ATTENDANCE AUTOMATION USING FACE RECOGNITION BIOMETRIC AUTHENTICATION

Soniya V
Department of Information Technology
Dhanalakshmi College of Engineering
Chennai, India
soniyavinothkumar@gmail.com

Swetha Sri R
Department of Information Technology
Dhanalakshmi College of Engineering
Chennai, India
r.swethasri@gmail.com

Swetha Titty K
Department of Information Technology
Dhanalakshmi College of Engineering
Chennai, India
swethatitty@gmail.com

Ramakrishnan R
Associate Professor/Information Technology
Dhanalakshmi College of Engineering
Chennai, India
ramakrishnana.it@dce.edu.in

Sivakumar S
Associate Professor/Information Technology
Dhanalakshmi College of Engineering
Chennai, India
sivakumar.it@dce.edu.in

***Abstract*— Attendance automation has become one of the most important needs in educational institutions and work places across the world, since it saves time and accurate too. Face recognition system needs least human cooperation and is viable too. The system automatically detects the student's entry in the class and marks attendance for the particular student periodically. The data collected can be used by the system further for attendance score calculation and other managerial decisions. Arduino is used to create and control the system that could automatically mark the attendance for the students. Thus the system reduces the manual collection of attendance and the time taken for report generation.**

Keywords- Attendance; Microcontroller; Face Recognition; Pattern

I. INTRODUCTION

The technology is going at a very fast rate and the things are getting automated day by day. A boon in the field of technology is Internet of Things (IoT). It enables communication between two hardware devices with help of Internet. Internet is the major communication resource, almost used by the entire world. In other words, IoT can be as an internetworking of physical devices, vehicles, buildings, etc., deployed along with electronics, software, sensor, network connectivity that enables communication. Some of the major devices of IoT include heart monitoring implant, biochip transponders on farm animals, electronic clams in coastal waters, automobiles with built-in sensors, DNA analysis devices.

In olden days, the organizations made use of manual sources for attendance marking. As the technology grew, the attendance based information were stored in databases with the security of data taken into consideration and also for accuracy manual collection of attendance was replaced by RFID based attendance system. In RFID, the users were provided with a tag as the pass key and a tag reader was used to read the presence. But, the tag reader was time consuming. Also, there were chances of misusing the cards (one person could have two cards at once and mark attendance for the missing person too).

In order to overcome, the drawbacks of RFID, the biometric identification was introduced. The biometric includes various types like, thumb impression, face pattern, iris pattern, etc., the thumb pattern for each person is unique and it was easy way to make use of it as an identifier entity. But, then if there was any bruise in the fingers, then the pattern would mismatch. So, the face recognition turned out to be the most suitable method for identifying purpose.

II. LITERATURE SURVEY

The authors Arulogun O. T. et al speaks about how to solve recurrent lecture attendance monitoring problem using RFID technology [1]. Student attendance monitoring has been developed, deployed and is capable of reducing time taken during manual collection of attendance. The authors Karthika R., et al speaks about how Face Recognition system can be used for security purpose [2]. It also elaborates on how a person's face is scanned and matched against a library of known faces. In future, instead of face images the live movements of face can be detected. Face recognition is an effective means for authenticating a person. The demand for secure system is covered which has to be reliable and fast responded for the industries and companies [3]. Hence attendance automation which is accurate is elaborated and covers the steps to be taken

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for the same. Here, if the faces are not recognized in the database, then the threshold value of the pixel points varies and considered as unrecognized face or asks user to update in the database. It also speaks about Principal Component Analysis (PCA). PCA is used to reduce image dimension space which is needed to describe data from the database.

Images stored are in gray scale. Test images are converted to gray scale, which is easier for applying computational techniques in image processing. In PCA algorithm, the Eigen face and Eigen vector are used to calculate the threshold value and to identify the presence of a person. This PCA is used to find data patterns. The training data should be projected onto PCA subspace (data centered) recognition system which implements the Eigen faces [4]. Arduino microcontroller has read and write capabilities [5] . It makes the port, channels, convertor to produce the accurate results. When Arduino is interfaced with the system, it produces the high accurate results and has high performance. [1,5]. In face recognition system, face detection, face extraction, face recognition process varies and these phases are merged to recognize the face and have the tracking capability.

III. PROPOSED SYSTEM

The proposed system makes use of face recognition technique to identify the student's presence and mark attendance. For every period the attendance can be updated same as the previous period's value. In case, if the students go out in between, then their faces are to be again analyzed and the attendance is hold on for 15 minutes (excluding break and lunch hours). While re-entering the attendance is marked "present" again if the students come back within 15minutes. If not then the attendance is marked "absent". Hence periodic attendance is automated. The stored data can be further used for attendance calculation.

IV. COMPONENTS USED IN THE PROPOSED SYSTEM

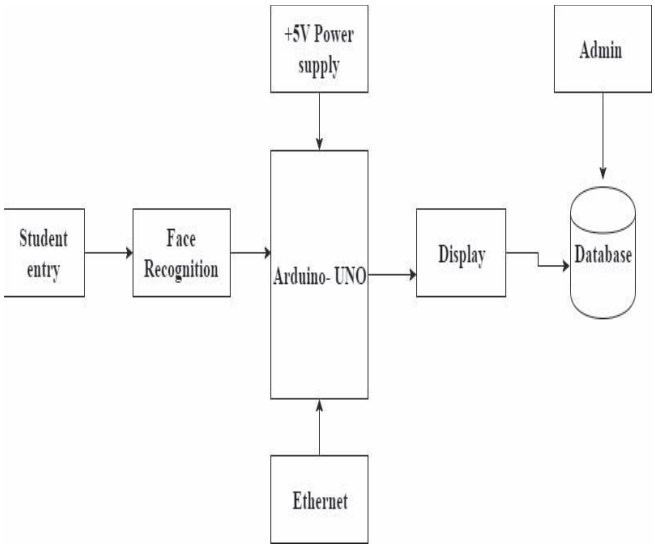


Fig. 1. Block diagram of proposed system.

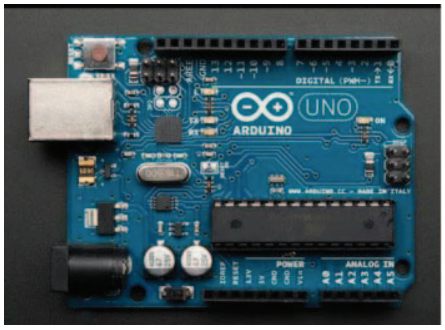
The attendance automation is achieved through face recognition using the above components as shown in the figure 1. Each student's presence is marked by analyzing his/her face pattern by the camera. The Arduino microcontroller carries out the process by comparing the test image(image captured then) and checks for similarity in the database, where a collection of patterns are already stored.

If the pattern matches then the attendance is marked for the student and it is displayed in the display device (monitor). The database is updated correspondingly. The admin can make exceptional changes if any, in the database. The description for each of the components is found below.

A. Camera

It has in-built sensitive microphone and CMOS image sensor. It offers an image resolution of 300k pixels and has light sensor to switch on 4 lights automatically when in dark. The camera provides a superior image control, color saturation, brightness and sharpness. Here the brightness is adjustable and snap shot switch is perfect for taking still pictures. It supports YUY2 video format USB2.0 interface and is compatible with USB1.1. It offers a transmission speed of 320*240 25 frames/second, 640*480 15 frames/second and 2560*1920 15 frames/second. Has microphone with 3.5mm jack and supports Windows XP/VISTA/7/8 systems, manual focus adjusting and manual snapshots.

B. Arduino-UNO



Arduino-UNO is an 8-bit AVR RISC based microcontroller with a high performance Atmel Pico power. Some of its features include

- 32KB ISP flash memory with read-while-write capabilities.
- 1KB EEPROM.
- 2KB RAM and 23 general purpose input –output lines.
- 32 general purpose working registers.
- three flexible timer/counters with compare modes.
- serial programmable USART, SPI serial port and 6-channel 10 bit A/D convertor.

This controller operates between 1.8V-5.5 volts. This controller interfaced with LCD and buzzer, micro SD card using various ports.

V. FLOWCHART FOR THE PROPOSED SYSTEM

The system starts with the registration of new user (student). Meanwhile the registered data is stored in the database. New student's face is analyzed and the pattern is stored in the database. During entry, the student's face is detected using the camera and the pattern is checked for similar one from the database. If the pattern matches, the time of entry of the student is checked. If the time is within the limited range (e.g.: for the first hour, the entry should be within 9 am and an extended duration of 15 minutes is provided), then the attendance for the student is marked "*present*". Otherwise the attendance is marked "*absent*". In case of any exception (like if the student comes in late in the knowledge of the staff), then that particular staff has the authority to make changes in the stored data. The collection of each student's attendance from the database is retrieved later for *internal mark calculation.* Based on that, a score out of 5 is provided for each student.

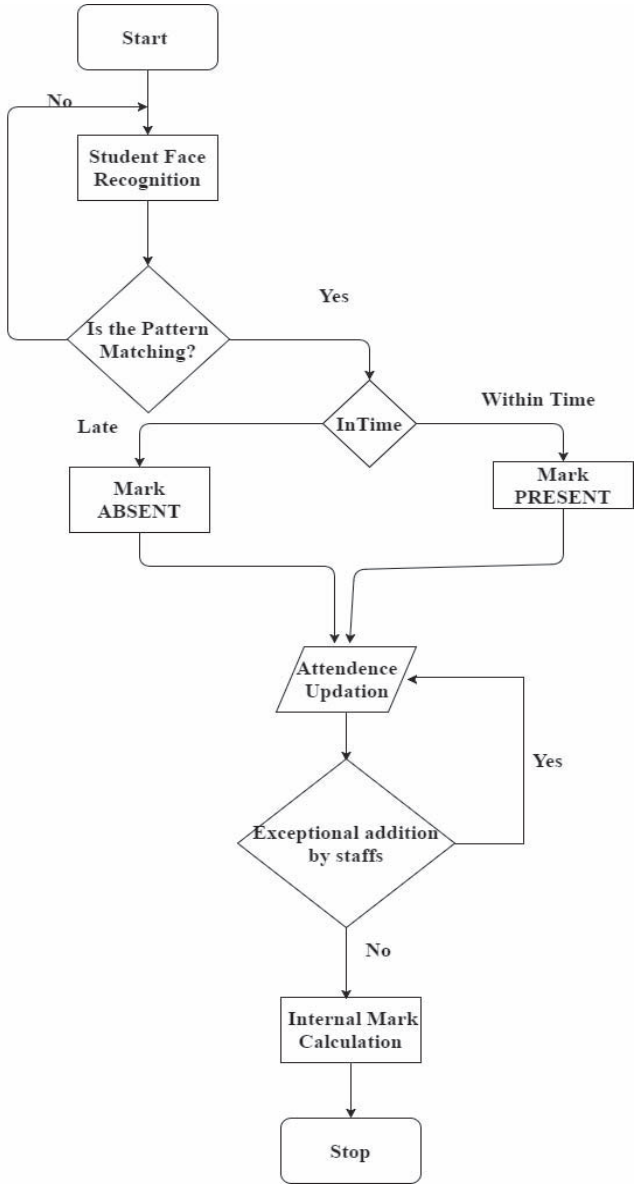


Fig. 2. Workflow of proposed system.

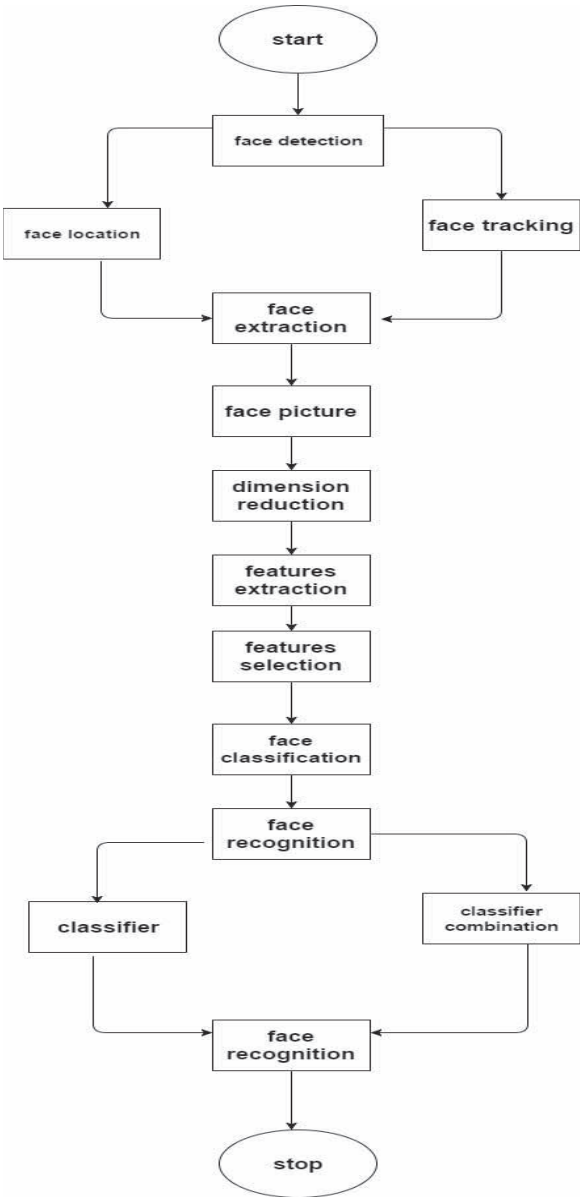


Fig. 3. Face recognition biometric subsystem.

The face recognition consists of various detection methods. The face recognition is of two types; they are face location and face tracking. The face location spots the specific place which is suitable for detection. Face tracking tracks the length, breadth, size and pixels of the face. The next process of face detection is face extraction where the face picture, dimensions and reduction, feature extraction and feature solution are determined. In face picture, the pigment of the face is captured and extracted. The solution determines the capturing of a perfect snap. Face extraction is followed by face classification which includes classifier and classifier combination. The classifier is classified into three types; they are similarity, probability decision boundaries. In similarity, patterns that are similar should belong to the same class and to establish a metric that defines similarity and representation of same class samples. In probability, its approach is to check the probability of miss-classifiers. In decision boundaries, it reduces the criterion between the stored image pattern and test image pattern. The classifier combination is a problem of finding the combination function. Each classifier is developed with different approach and using the combiner the different classifiers are combined. The classifier combination is of three types, parallel, serial and hierarchical. In parallel, classifiers are executed independently and then it is combined. In serial, the classifiers execute one after another and each classifier's input depends on the previous result. In hierarchical, the classifier combined into a tree-like structure.

VI. PCA ALGORITHM

PCA stands for Principal Component Analysis band it uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called Principal components .The face pattern can be detected and recognized using the Principal Component Analysis algorithm. The following steps show the process of PCA.

1. The data's center is taken as the mean value.
2. The covariance matrix of the given dimension (element) is calculated as,

$$C = A^T A$$

3. Compute eigenvectors and Eigen values of the covariance matrix C which can be calculated as,

$$D = CV\ V^{-1}$$

4. Eigen Vectors are sorted in the decreasing order of Eigen values.
5. The Eigen vectors are projected based on the threshold.

FMR is obtained when a genuine match is recognized using the recognition algorithm. FNMR is obtained when the genuine user is blocked to access its own. Setting the threshold value too low will produce the FMR high (near 1) and the FNMR low (near 0).By setting the threshold high the FMR will near 0 that is low and the FNMR will near 1 that is high. The sample tabulation is represented in the above figure 4. The FMR and
FNMR values from the table are taken and a graph is plotted as shown in figure 5.

Threshold	FMR	FNMR
0	1.00	0.01
20	0.72	0.45
50	0.11	0.75
80	0.03	0.89
100	0.00	1.00

Fig. 4. Sample Tabulation of threshold values with FMR, FNMR values

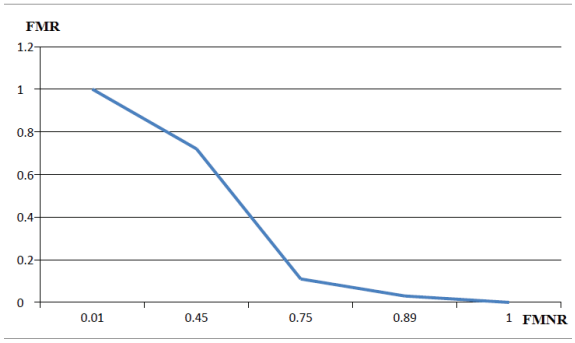


Fig. 5. Graphical representation of FMR, FNMR values

The graph includes FMR along x-axis and FNMR along y-axis.

VII. SOURCE CODE

```
public void actionPerformed(ActionEvent ae)
{
   try
   {
      for(int j=0; j<rows; j++)
      {
         String updt ="update students set Status=
         "+cubeData[j][coo]+"' where
         Rollno="+stChange[j];
         this.con=DriverManager.getConnection(
         this.dbURL);
         this.stmt.executeUpdate(updt);
      }
      this.con.commit();
      System.out.println("Records updated..!");
      con.close();
   }
   catch(Exception ex)
{
```

```
        System.err.println(ex.getMessage());
        ex.printStackTrace(System.err);
    }
}
public static void main(String args[])
{
        new attendance("..:: Attendance Form ::..
        ","mydb.mdb","SELECT *  FROM students order by
        Rollno");
}
```

The above Java code explains the updation of a class student attendance in the excel database one by one using for-loop. The method *actionperformed ()* is called, when user clicks the update button. A *for loop* inside the method moves one row after another, till the last row is reached. The array *cubeData[j][coo]* and *stChange[j]* in the string *updt* corresponds to the value of absent/present status and rollno of the student. Connection to the database is established using the DriverManager, the database is updated using the *executeUpdate()*. Finally, the database is committed using *commit()* and the connection is closed. In case of any exceptional errors, it can be notified with the help of a method *System.err.println()*. The Student's data once stored can be analysed with fresh analysis and if the pattern matches the database connectivity is enabled and through that the values (0 for pattern mismatch and 1 for pattern match).

VIII. INPUT AND OUTPUT

The input first taken is the face pattern of a new student. The face pattern is analyzed with the help of camera and Arduino helps to control the entire process. The patterns once collected can be stored in the database along with the students' details. During the entry of the student, the system checks for each of their faces' patterns and searches for a similar match in the database connected as shown in the figure 6 . If there is a similar pattern matching for utmost 85%, then a value 1 is returned to the database which marks attendance status for the corresponding student as "*present*". Otherwise 0 is returned in case of miss match and attendance is marked *"absent"*. SQL Update Queries can be used to achieve it. The same values are repeated periodically and incase if any student wants to go out then the face pattern is identified by the camera and if the students returns within 15 minutes of holding time, then same value as the previous hour is repeated. In case, if the student comes back late with the knowledge of concerned faculties then the value 1 can be returned as exception by the faculty later. If none of the two happens and the student comes back late then the value 0 will be returned for every hour until the student's faces is detected and updated again. Hence periodic attendance can be achieved.

The face recognition is possible even in different environments and that is shown in the figure 7.

Fig. 6. Image pattern analysis

Fig. 7. Image pattern analysis

The final output achieved will be the internal marks of attendance for each of the students enrolled in the system. Once the periodic attendance is stored for each student over a term then those values can be collected to calculate the internal marks out of 5 for each student. SQL SELECT queries can be used to retrieve the marks.

Sample output of the attendance marks retrieved from database is shown in the figure 6.

		Present/Absent							
DATE	NAME	1	2	3	4	5	6	7	8
2/1/2017	Maanik S.	1	1	1	1	1	1	1	1
3/1/2017	Pavan B.	1	0	1	1	1	1	1	1
4/1/2017	Virat K.	1	0	0	0	1	1	1	1

Fig. 8. Sample output of an attendance.

IX. CONCLUSION

Attendance automation using face recognition is a non-intrusive method and it helps the management to maintain an accurate attendance database as the test image is passed through different levels. The in-time and out-time of the students is checked and based on the time the attendance is marked. Hence this system if implemented, it would turn out to be a secured and authenticated system with high performance.

X. FUTURE ENHANCEMENT

The system can be enhanced in future by updating internal marks for each of the students along with their attendance marks and the collected data can be hence uploaded in the respective portals. A complete database of the students will be maintained in a secured way. Also the push messages could be sent to the parents once the attendance of their ward is marked absent.

XI. REFERENCES

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