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A Review on Fingerprint Based Biometric Attendance System

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Abstract - Fingerprint attendance system aims to automate the attendance taking procedure using biometric technology (fingerprint). Fingerprints are a form of biometric identification which varies from person to person uniquely. The automated attendance system is extremely efficient and time saving compared to the traditional call out procedures. This paper gives us the information about fingerprint based attendance system that records the attendance of a person using a hand held fingerprint sensor.

Keywords - biometric, fingerprint, feature extraction, attendance management, optical sensor, minutiae detection.

[1] INTRODUCTION

Biometric system identification refers to the automatic identification of living individuals based on their physiological, behavioral or biological characteristics. Biometric system provide the next layer of security by focusing on a few physical characteristics such as fingerprint, facial thermo grams, hand vein, iris, retinal pattern and many more.

The most commonly used biometric technology currently is the fingerprint recognition attendance system which can be used for both verification and identification. In this the system reads finger patterns from the fingerprint module and compares the input fingerprint with the prints of all enrolled users in the database. If the details present in the database matches with the stored fingerprints, the system acknowledges the attendance.

[2] ATTENDANCE MANAGEMENT SYSTEM

Attendance management is the act of managing attendance or presence in a work setting to minimize loss due to an employee downtime [4]. Nowadays, it is a major part of today's human resource systems. To take organization towards better human resource practice, systems and excellence, hence regular attendance and punctuality are expected of all candidates in the workspace. Traditionally taking of attendance is much more time consuming and it is difficult to ascertain the number of candidates that have made the minimum percentage. Thus, the advanced automated technologies such as sensors and detectors would help us to eliminate all of these trouble spots.

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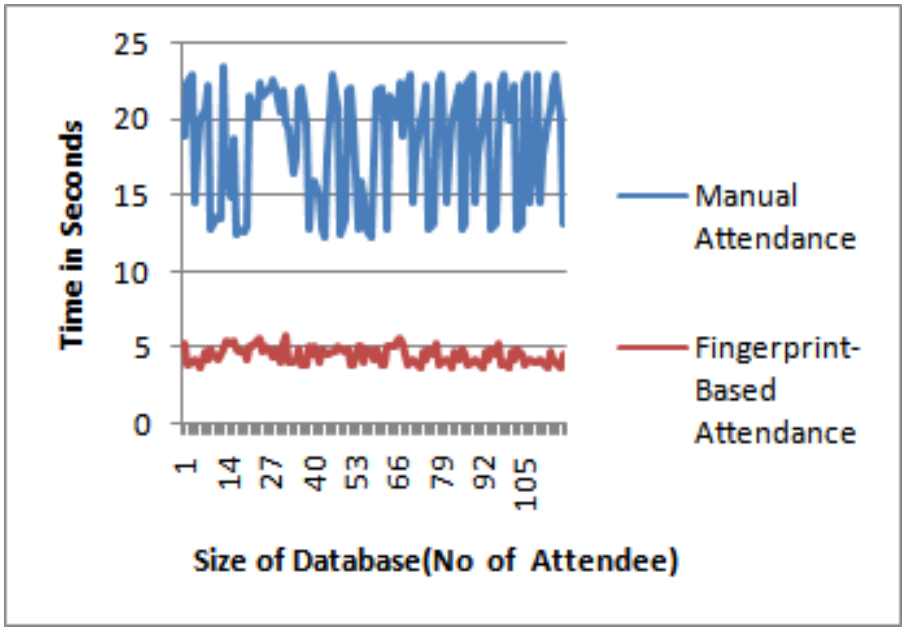

Fig. 1 – A survey on comparison of manual attendance system vs. automated attendance system in an organization [7]

[3] LITERATURE REVIEW

With the help of many researchers, we have implemented a fingerprint based digital attendance system which makes us use of a fingerprint sensor along with other technologies. The following systems are classified that is based on the techniques used to implement the system:

[3.1] *LAB View*

The system is designed using the 8051 microcontroller, R305 optical fingerprint sensor and LAB View. Firstly, microcontroller communicates with computer in which LAB View is installed and RS 232 is used for serial communication between the microcontroller and computer [10]. LAB View is system design software that is used in the system for storing attendance records, maintaining it in a text file and display it to the user.

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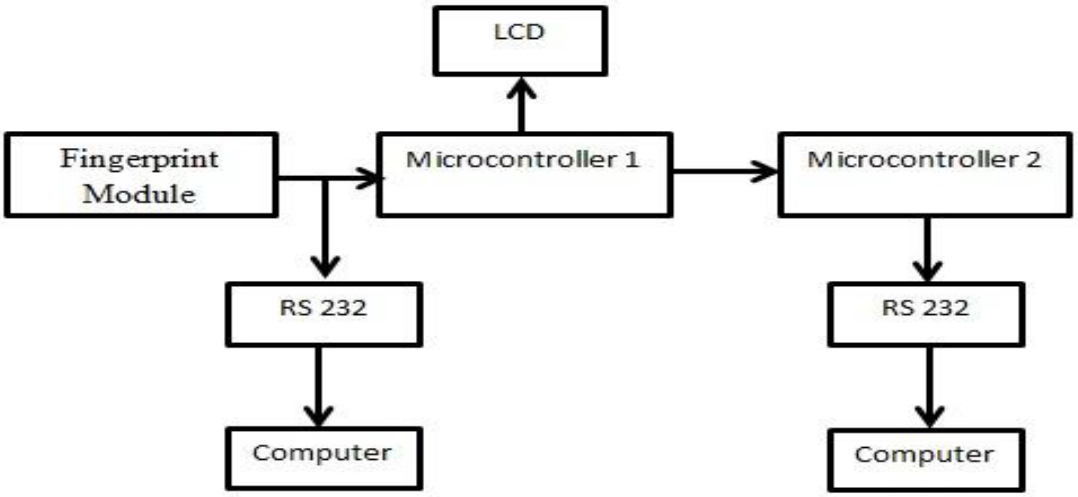

Fig. 2 – Block diagram for Microcontroller based system

[3.1.1] *System Overview*
The proposed system is totally based on an automatic attendance management technique that integrates fingerprint authentication into the process of attendance management. It consists of two processes, i.e., enrolment and authentication.

During enrolment, the biometrics of a user is captured and the data is extracted and stored in a database. This feature provides sufficient information to recognize the identity of the user, formulating the process of authentication. This process is carried out by the administrator of the attendance management system.

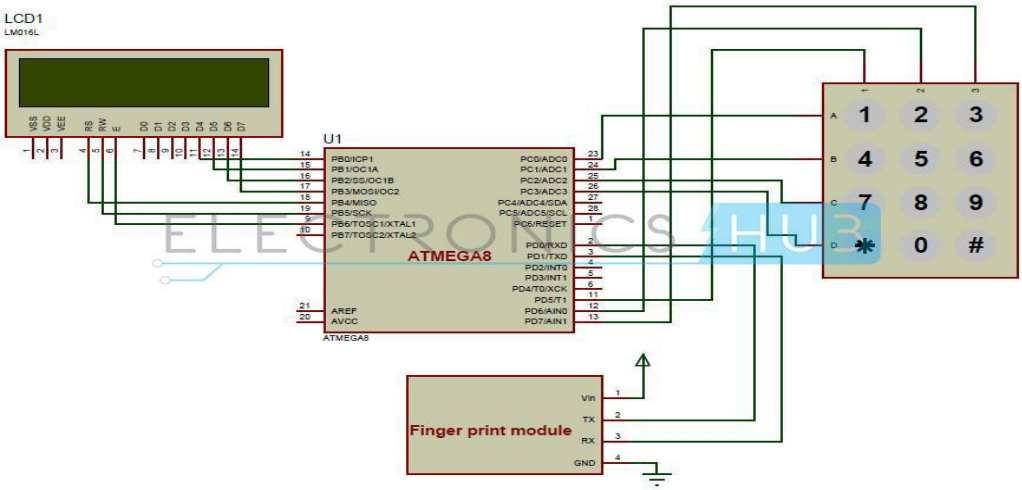

Fig. 3 – Setup for fingerprint based attendance system database [12]

And during authentication, the biometrics of the user is captured again and the extracted features are compared with the ones already existing in the database to determine a match. After a successful match, the attendance is marked by matching with the registered biometric identity of the user.

[3.2] *Internet of Things*
Hardware of the system includes like ARM9 S3C2440 processor board and FPS200 solid state fingerprint sensor. The database is designed using SQLite database management tool [5]. The main

function of the system includes automatic uploading of attendance. It allows for real time attendance data monitoring and processing using a website for any information regarding attendance records can be obtained from the website.

Fig. 4 - Fingerprint Sensor

[3.3] *RFID and Android*

This attendance monitoring system uses RFID (Radio Frequency Identification) technology where student has to swipe the RFID card along with his fingerprint to mark the attendance [3]. To check the record of any student at any area, an android application system is developed to track the location.

[3.4] *ZigBee, DSP and MATLAB*

Using ZigBee wireless technology, we can manipulate attendance which is portable in nature. This technology comprises of transmitter and receiver section and attendance supervision terminal. Transmitter section consists of optical fingerprint sensor such as OP-100N, ADSP-BF532 & ZigBee transmitter. Image enhancement is performed using MATLAB [2]. MS-access and Visual basic are used for database implementation and also RF (Radio Frequency) module can be in place of ZigBee to increase the range.

[4] FINGERPRINT BASED IMAGE PROCESSING

This processing tries to figure out the steps in variations of lighting, contrast and other inconsistencies which are introduced by the sensor during acquisition process. There are many such processes to develop the image, but some of the presently most famous and used techniques are like: Gaussian blurs, Sliding window contrast adjustment and, histogram based intensity adjustment.

Fig. 5 - A fingerprint acquired by optical sensor [11]

So, fingerprint recognition algorithms are diverse and are based on different techniques in order to extract useful information from the input image. With increase in clearance of the image, there is an increase in the accessibility of the system.

An image sensor is composed of "pixels", which is the smallest units of photo sites. Each pixel of an image sensor records the amount of light to which it is exposed and converts it into smaller unit of cells. The stronger the light, the higher amount of pixels are generated.

[4.1] *Image Data Acquisition and Database Matching*

The automated fingerprint use digital images of fingerprint for verification purpose. These sensors are based on optical, capacitance, ultrasonic and thermal and other imaging technologies. When a finger touches the sensor surface which is actually a side of a glass prism, in which one side of the prism is illuminated through a diffused light.

While the fingerprint valleys that do not touch the sensor surface reflect the light, and hence ridges that touch the surface absorb the light. The sensor features this property of light reflection to classify the ridges into different parts that appears dark.

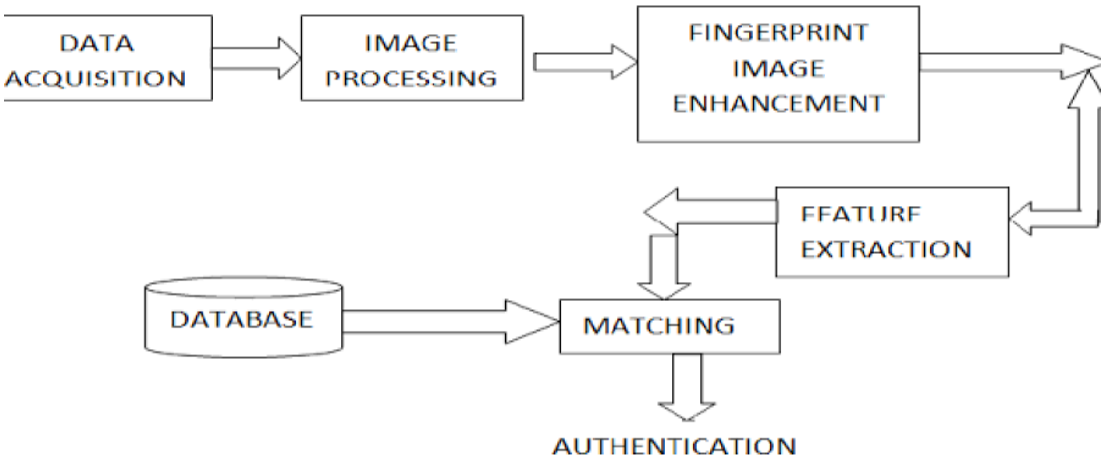

Fig. 6 - Block diagram for data extraction processing [4]

[4.2] *Feature Extraction*

Feature extraction techniques are pixel processing algorithms that are used to locate points on an image that can be registered with smaller points on other images [14].

A fingerprint image is composed of a spatial map of the friction ridges of the skin. There are various features used in the process of matching fingerprints such as fingerprint minutiae, ridge bifurcation and ridge ending. In this technique, the most commonly employed method is the minutiae extraction upon which the Crossing Number (CN) is based on. The CN for a pixel X is given by,

$$CN=0.5 \sum_{i-1}^{8} |X_i - X_{i+1}| \qquad X_9=X_1 \qquad \text{.....} \quad \text{(i)}$$

where, X_i is the pixel value in the neighborhood of X.

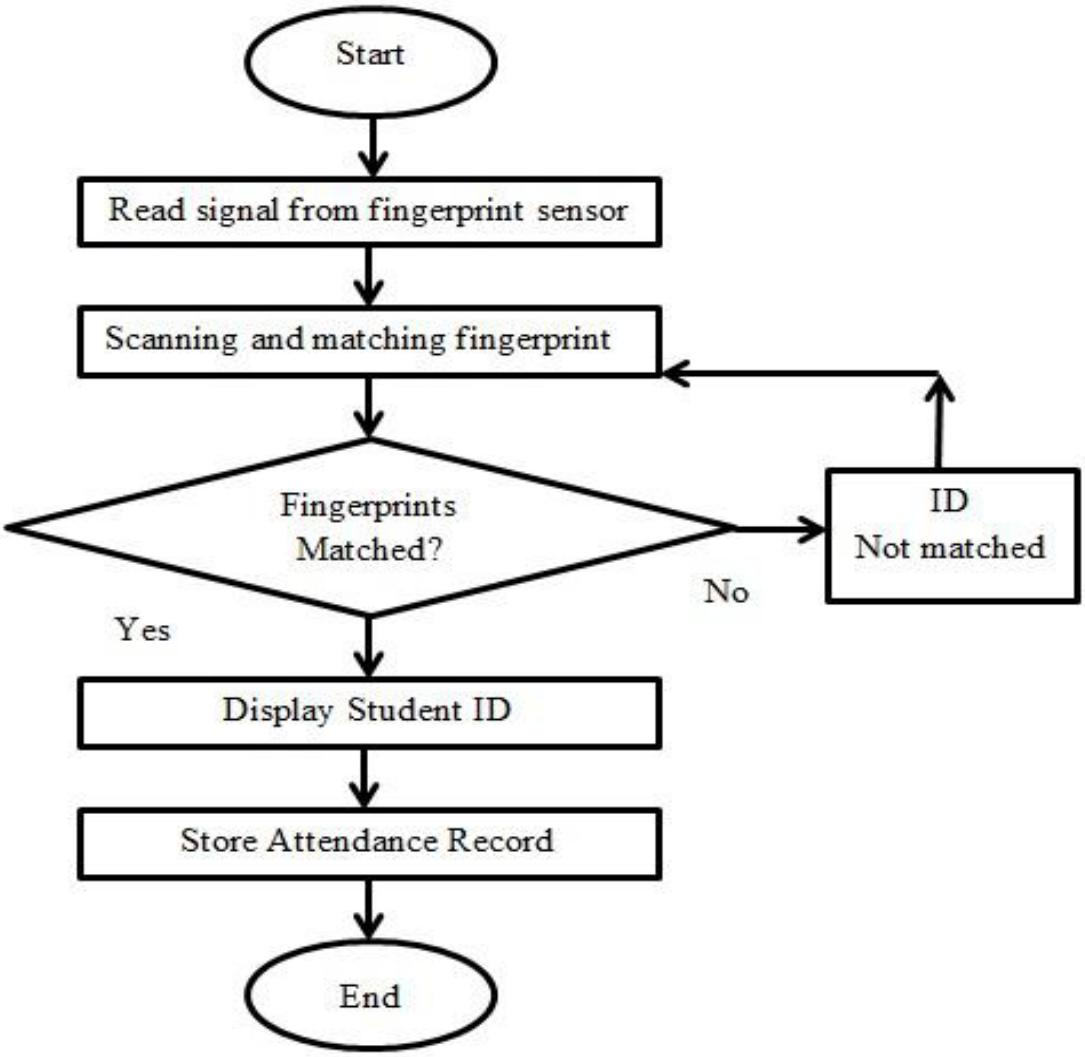

Fig. 7 – Flowchart for working of fingerprint based management system

The feature extraction technique for minutiae points is described below: -

[4.2.1] *Minutiae Extraction*

Most of the Minutiae extraction traces the fingerprint skeleton to find different types of minutiae points.

(a) Orientation Estimation: The fingerprint picture gives an oriented ridge and texture pattern at a pixel (x, y) at which the angle of the ridges lies within a small neighborhood centered at the same coordinates from the horizontal axis. Therefore a fingerprint is classified into many small units of blocks.

(b) Segmentation: During this stage the portions of fingerprints depicting the finger foreground is segmented.

[4.2.2] *Ridge Detection*
When the value of gray level appears on the ridges it reaches the local maxima along a direction at an angle of 90^{o} to the local ridge patterns. It falls under one of the major characteristics of it in forming an image of the fingerprint. The resulting ridge map often contains false ridges in the form of holes and spackles. A connected component algorithm is used for cleaning the ridge map. Finally the ridges are thinned using standard thinning algorithm [6].

[4.2.3] *Minutiae Detection*
The minutiae points are extracted from the thinned ridge map by testing the very next of each ridge skeleton pixel. Although the information extracted may contain spurious minutiae but the bending of ridge direction and width are the main data extracted.

[4.2.4] *Post processing*
For the elimination of spurious minutiae, a number of heuristics are being used. False minutiae points are mainly generated at the ridges. These false minutiae at the border can be recognized by examining the number of foreground pixels in a region around minutia point [1]. The minutia points can be removed if and only if, number of foreground pixels is comparatively smaller.

[5] ACKNOWLEDGMENT

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[6] CONCLUSION

Biometric technology is a reliable tool for authentication. This paper has successfully presented a reliable, secured, fast system replacing a manual and unreliable system, holding the hands of this biometric technology. This system can be implemented in any of the institutions regarding the management of attendance. Hence, a system with expected results has been developed but there is still room for improvement.

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