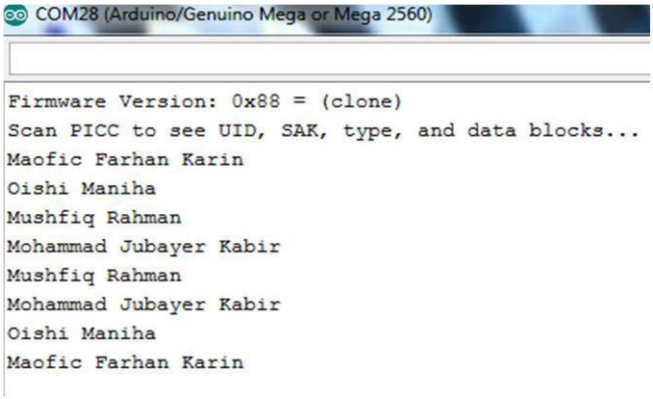

Fig 11: RFID Data

Fig. 11 shows the RFID data from the input device. Each card's UUID is programmed with the users name. So as the user swaps his/her card, the name appears on the serial window. This is read by the microcontroller and sent to the database.

Fig 12: Finger print scanner read

Fig. 12 shows the serial data being read by the finger print scanner. Each user's fingerprint is initially read and stored to the system. This also works in similar fashion as the RFID.

	A	B
1		
2	Sat Jan 20	Touhid
3	Sat Jan 20	Hasib
4	Sat Jan 20	Priya
5	Sat Jan 20	Hiya
6	Sat Jan 20	Hasib
7	Sat Jan 20	Touhid
8	Sat Jan 20	Touhid
9	Sat Jan 20	Hasib
10	Sat Jan 20	Hiya
11	Sat Jan 20	Hasib
12	Sat Jan 20	Priya
13	Sat Jan 20	Hasib
14	Sat Jan 20	Hasib

Fig 13: Facial Recognition Excel Sheet

Fig. 13 shows the entry log of different users via the face recognition technique. When the python scripts read a known face, the time data stamps of that user is recorded in an excel sheet. This was used only for debugging purposes which was later connected to the mysql database.

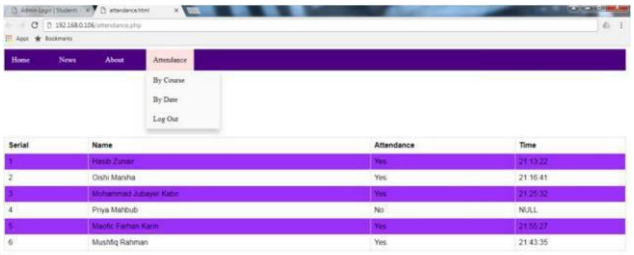

Fig 14: Entry Logging on Web App

Fig. 14 shows the entry logging method of the system which logs attendance as the user places any of the three inputs. Since, the system works in a 24 hour interval it registers the users input accordingly. If a certain individual does not register within that time it is registered as NULL as shown.

VI. FUTURE WORK

There are still a lot of ways this system can be developed more for a better safety and security system. Things that can be of future addition to the system are adding a proper warning system with continuous surveillance. Deep learning can be integrated for facial recognition, trained on a larger dataset. Also, making the device more compact by adding a mobile application for dynamic entry of a new user.

VII. CONCLUSION

Recent security crises demands for a proper security system, this system acts not only as an attendance system but also a surveillance system. It is working to shrink some of the security concerns. It is a dynamic system where users get to choose how they will provide the inputs, RFID tag, Fingerprint, Facial recognition. With all three sub-systems running together along with the web application, it can be concluded that the system is effective and secure.

VII. ACKNOWLEDGEMENT

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