American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-03, Issue-03, pp-121-126
www.ajer.org

Research Paper Open Access

Development of a Networked Thumb Print-Based Staff Attendance Management System

Tolulope Awode [1], Oluwagbemiga Shoewu [2], Oluwabukola Mayowa Ishola [3], Segun O. Olatinwo [4]

[1] *Department of Computer Science and Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.*
[2] *Department of Electronics and Computer Engineering, Lagos State University, Epe Campus, Nigeria*
[3] *Department of Computer Science, University of Lagos, Akoka, Lagos State, Nigeria.*
[4] *Department of Computer Engineering, Moshood Abiola Polytechnic, Abeokuta, Nigeria.*

Abstract: - This paper focuses on the development of a networked thumb print-based attendance management system. Now, more than ever, it has become necessary to give more thought to the methods of time and attendance management. The traditional time clock, manual attendance registering often no longer makes sense and simply does not meet the needs of the modern work environment. This system offers a comprehensive software solution that will streamline company's operations, and simplify timekeeping. Nowadays, the need of a solution for Time and Attendance in the modern company is a necessity. It is important to be able to manage and control the workers by means of a system of control of times and schedules.

Keywords: - *Staff attendance management, networked thumb print, Service Oriented Application*

I. INTRODUCTION

Centuries back, employees' attendances are captured by using attendance sheet. The attendance sheet is the paper used by the employer to take their employees' attendance. In the attendance sheet, the information needed are the employee's name, address and their signature. In this attendance, signature is really important because it is used to verify the employee's attendance. Time and attendance management is a system of monitoring employees' work hours for the entire company and the analysis of various human resource figures such as overtime allowance, meal allowance, transport allowance and even bonus that are often derived from employee working hours. For the management level personnel, such a system allows them to monitor employee performance automatically and thus allowing them to evaluate if there are any loopholes within the system. It also keeps track of employees within the organization by forcing them to be accountable for their absences – once again, better for the business than for the employee himself. That is why most bosses are eagerly engaging in implementing time and attendance management system into their standard operating procedures.

In manual attendance system all work is done on paper. The whole session attendance is stored in register and at the end of the session the reports are generated. Some of the problems encountered with manual attendance system are: less user friendly, difficulty in report generation, manual control, lots of paperwork, and time consuming. The proposed system is allows efficient control of attendance and punctuality of all employees. It empowers management with real-time employee information and labour data such as working times, absences, attendance, tardiness and more. The system can be set up in companies/ businesses as a technology demonstration project wherein employees and visitors of the organization are tracked. It is the key to proficient and successful time tracking and management in your workplace. It enables you to collect and organize your employees' time data simply and accurately. It represents the most state-of-the-art method of time management for today's businesses.

II. MATERIALS AND METHODS

Design Methodology Overview

This paper attempts to design and implement a networked thumbprint based attendance management system which requires that staff should register the attendance as soon as he/she gets to the office in the morning, and the Staff is expected to register at the end of the day's work. The proposed system is enhanced with advanced patented Biometric Technologies. It significantly simplifies the routine time management tasks and makes the procedures of registering the coming and leaving events quick, fool-proof and convenient.
The proposed system performs: recording of employees' arrival and departure events, accounting of work hours for each employee, department or company, automation of report, data export to .html, .xls, .xml, .pdf formats, storage and search of employees' biometric records in the database, creation of Company's Divisional Structure, monitoring of employees' activity, On-line notification to the Administration Officer on the presence of employees at their workplaces;

Application Requirements
The functional components employed by the proposed system are: fingerprint scanner, Griaule Fingerprint SDK, laptops, network, Service Oriented Application (SOA), Web Server, Back-End/Database, web camera

Application Components
The application components are subdivided into seven main components as shown in Figure 1.

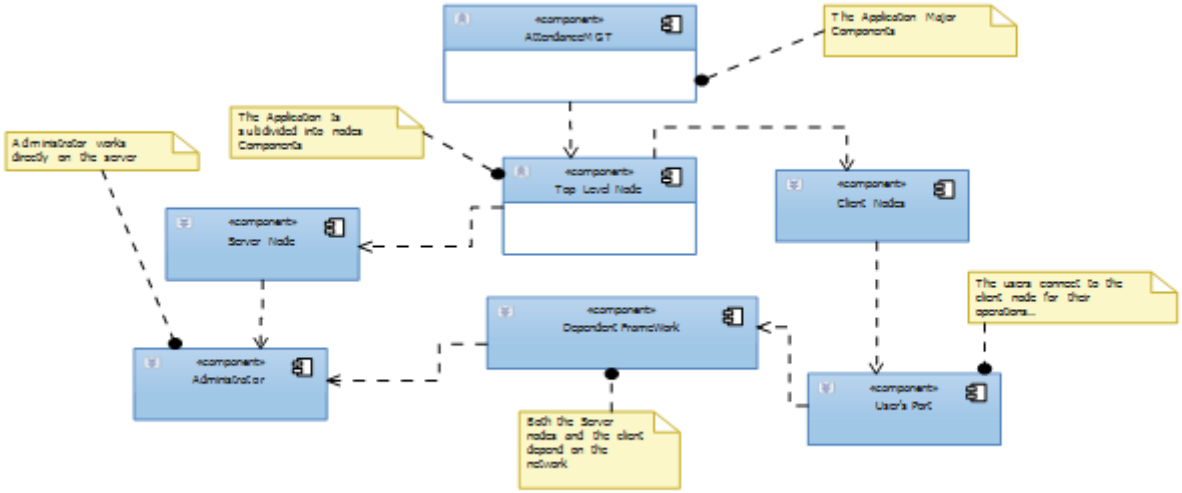


Figure 1: Application Components

Application Use Case
Figure 2 detailed the interaction between the application and the users (Administrators and the other users) also known as the actors can be explained in the diagram below:

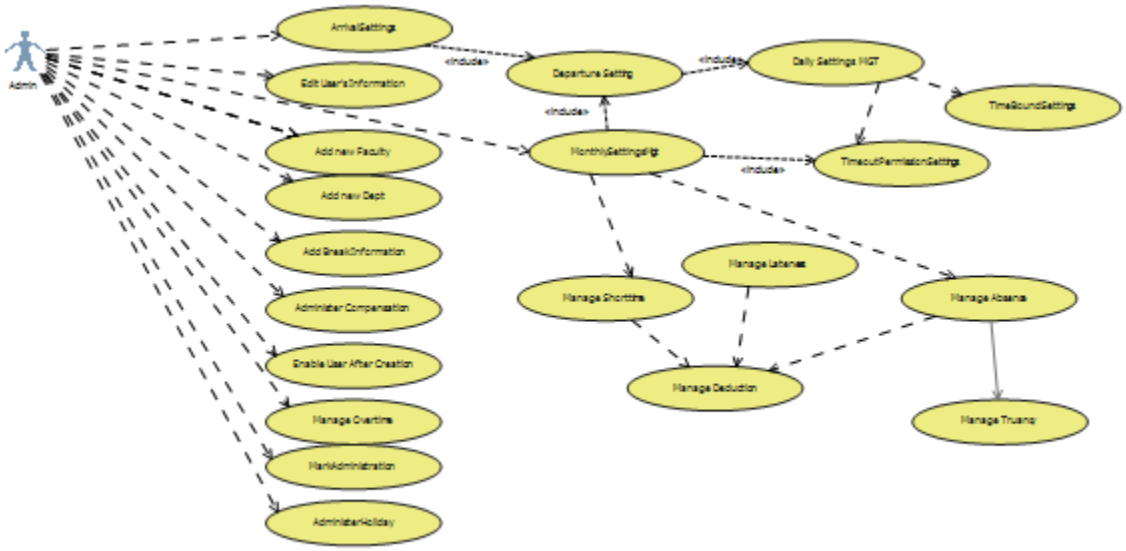


Figure 2: Application Use Case

The Administrator performs the following actions: manage users, manage attendance, manage deductions, manage faculty, manage departments, and manage reports

III. FINGERPRINT MATCHING ALGORITHM

Fingerprint Matching

Given a reference representation in database and an input representation extracted from an input image, the matching stage determines the similarity of two fingerprint features and decides whether they are of the same finger. In most Automated Fingerprint Identification Systems (AFIS), the representation of fingerprints is based on minutiae such as ridge ending and ridge bifurcation, with each minutia being characterized by its locations and orientation. With this representation, the matching problem is reduced to a point pattern matching problem. In the ideal case described by Jain, the matching can be accomplished by simply counting the number of spatially overlapping minutiae. But in practice, the sensing system maps the three-dimensional finger on to two dimensional images. Once the location, pressure and direction of impression change, the mapping will change accordingly, which inevitably leads to nonlinear deformation of fingerprint images. Two fingerprint images may have translation, rotation or even nonlinear deformation between them. If the time span between two impressions is long, the images may also change due to cuts on finger or skin disease. In most systems, fingerprint is represented with a set of minutiae which is called Template. The representation itself may be noisy due to presence of spurious minutiae and absence of genuine minutiae. Also, the properties of minutiae such as the location and orientation may be inaccurately estimated due to image degradation and imperfect reprocessing. Considering these, a good fingerprint matching algorithm should meet the following two criteria:

- Be robust to all kinds of possible deformation which are commonly observed in fingerprints and are hard to model.
- Be robust to small perturbation on minutiae and minutiae properties.

Several approaches have been proposed for point pattern matching, but these methods did not perform well because they did not make use of the extra information provided by fingerprint minutiae.

Fingerprint Matching Based on Error Propagation

After a fingerprint image is enhanced and thinned with image processing methods, the ridges associated with each minutia are tracked. The tracking procedure stops when the tracking length reaches a certain predefined threshold or another minutia is encountered on the ridge. The ridge sampling method is similar to that of Hong's. In order to overcome the ambiguity that orientation may cause, we use the direction of minutiae as x-coordinate in our sampling instead. Therefore, each ridge is represented by its direction and sampling values. And each minutia is repented by its type, position, direction as well as the ridges it resides (one ridge for an end and three ridges for a bifurcation). The matching algorithm is a three-step method:

- First, each minutiae in the reference template is matched with each minutiae in the input template and all resulting potential correspondences are used to find several most reliable one, the initial correspondences, using Hough transformation;
- Secondly, all minutiae surrounding the correspondence are matched and those minutiae pairs whose matching error are less than certain thresholds are added to the MatchedSet;
- Finally, we adjust the matching error of each unmatched minutia according to the information provided by the MatchedSet recursively until the number of elements in MatchedSet stops increasing. A conformation process which checks the consistency of the matching errors of elements in the MatchedSet is made to label and remove the mismatched minutiae after each iteration.

Correspondence Estimation

In the ideal case, the alignment of two point patterns can be precisely decided according to one correspondence. But in practice, we need more candidates to estimate correspondences robustly. To do this, we define two kinds of correspondences: End Correspondence and Bifurcation Correspondence. The similarity criteria are different in the two cases. Suppose that d and D (the reference and input features are denoted by lowercase and capital letters respectively) are the reference and input ridges respectively, d^i and D^i are the i_{th} points on the ridges, and the Similarity S of two ends is defined in Equation 1.

$$S = \frac{\sum_{i=0}^{L} \left(d^i - \mathrm{D}^i\right)^2}{L} \qquad (1)$$

d^i = Reference input in the i^{th} points on the ridges
D^i = Input ridges in the i^{th} points on the ridges
S =Similarity of two ends

L = Length of the shorter ridge.

Here, nonlinear penalty function is adopted to ignore small deformation and emphasize large deformation because our goal is to find the most consistent area (the region around the correspondence) of the two templates. The similarity measure of bifurcation is composed of two parts, namely the sum of the similarity scores of the three ridges and the matching error of direction.

Then the similarity measure of two bifurcations is defined in Equations 2 and 3.

$$S = \frac{\sum_{j=0}^{2} \frac{\sum_{i=0}^{L_j} \left(d^i_j - \mathrm{D}^i(k+j)\%3\right)^2}{L_j}}{4} \qquad (2)$$

d_0, d_1, d_2= reference ridges in the ith points on the ridges

D_0, D_1, D_2 = three input ridges in the ith points on the ridges

T_0,T_1,T_2 are the orientation of these ridges respectively.

k = point on the ridge % = modulo operation

S =Similarity of two ends

$$\Delta\theta = \min_{i=0}^{i=2}\left(\left|\theta_1 - \Theta_{(i+1)\%3} - \left(\theta_0 - \Theta_i\right)\right| + \left|\theta_2 - \Theta_{(i+2)\%3} - \left(\theta_0 - \Theta_i\right)\right|\right) \qquad (3)$$

k = point on the ridge % = modulo operation

Θ = ith input minutiae

θ = ith template minutiae

IV. RESULTS AND DISCUSSION

User Interface of the System Design

The Attendance Management System starts with the Administrator to preset the username and the password. Admin may also find it convenient to access the system with his private login password initially set by default to "admin". The admin can create a new staff with the following fields: staff Id, surname, other names, phone no, department and address, etc. The fingerprint of staff is registered into the database through finger print reader and also the passport of the staff.

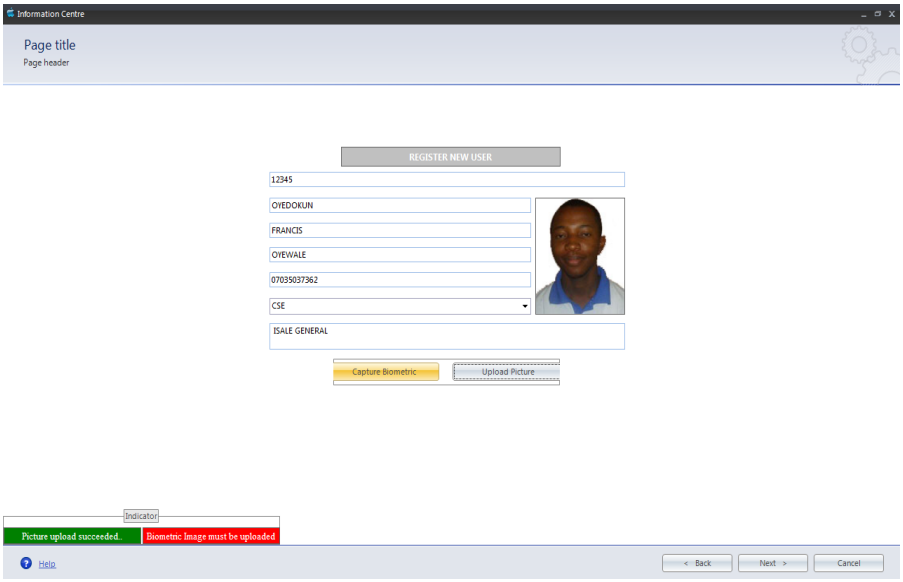
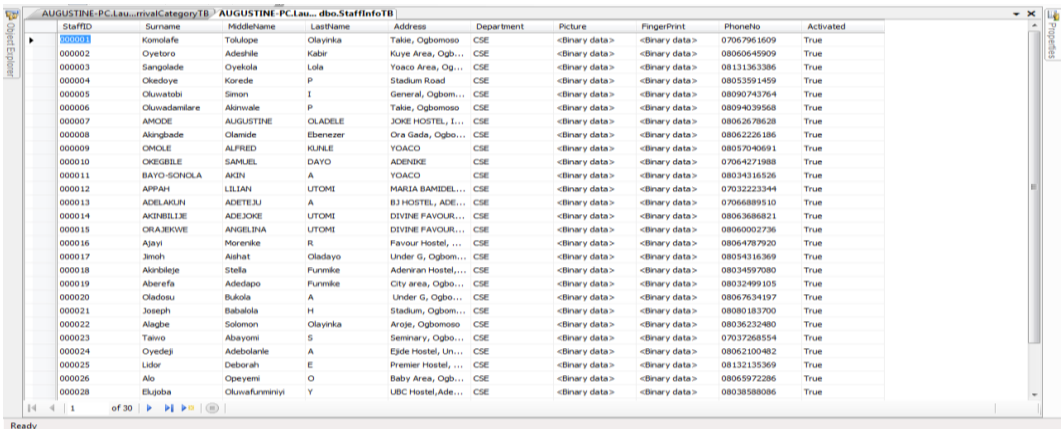


Figure 3: Registration Interface

Users Information

The interface below shows the information of all the Users as registered in the database:



StaffID	Surname	MiddleName	LastName	Address	Department	Picture	FingerPrint	PhoneNo	Activated
000001	Komolafe	Tolulope	Olayinka	Takie, Ogbomoso	CSE	<Binary data>	<Binary data>	07067961609	True
000002	Oyetoro	Adeshile	Kabir	Kuye Area, Ogb...	CSE	<Binary data>	<Binary data>	08060645909	True
000003	Sangolade	Oyekola	Lola	Yoaco Area, Og...	CSE	<Binary data>	<Binary data>	08131363386	True
000004	Okedoye	Korede	P	Stadium Road	CSE	<Binary data>	<Binary data>	08053591459	True
000005	Oluwatobi	Simon	I	General, Ogbom...	CSE	<Binary data>	<Binary data>	08090743764	True
000006	Oluwadamilare	Akinwale	P	Takie, Ogbomoso	CSE	<Binary data>	<Binary data>	08094039568	True
000007	AMODE	AUGUSTINE	OLADELE	JOKE HOSTEL, I...	CSE	<Binary data>	<Binary data>	08062678628	True
000008	Akingbade	Olamide	Ebenezer	Ora Gada, Ogbo...	CSE	<Binary data>	<Binary data>	08062226186	True
000009	OMOLE	ALFRED	KUNLE	YOACO	CSE	<Binary data>	<Binary data>	08057040691	True
000010	OKEGBILE	SAMUEL	DAYO	ADENIKE	CSE	<Binary data>	<Binary data>	07064271988	True
000011	BAYO-SONOLA	AKIN	A	YOACO	CSE	<Binary data>	<Binary data>	08034316526	True
000012	APPAH	LILIAN	UTOMI	MARIA BAMIDEL...	CSE	<Binary data>	<Binary data>	07032223344	True
000013	ADELAKUN	ADETEJU	A	BJ HOSTEL, ADE...	CSE	<Binary data>	<Binary data>	07066889510	True
000014	AKINBILLIE	ADEJOKE	UTOMI	DIVINE FAVOUR...	CSE	<Binary data>	<Binary data>	08063686821	True
000015	ORAJEKWE	ANGELINA	UTOMI	DIVINE FAVOUR...	CSE	<Binary data>	<Binary data>	08060002736	True
000016	Ajayi	Morenike	R	Favour Hostel, ...	CSE	<Binary data>	<Binary data>	08064787920	True
000017	Jimoh	Aishat	Oladayo	Under G, Ogbom...	CSE	<Binary data>	<Binary data>	08054316369	True
000018	Akinbileje	Stella	Funmike	Aderiran Hostel,...	CSE	<Binary data>	<Binary data>	08034597080	True
000019	Aberefa	Adedapo	Funmike	City area, Ogbo...	CSE	<Binary data>	<Binary data>	08032499105	True
000020	Oladosu	Bukola	A	Under G, Ogbo...	CSE	<Binary data>	<Binary data>	08067634197	True
000021	Joseph	Babalola	H	Stadium, Ogbom...	CSE	<Binary data>	<Binary data>	08080183700	True
000022	Alagbe	Solomon	Olayinka	Aroje, Ogbomoso	CSE	<Binary data>	<Binary data>	08036232480	True
000023	Taiwo	Abayomi	S	Seminary, Ogbo...	CSE	<Binary data>	<Binary data>	07037268554	True
000024	Oyedeji	Adebolanle	A	Ejide Hostel, Un...	CSE	<Binary data>	<Binary data>	08062100482	True
000025	Lidor	Deborah	E	Premier Hostel, ...	CSE	<Binary data>	<Binary data>	08132135369	True
000026	Alo	Opeyemi	O	Baby Area, Ogb...	CSE	<Binary data>	<Binary data>	08065972286	True
000028	Elujoba	Oluwafunminiyi	Y	UBC Hostel,Ade...	CSE	<Binary data>	<Binary data>	08038588086	True

Figure 4: Attendance Record Showing Staff Information

The primary key linking each table containing the records were indicated with a small "key" icon in each of the tables linked. The backend was implemented using microsoft SQL server 2008.

Staffs' Attendance and Report

Figure 5 shows a staffs' attendance for a day. The time at which the User clocks in will be recorded into the database.

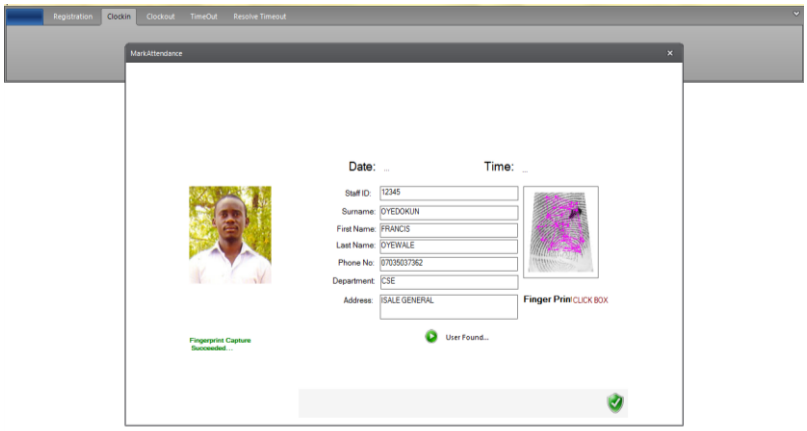


Figure 5: Daily Attendance Record

Attendance Management

The attendance of the Staff marked was documented and sectional reports based on the arrival list, departure list, all staff List, Truancy list, Lateness and Deduction based on the decision of the Administration.

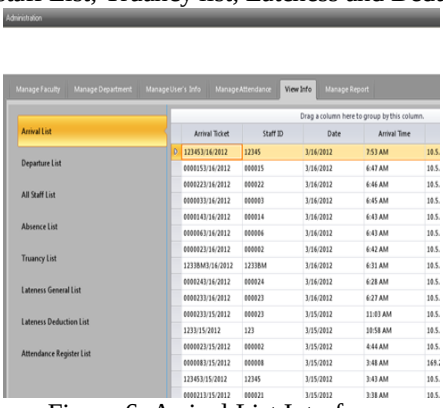


Figure 6: Arrival List Interface

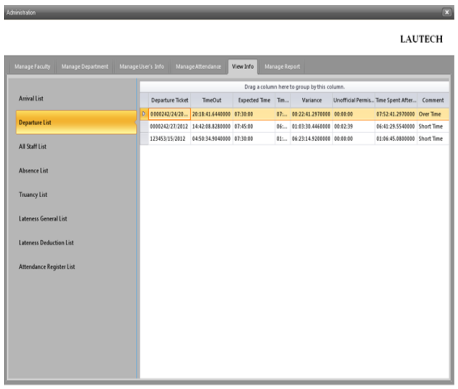


Figure 7: Departure List Interface

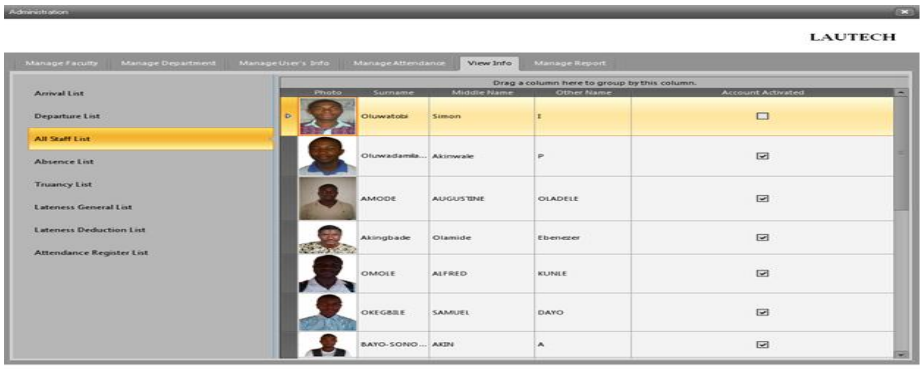


Figure 8: All Staff List Interface

V. CONCLUSION

Thumbprint based attendance system was aimed to address the shortcomings of existing means of taking attendance with a view of improving sanity and credibility of the education system in tertiary institutions and to keep the attendance of the staff for future reference. This also allows the implementation of the deduction on the staff that did not fulfill the basic requirement of marking their daily records. Employing the uniqueness and simplicity of thumbprints in the development ensured that the proposed aim of this work was achieved.

Recommendations

From the foregoing discussions, the following suggestions were made:

- The system could be used for attendance management system in an educational system but could also be adapted to benefit other similar areas such as industrial sector, banking sector, ministries among others.
- Also, staff may not prove their level of commitment to the work they employed for because many may come to mark attendance in the morning and leave the environs with the aim of coming back in the evening to sign out without doing any tangible work for the day. In lieu of this, it is recommended that the establishment should employ the use of access control database system that will only allow the employee (Staff) to open the door if and only if he signs out. This requires the use of fingerprint door.

REFERENCES

[1] AK Jain, A Ross and S Prabhakar. An introduction to biometric recognition, Circuits and Systems for Video Technology. IEEE Transactions. 2004; Vol. 14, Issue 1, p. 4 – 20.
[2] HP Cheong and H Park. Fingerprint classification using fast Fourier transform and nonlinear discriminant analysis Pattern Recognition. 2005; 38, 495 – 503.
[3] Digital Persona. Guide to Fingerprint Recognition, Inc. 720 Bay Road Redwood City, CA 94063 USA, Available at: http://www.digitalpersona.com, accessed November 2008.
[4] F Zhao, X Tang. Preprocessing and post-processing for skeleton-based fingerprint minutiae extraction, Pattern Recognition. 2007; 40(4): p. 1270-1281.
[5] Fingerprint Database (FVC2002). Available at: http://bias.csr.unibo.it/fvc2002, accessed July 2012.
[6] U Halici, LC Jain, A Erol. Introduction to Fingerprint Recognition, Intelligent Biometric Techniques in Fingerprint and Face Recognition, CRC Press. 1999.
[7] E. Hastings. A Survey of Thinning Methodologies, Pattern Analysis and Machine Intelligence, IEEE Transactions. 1992; Vol. 4, Issue 9, p. 869 - 885
[8] HC Lee and RE Gaensslen. Advances in Fingerprint Technology, Elsevier Science, New York, ISBN 0-444-01579-5. 2009.
[9] L Hong. Automatic Personal Identification Using Fingerprints. Ph.D. Thesis, ISBN: 0-599-07596-1. 1998.
[10] D Maltoni, D Maio, AK Jain, S Prabhaker. Handbook of Fingerprint Recognition. Springer, New York, USA. 2003
[11] K Manvjeet, M Singh, G Akshay, and SS Parvinder. Fingerprint Verification System using Minutiae Extraction Technique. World Academy of Sci. Eng. and Tech. 2008