Automatic Attendance and Student Database Management System Using Face Recognition Methods in Educational Institutions

M.Hajira Khathun M.E

TeachingResearch Fellowship, Dhirajlal Gandhi College Of Technology, Salem.

ABSTRACT: Whole world and administrators of Educational institutions' in our country are concerned about regularity of student attendance and their academic achievement in college wise and university wise. Student's overall academic performance is affected by the student's present in his institute. In this paper, the development of an attendance and database maintenance of the students using face recognition based biometrics is proposed. Manual maintenance of student attendance and automatic updation of the student's details in the main database becomes very difficult task. The ability to compute the attendance percentage and mark calculation of the student becomes a major task as manual computation produces errors, and consumes lot of time. For the stated reason, an efficient attendance and database management system using biometrics is designed. This paper presents a method for estimating the attendance precisely using all the results of face recognition obtained by continuous observation. This system takes attendance electronically with the help of a face recognition device and the records of the attendance are stored in a database. Attendance is marked after student face is matched. For this purpose, initially, the features of the face is extracted using Genetic LBP which is then applied to each pixel of a patch resulting in a histogram representing the feature characteristics for that particular patch. Feed forward and self-organizing neural network are used for matching of the students face and attendance details are updated automatically, correspondingly current mark status in semester wise also updated in database. The system adopted biometric access control techniques, which is designed with extended graphical user interface by using Microsoft visual studio 2010 and integrated with face recognizer. Actually, this system is more efficient than others student attendance and database maintenance methods since the detection and the recognition are considered to be the best and fastest method for the biometric system.

KEYWORDS: Automated management system, Attendance management system, Database, Authentication, face recognition and biometric authentication.

I. INTRODUCTION

Empirical evidences have shown that there is a significant correlation between students' attendances and their academic performances [1]. There was also a claim stated that the students who have poor attendance records will generally link to poor retention [2]. This is also agreed by Mazza and Dimitrova where they both claimed that the students' attendances to the course may indicate their behaviours towards the subject where it can be used to judge their tendency and commitment to the course [3].

Attendances of every student and database of each students are updated and being maintained by every school, college and university. Faculty has to maintain proper record for the attendance. The manual attendance record system is not efficient and requires more time to arrange record and to calculate the average attendance of each student. Hence there is a requirement of a system that will solve the problem of student record arrangement and student average attendance calculation.

Biometric can be defined as any automatically measurable, robust and distinctive physical characteristics or personal trait that can be used to identify an individual or verify the claimed identity of an individual [4]. It is also science and technology of authentication by measuring persons' physiological or behavioural features. According to [5] examination is an instrument for testing, assessment evaluation and accreditation. But in most institution before any student is allowed to sit for examination such student needs to meet specified percentage of class attendance but due to stress of manual attendance taking and record keeping the percentage required before sitting for an examination has not been adhered to in many institution of developing nation.

In order to keep record of class attendance in most institution in developing country the process being adopted is the use of pen and paper for student class attendance, and this has been prove to be very stressful, time consuming, unreliable, inaccurate and inefficient [6]. According to the research carried out by [7], it was discovered that the use of biometric for attendance has eliminated need for stationary materials and personnel for keeping records, thereby reducing stress of manual attendance process.

Biometric Identification Systems are widely used for unique identification of humans mainly for verification and identification. Biometrics is used as a form of identity access management and access control. So use of biometrics in student attendance management system is a secure approach. There are many types of biometric systems like fingerprint recognition, face recognition, voice recognition, iris recognition, palm recognition etc.

Face detection and recognition [8] are very advanced in terms of computer authentication technology. The

technology of student attendance system is used to support the teacher for checking his/her students' attendance in modern way. Face detection and recognition are considered to be the best and fastest method for biometric attendance system. They are secure to use and working without any preparation since the camera can direct capture the student faces, and then the report of attendant students will be produced immediately with no more effort. Hence the paper is proposed to tackle all these issues [9].

Designing a trustworthy student attendance and database management system based on face detection and recognition is considered the faster and optimal way to manage the records for students' attendance in institutes. Furthermore, any business organization or educational institution has to maintain the attendance of students or employees for effective functioning of business records. The important key of this paper is to design a better student attendance and database management system with ease interface and accurate results. In this work use a face recognition system. The proposed system consists of a high resolution digital camera to monitor the classroom or office room. The proposed face image is loaded into user interface by Microsoft visual studio 2010, and then student details are added into student database which is maintained in special folder. The data or images obtained by the camera are sent to a computer programmed system for further analysis. After details are added then next it is automatically calculate the attendance percentage based on the face recognized, for this purpose features are extracted using genetic based LBP pattern feature extraction method, then face matching is performed based on neural network learning and self organized map based leaning method, The obtained images are then compared with a set of reference images of each of the employees or students & mark the corresponding attendance and students details also maintained . The system also provides for continuous monitoring of the classroom by an operator if needed.

II. BACKGROUND KNOWLEDGE

In [7], the attendance of each student is taken during both the examination times and also on regular hours. A fingerprint device is used and the attendance of the students is stored in the database. The report can also be sent to the parents e-mail id. Some also used RFID to track attendance of the students. Coventry et.al [10] designed a student metric card embedded with an RFID tag for tracking their whereabouts. When the metric card passes through the RFID reader, it will trigger the system to read the data from the RFID tag to the database where the access data can be viewed online by the management for monitoring purposes.

Chitresh & Amit [11] created an attendance management system mainly for employees. It records the attendance of employees once per day. Wireless attendance management system is also designed by some authors. In [12], attendance is managed wirelessly. Once the presence for a particular employee is taken through a biometric device, the presence is stored in the database through Wi-Fi. The students will be notified their presence through a LCD screen which displays the relevant information each time he/she keeps the finger.

In 2008, Nucleus Research proposed the use of a computerized attendance system, which can eliminate human involvement, human data entry mistake, repetitive work. This system is going to increase productivity, reduced payroll error, and reduced payroll inflation, reduced overtime, retirement of legacy systems, Elimination of paper costs, and which can provide all the reports on demand. In this system, faculty has to take attendance manually, only these records have to be entered into the computerized system. But in this also, the problem of data entry mistake may occur [13].

A desktop application developed by Jain et al. [14], in which all the list of registered students in a particular course will be displayed when the lecturer start the application. The attendance registration is done by clicking a check box next to the name of the students that are present, and then a register button is clicked to mark their presence. But in this also, human involvement for attendance tracking is needed. Another similar project was proposed, but in this case the student will have to register individually using a client server socket program from their device (laptop) [15]. Registering the attendance by proxy is eliminated in the first and second project since the lecturer will see each and every student in the class, while in the latter case student snapshot is taken by the client application. Even though in both projects the time wastage is also there, but still it is an improvement on the manual process since attendance data can be stored safely and reports can be easily generated.

Cheng, et al. [16] developed the system to manage the context of the students for the classroom lecture by using note PCs for all the students. Because this system uses the note PC of each student, the attendance and the position of the students are obtained. However, it is difficult to know the detailed situation of the lecture. our system takes images of faces.In recent decade, a number of algorithms for face recognition have been proposed [17], but most of these works deal with only single image of a face at a time. By continuously observing of face information, our approach can solve the problem of the face detection, and improve the accuracy of face recognition.

III. PROPOSED AUTOMATIC ATTENDANCE MANAGEMENT AND STUDENT DATABASE MANAGEMENT SYSTEM

In this paper propose a novel face recognition method to take the attendance, where the faces are enrolled to Visual studio language based on continuous observation ,then student detail are registered with their face image. The personal details of the student and the mark scored by student in the school wise is initially stored ,academic achievements of the students is also registered in the registration phase once these details are entered then ID is allocated to student with their face image .In order to

perform the automatic calculation of attendance management system ,the features of the faces where extracted using the genetic based LBP feature extraction methods ,then matching is performed based on the neural network learning and self organizing map (SOM). Once the recognition is matched then current day attendance is calculated and updated in the database. During this attendance calculation process the details and current achievements the status of the student is automatically SMS to parents mobile. In this paper, purpose is to obtain the attendance, positions and images of students' face, which are useful information in the classroom lecture. Face images where converted into texture patterns with numerical data that can be recorded in a database. Like facial recognition software, an individual's code against an existing database of codes in order to confirm that individual's identity. Before scanning the face image everyone has to fill the registration form. These forms have the some of the basic details of the individual such as name, father's name, mother's name, date of birth, address, academic and school details and so on. After completion of the registration then next day face recognition is performed in the following ways (See Figure 1):

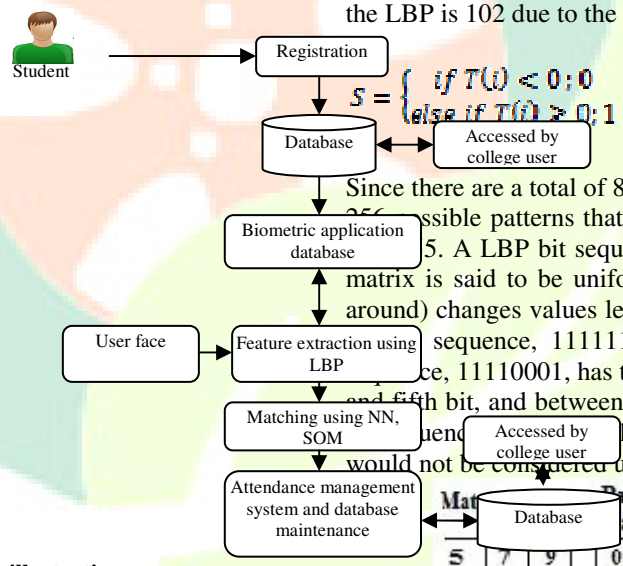


Figure 1.System process illustration

LBP can be introduced as follows. For the LBP method, typically a gray-scale image (as shown in Figure 2a) of a subject is initially segmented into a number of uniform, evenly distributed patches that cover the entire image as shown in Figure 2. LBP is then applied to each pixel of a patch resulting in a histogram representing the feature characteristics for that particular patch. A feature vector is created by simply concatenating all of the histograms associated with each patch. Figure 2 shows an example of how an LBP is calculated for one pixel within a patch. In Figure 2, consider a pixel surrounded by eight neighbors. The matrix represents the normal pixel values in an image. The values in the pattern matrix are obtained after using Equation 1. The weights are the worth of each value in the pattern matrix. To extract the LBP for the center pixel, C, the difference between it and each of its neighbor pixels, W, are calculated.

Figure 2a: Subject image

Figure 2b: Segmented

If the difference is zero or greater, then a value of '1' is associated with the difference. If the difference is negative, then a '0' is associated with the difference (as shown in Equation 2). The sequence of differences forms what we refer to as a pattern matrix.

$$T = \{(w_0 - c), \ldots . (w_{p-1} - C)\} \quad (1)$$

After the pattern matrix has been created, the binary number associated with the pattern matrix is computed starting with the top right neighbor and calculating clockwise. The values in the resulting matrix are summed together to get the LBP. For the center value in Figure 3, the LBP is 102 due to the sequence: 01100110

$$S = \begin{cases} if\ T(i) < 0; 0 \\ else\ if\ T(i) \geq 0; 1 \end{cases} \quad (2)$$

Since there are a total of 8 neighbors there exists a total of 256 possible patterns that can be extracted, ranging from 0 to 255. A LBP bit sequence corresponding to a pattern matrix is said to be uniform if the sequence (with wrap around) changes values less than two times. For example, the bit sequence, 11111111, has zero changes, the bit sequence, 11110001, has two changes: between the fourth and fifth bit, and between the seventh and eighth bit. The bit sequence has more than two changes and would not be considered uniform.

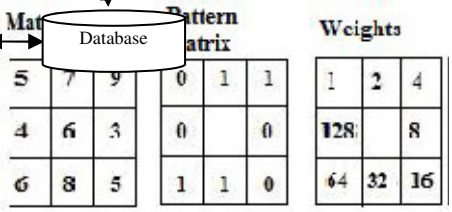


Figure 3: Computing LBP

As stated earlier, every patch has an associated histogram. Each histogram has 59 components referred to as bins: there are 56 bins that correspond to the 56 uniform bit sequences that have exactly two changes, 2 bins that correspond to the two bit sequences that have no change, namely, 00000000 and 11111111. These two sequences are assigned to Bin 0 and Bin 58 respectively. Finally, all non-uniform sequences are assigned to Bin 59. Thus, the histogram associated with a patch is a count of the number of sequences (of the pixels within a patch) that are associated with one of the 59 bins. A feature vector or template is a concatenation of all the histograms corresponding to the patches on an image. For example, if there are 24 patches and each patch has 59 bins, the total

size of the corresponding feature vector would be1416. In the feature vector, the

features corresponding to the first patch would start at 1 and go to 59. Similarly, the features of the second patch would begin at 60, while the 59 features associated with the 24th patch would begin at 1358. Recognition is performed by comparing a captured probe template, p, with all the vectors in a gallery set $H = \{h_0, h_1, \ldots, h_{q-1}\}$using the Manhattan distance metric (City Block). The subject, h_j, from the gallery set that is closest to $p$is considered to be its match.

The GEC used in this paper is a Steady State Genetic Algorithm (SSGA) [18]. This algorithm was chosen because of its simplistic nature. The SSGA is used to evolve a population of candidate feature extractors (FEs). A candidate FE, fe_i, is a 6-tuple, $<X_i,Y_i,W_i,H_i,M_i,f_i>$, where $X_i = \{x_i^0, x_i^1, \ldots x_i^{n-1}\}$ represents the x-coordinates of the upper leftmost pixel of the n possible patches , $Y_i = \{y_i^0, y_i^1, \ldots, y_i^{n-1}\}$ represents the y-coordinates of the upper leftmost pixel of the possible patches, $W_i = \{w_i^0, w_i^1, \ldots w_i^{n-1}\}$ represents the widths of the n possible patches measured in pixels, $H_i = \{h_i^0, h_i^1, \ldots h_i^{n-1}\}$ represents the heights of the n possible patches, $M_i = \{m_i^0, m_i^1, \ldots m_i^{n-1}\}$ represents the mask for each patch (1 means to extract features from the corresponding patch, 0 means do not extract features from the corresponding patch), and f_i represents the fitness of fe_i . Given a probe set and a gallery set the fitness is the number of errors made when comparing each probe to the gallery multiplied by 10 plus the fraction of the n patches from which features were extracted.

The evolutionary process of selecting parents, allowing them to create an offspring, and allowing the offspring to replace the worst fit FE in the population is repeated a user specified number of times (see Figure 3).

```
compute SSGA{
t = 0;
initialize pop(t)
evaluate pop(t)
While(Not done){
Parent1 = Select_From_Pop(t)
Parent2 = Select_From_Pop(t)
Child = Procreate(Parent1, Parent2)
Evaluate(Child)
Replace(Worst(Pop(t+1), Child)
t = t+1;
}
}
```

Figure 3: Psuedo-code for SSGA

Once the feature set of the student is extracted then perform matching between the input image and stored image in the database.

Artificial Neural Network : In recent years, there has been an increase in the use of evolutionary approaches in the training of artificial neural networks (ANNs). While evolutionary techniques for neural networks have shown to provide superior performance over conventional training approaches, the simultaneous optimization of network performance and architecture will almost always result in a slow training process due to the added algorithmic complexity [19]. The Back propagation neural network is also called as generalized delta rule. The application of generalized delta rule at any iterative step involves two basic phases. In the first phase, a training vector is presented to the network and is allowed to propagate through the layers to compute output for each node. The output of the nodes in the output layers is then compared against their desired responses to generate error term. The second phase involves a backward pass through a network during which the appropriate error signal is passed to each node and the corresponding weight changes are made. Common practice is to track network error, as well as errors associated with individual patterns. In a successful training session, the network error decreases with the number of iterations and the procedure converges to a stable set of weights that exhibit only small fluctuations with additional training. The approach followed to establish whether a pattern has been classified correctly during training is to determine whether the response of the node in the output layer associated with the pattern class from which the pattern was obtained is high, while all the other nodes have outputs that are low.

Self Organizing Map : The self-organizing map, developed by Kohonen, groups the input data into cluster which are, commonly used for unsupervised training. In case of unsupervised learning, the target output is not known [20]. In a self-organizing map, the neurons are placed at the nodes of a lattice that is usually one or two dimensional. Higher dimensional maps are also possible but not as common. The neurons become selectively tuned to various input patterns or classes of input patterns in the course of a competitive learning process. The locations of the neurons so tuned (i.e., the wining neurons) become ordered with respect to each other in such a way that a meaningful coordinate system for different input features is created over the lattice. A self-organizing map is therefore characterized by the formation of a topographic map of the input patterns in which the spatial locations of the neurons in the lattice are indicative of intrinsic statistical features contained in the input patterns, hence the name “self-organizing map”.

Algorithm 2: Self Organize Map
Select network topology;
Initialize weights randomly; and select D(0)>0;
While computational bounds are not exceeded, do
1. Select an input sample i_i;

2. Find the output node j* with minimum

$$\sum_{n_k} (i_{i,k}(t) - w_{j,k}(t))^2 \qquad (3)$$

3. Update weights to all nodes within a topological distance of D(t) from j*, using

$$w_j(t+1) = w_j(t) + \eta(t)(i_i(t) - w_j(t)) \quad (4)$$

where $0 < \eta(t) \leq \eta(t-1) \leq 1$;

4. Increment t;
End while

IV. EXPERIMENTATION WORK

The enrolment and registration phase is an administrative phase in which the administrator needs to log in. The user fingerprint as well as the other bio-data is stored for the first time into the database for student registration. The courses, lecturers and exams are also registered at this phase. All data and information required for the proper recording of attendance are enrolled. The lecturer selects the course code and the attendance type, then the student places his/her fingerprint on the fingerprint reader; the finger recognition unit compares the fingerprint features with those stored in the database. Visual Basic is used to create the graphical user interface between users and database. Figure 4 shows the main menu display for the attendance system.

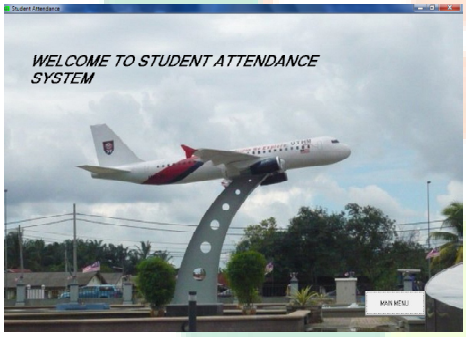


Figure 4 : Main menu display for the attendance system

There are three modes of operation to choose from which are Administrator, Lecturer and Student as shown in Figure 5. Administrator mode is used by staff at the administration office who will take the responsibility to manage student registration process for all courses. Administrator is also given authority to access to the database directly during add and drop period which is normally happen in the middle of each semester.

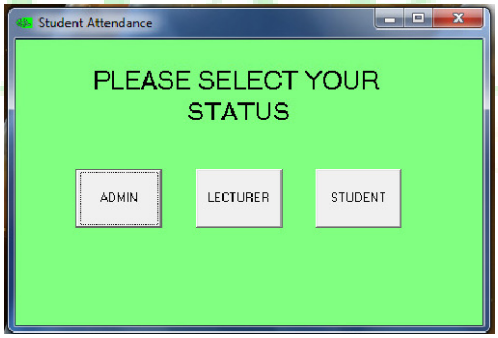
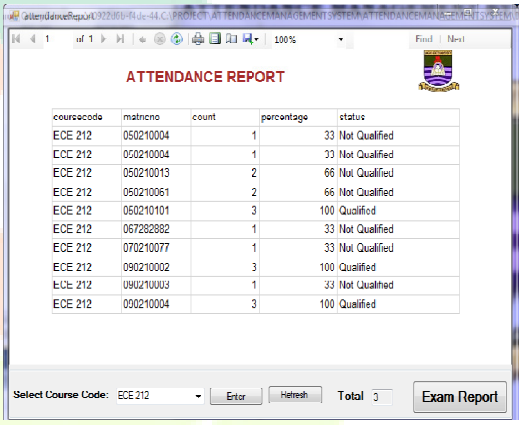


Figure 5 : Three modes of operation; Administrator, Lecturer and Student

Verification Process

When a student scan the face image on the sensor in order to be verified or identified, a verification template is created. The face matching process uses a proprietary algorithm to calculate the probability that a verification template and a registration template come from the same face. If the verification process is successful, student attendance status for that corresponding class will be updated as 'PRESENT', otherwise their status is considered as 'ABSENT'.Reports are generated for each course and the total number of students for each attendance is listed and their corresponding status. An example is shown in Figure 6.



coursecode	matricno	count	percentage	status
ECE 212	050210004	1	33	Not Qualified
ECE 212	050210004	1	33	Not Qualified
ECE 212	050210013	2	66	Not Qualified
ECE 212	050210061	2	66	Not Qualified
ECE 212	050210101	3	100	Qualified
ECE 212	067282882	1	33	Not Qualified
ECE 212	070210077	1	33	Not Qualified
ECE 212	090210002	3	100	Qualified
ECE 212	090210003	1	33	Not Qualified
ECE 212	090210004	3	100	Qualified

Figure 6:Reports Form for Attendance System

The test results shows that the system is effective and it has a fast response. There was no false identification of students, few cases of false reject which was later accepted and only pre-registered students were authenticated. The matrix of the identified students was enrolled for attendance automatically. The system was tested using the bio-data and faces collected from eighty (80) students of the department of Electronics and Computer Engineering, Lagos State University, Epe, Lagos State, Nigeria. In the test, there was no false acceptance i.e. a person that was not pre-registered was not falsely enrolled for attendance. There were a few false rejections during the test in which the system failed to identify some pre-registered users. The false rejects could be attributed to improper placement of the face on the scanner and fingers that have been slightly scarred due to injuries. The 80 candidates are divided into 8 groups of 10 students and a success rate of over 95.89% was obtained from the tests carried out. The results of the test are shown below in the chart (Table 1).

Table 1: Comparison of Success and Failure Rate

Groups	1	2	3	4	5	6	7	8
Success (%)	10	92.5	10	10	87.5	10	9	10
Failure (%)	0	10	0	0	20	0	10	0

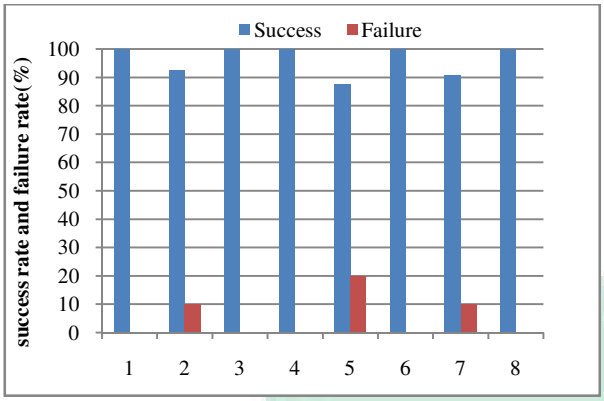


Figure 7: Comparison of Success and Failure Rate

The manual attendance system average execution time for eighty (80) students is approximately 17.83 seconds as against 3.79 seconds for the this automatic attendance management system using face recognition . Reports generation for the attendance system takes approximately 30s. The table is a 25 student sample out of the 80 tests conducted. It can be shown in the graph below and thus, it can be seen that the automatic attendance management system using face authentication is better and faster than other methods.

V. CONCLUSION AND FUTURE WORK

This paper presents the development of attendance and database management system for college system .For maintaining the student's attendance the entire database for college; initially the user enrol the face image ,then college student's details are added and stored in the database management system. After the details are stored in the database for authentication purpose biometric based attendance management system is proposed in this paper. The features of the face will be extracted using Genetic Based LBP Feature Extraction ,once the feature are extracted then matching is performed if it is correct then the present attendance is added to database management system. The proposed system not only performs attendance management system it also additionally manage the details of the students in entire system. The main purpose of this paper is to monitor the student attendance and maintain the database of the students which includes personal details, internal and external marks percentages in theory and laboratory sessions in more efficient way and send these details to their parents. This system resists students from bunking classes through SMS sending feature to parents. The following suggestions should be considered in carrying out further work on this study: The system could be modified into a web based system so that reports could be generated anywhere. The system could be adapted for human resource use i.e. attendance, pension, payroll processing, etc. Regarding our face recognition system, are planning introduce more different damaged faces of the same student and how to support damaged faces for maintenance of student and attendance generate database of the student which corresponds to student details it consists of address ,school details etc. for making the search more faster. On the other hand, the present methods can be improved by integrating video-streaming service and lecture archiving system, to provide more profound applications in the field of distance education, course management system (CMS) and support for faculty development (FD).

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