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Automated Student Attendance System using Fingerprint Recognition

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Abstract

The project work aims at designing a student attendance system which could effectively manage attendance of students of the department of Computer Science and Engineering at Jatiya Kabi Kazi Nazrul Islam University. In this project work, attendance is marked after students biometric identification. For student identification, a fingerprint recognition based identification system is used. Fingerprint features are considered to be the best and fastest method for biometric identification. These features are more secure to use and unique for every person that dont change in ones lifetime. Fingerprint recognition is a mature field today, but still identifying individual from a set of enrolled fingerprints is a time taking process. It was very necessary to improve the fingerprint identification system for implementation on large databases, e.g. of an institute or a country. In this project, the minutiae algorithm is used to develop the identification system which is faster in implementation than any other available today in the market. The proposed automated attendance system based on fingerprint recognition was tested on a class of student fingerprint databases and achieved significant results for taking an attendance of the students of the Department of Computer Science and Engineering. The proposed system has been implemented using C# programming paradigm platform.

Keywords: Attendance System, Biometric Features, Fingerprint Recognition, Identification, Verification.

Introduction

The present is the revolutionary time of computer technology. Most of the works depends on computer application. The traditional student attendance includes all the hassles of roll calling and very time consume of the students as well as teachers for conducting the classes in the department. The process is very boring and very time-consume of the students as well as teachers. So, a new approach will be needed to handle this process. This motivates us to design a reliable system for student attendance. The Biometric Identification Systems are widely used for unique identification of humans, like students, mainly for verification and identification. Also, the use of biometric features in student attendance management system is a secure approach. A biometric system can be either an identification system or a verification (authentication) system. Several biometric features are used for user verification. These are DNA Matching (Chemical Biometric), Ear(Visual Biometric), Eyes (Iris Recognition and Retina Recognition), Face Recognition (Visual Biometric), Fingerprint Recognition (Visual Biometric), Gait (Behavioral Biometric), Signature Recognition (Visual/Behavioral Biometric)**,** Speech and Speaker Recognition (Auditory Biometric), etc. Designing and developing a student attendance system based on fingerprint recognition manages records for attendance in the departments like CSE department of Jatiya Kabi Kazi Nazrul Islam University will be hassles-free, accurate and save valuable time of students as well as teachers for conducting the classes.

Automated Attendance Systems

An automated system eliminates the need for paper tracking and instead makes use of barcode badges, electronic tags, touch screens, magnetic stripe cards or even biometrics (fingerprints, retinal scans and facial features). This makes life easier for both the employee and the business as work hours are logged automatically when the employee enters and leaves the office. This eliminates the possibility of timesheets getting lost or manipulated. It also saves a lot of time for the payroll department since automated systems usually have integrated reporting functionalities which take care of most of the pay processing. Several types of automated attendance systems are available, such as, Radio Frequency Identification Cards Based Attendance System [1], Barcode Attendance Tracking System [2], Smart Card Access Control Attendance Systems [3], Punch Card Based Attendance System [4], Magnetic Stripe Card Based Attendance Systems [5], Biometric Attendance System [6], etc. Biometric time and attendance system has brought more precise system to measure group or individuals activities and attendance as well. This includes the addition of the different options; such as, Fingerprint Based Attendance System [7], Retina Based Attendance System [8] and Face Recognition Attendance Systems [9]. In this project work, fingerprint-based attendance system has been introduced for automatically monitoring and calculating the student attendances in a class.

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Fingerprint Recognition

Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and do not change in ones life time. A fingerprint recognition system operates either in verification mode or in identification mode [10]. Automated fingerprint identification is the process of automatically matching one or many unknown fingerprints against a database of known and unknown prints. Automated fingerprint verification is a closely related technique used in applications such as attendance and access control systems. On a technical level, verification systems verify a claimed identity (a user might claim to be John by presenting his PIN or ID card and verify his identity using his fingerprint), whereas identification systems determine identity based solely on fingerprints. The matching algorithm plays a key role in a fingerprint recognition system. Matching algorithms are used to compare previously stored templates of fingerprints against candidate fingerprints for authentication purposes [11]. Two majorly used algorithms are Pattern-based (or image-based) algorithms and Minutia Feature extraction based algorithms [12]. Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. Other algorithms use minutiae features on the finger. The major Minutia features are ridge ending, bifurcation, and short ridge (or dot) [13]. The ridge ending is the point at which a ridge terminates. Bifurcations are points at which a single ridge splits into two ridges. Short ridges (or dots) are ridges which are significantly shorter than the average ridge length on the fingerprint. Minutiae and patterns are very important in the analysis of fingerprints since no two fingers have been shown to be identical. The Minutia Feature extraction based algorithm has been used for matching the fingerprint templates in this project work. The algorithmic steps of the Minutia Feature extraction based algorithm is shown in Figure-1 [14].
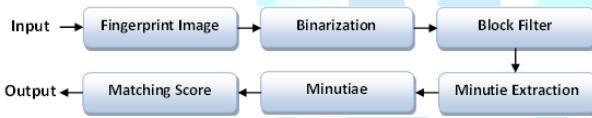
Figure 1: Implementation of Minutia Feature Extraction Based Algorithm.

Binarization converts gray scale image into binary image by fixing the threshold value. The pixel values above and below the threshold are set to 1 and 0 respectively. Its the most critical task in the fingerprint matching system. The binarized image is thinned using Block Filter to reduce the thickness of all ridge lines to a single pixel width to extract minutiae points effectively. Thinning preserves outermost pixels by placing white pixels at the boundary of the image, as a result first five and last five rows, first five and last five columns are assigned value of one. The minutiae location and the minutiae angles are derived after minutiae extraction. The terminations which lie at the outer boundaries are not considered as minutiae points and Crossing Number is used to locate the minutiae points in fingerprint image. Crossing Number is defined as half of the sum of differences between intensity values of two adjacent pixels. If crossing Number is 1, 2 and 3 or greater than 3 then minutiae points are classified as Termination, Normal ridge and Bifurcation respectively. To compare the input fingerprint data with the template data Minutiae matching is used. For efficient matching process, the extracted data is stored in the matrix format. During the matching process, each input minutiae point is compared with template minutiae point. In each case, template and input minutiae are selected as reference points for their respective data sets. The reference points are used to convert the remaining data points to polar coordinates. Matching an input image with a stored template involves computing the differences using distance measures techniques [15]. The matching score is combined with that obtained from the minutiae-based method,

using the some rule of combination [16]. If the matching score is less than a predefined threshold, the input image is said to have successfully matched with the template.

Methodological Steps

The methodological steps of the system are pictures by the block diagrams and shown in Figure-2. The proposed system has the following five major components.
  a) User and Device Interface
  b) Data Acquisition with Fingerprints
  c) Fingerprint Processing
  d) Fingerprint Verification
  e) Attendance Report Generation
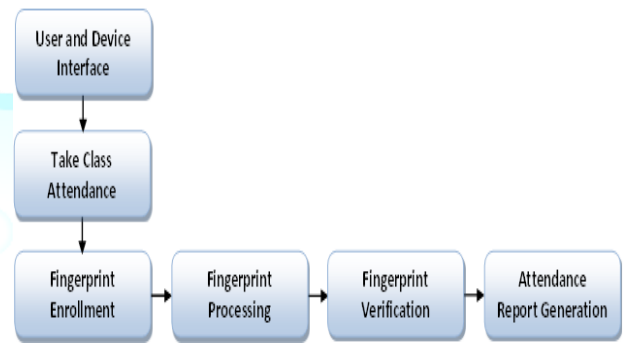
Figure 2: Block Diagram of the Proposed System.

User and Device Interface

User Interface is the communication between a user and the system. In the proposed system there are three panels, as shown in Figure-3. One is for the admin, one is for the teacher and the last one is for the student. Admin have to login the system in two ways. One is by providing the admins fingerprint and another way is to provide the username and password.

Figure 3: System User Interface.

Admin can add a students information, can add course, can assign courses to the teacher, can see the student and teacher report and can view the all students information at any time. The user interface also includes two registration forms that is used to get student and teacher information and their fingerprint. All the information about the student and teacher are taken through these form.
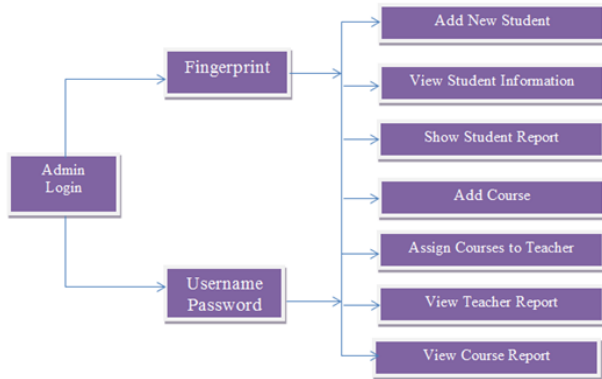

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Figure 4: Block Diagram of Admin Panel.

In teacher panel, every teacher gets a profile after registration. This profile shows all the basic information about the teacher. Admin assign different courses to different teacher. When a course is assigned to a teacher then it appears in his/her profile. Then the teacher can take attendance to each class both by manually or through fingerprint.

In student panel, student can only verify themselves through their fingerprint. When a student enrolls his finger the device collects his fingerprint template and matches this template with the entire stored template. If the template matches with any template then he/she is a verified student, otherwise not.

The system made the successful connection of fingerprint device with the computer, referred as fingerprint device interface. The device can be connected with the computer through 3 ways, such as TCT/IP Communication, Serial Port Communication and USB Client Communication. Here the fingerprint device was connected with the PC by using TCP/IP communication port.

Data Acquisition with Fingerprint

The system received the students Information by filled in the registration form and the students fingerprints from the fingerprint scanner as input, as shown in **Figure 5**. The fingerprint scanner can read fingerprints of any or more fingers of the both hands. The basic information was stored in the student profile table and the fingerprints were in the template data table. In this template table the key field is the student roll number. By this roll number all the templates are differed from one another.

Figure 5: Student Registration with Fingerprints.

Fingerprint Processing

When a student enrolls his finger on the devices scanner sensor, the device scans the edge and ridge of the finger. Then it set some value from the position of that ridges and edges and combines them. Finally from this point of fingers ridge and edge the device create binary template that is known as fingerprint template. The proposed system used these templates in the further steps, such as identification and verification.

Fingerprint Identification and Verification

Student Identification should be done by students fingerprint. For identification, the device scans the ridge and edge of the finger and creates a template. The system searches all the templates that are stored in the system database and matches with each saved template. If the templates match with the existing template then all the information of identified student have been displayed in the dash board, as shown in Figure-6. But if the template is not matched with any existing template then the system notifies that the user is not the valid student of the department. The teacher can take the student attendances through the fingerprint of the student by using fingerprint verification process.

Figure 6: Student Identification Form using Fingerprint.

Taking Class Attendance

The teacher can login the system by his/her username password or by fingerprint. The assigned courses are appeared in his/her profile, as shown in **Figure 7**. Then the teacher can take attendance to each class both by manually or through fingerprint. Teacher can take attendance through the fingerprint of the student. The process was done by fingerprint verification. The verified students attendances were stored in the attendance database. They can also take attendance manually by clicking the checkbox from the list of students, as shown in **Figure 8**.
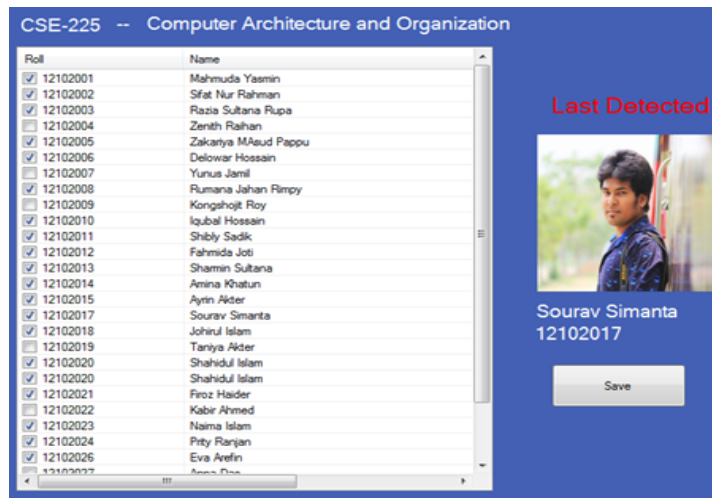

Figure 7: Teacher Profile Form.

Figure 8: Taking Student Attendance Form.

Figure 9: Details Attendance Report.

Attendance Report Generation

Finally, the student attendance report was generated from the attendance table. Two types of reports are available here. One is details report that contains the date by date attendance, total attended, total absent, percentage and the marks, as shown in Figure-9. The short report does not contain the date by date attendance.

Conclusion

An applicable attendance management system was designed for educational organizations in this project. This project mainly comprised of development of attendance management system and fingerprint identification system. This project presented a framework in which attendance management was made automated and on-line. There are some limitations of the fingerprint technology. These are the inability to enroll some users for poor fingerprints. For these cases one need to consider another biometric features. Also it can suffer some small changes along the time. To overcome this problem, the system may be necessary to re-enroll the fingerprint and/or use multiple fingerprints enrollment. The system needs to deploy specialized devices for fingerprint enrollment. In future this project can be extended to store fingerprint databases on the remote server that can be used over world-wide. A website will be hosted on the server for online access to attendance reports. The proposed system has been developed using C# programming paradigm platform. The proposed system can be implemented for all classes of the university if sufficient funds will be provided to us.

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