

Android Based Advanced Attendance Vigilance System Using Wireless Network with Fusion of Bio-metric Fingerprint Authentication

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Abstract— In this digital era, different organizations have started taking attendance using biometric fingerprint authentication. This will keep the track of employee's attendance but the question arises if the employee is fully present at his/her workplace after giving attendance. In this modern era of digitalization, it is seen that after giving attendance a huge number of employees escape away from their workplace and do their personal job in the office time. This paper focuses on a smart attendance system where an android device will be used as a smart ID card. A mobile application is developed in Java to ensure the attendance of an individual employee using bio-metric fingerprint authentication. In addition, the entire working place will be a Wi-Fi zone. So, the connection or disconnection of the android device (Smart ID card) to the router will determine whether an employee is present in the working place or not. A counter will be there into the system to count the total amount of time an employee spends in the working place.

Keywords— Wireless Network, Router, MAC address, Attendance System, Android Based Mobile Application, Fingerprint

I. INTRODUCTION

In the recent years, biometric fingerprint authentication has become very popular to identify an individual. Due to its uniqueness and consistency [1], it is widely used in the world. This technology can't be forged easily. It is highly secured. Different organizations use it to identify their employees. It diminishes the proxy giving the attitude of the employees. To identify the employee, the fingerprint sensors are generally set up in front of the entrance or exit door. Sometimes, some employee misuses the advantage of this fingerprint sensor. An employee uses his own fingerprint to open the door for someone else to leave. So, the fingerprint sensor can't ensure the presence of an employee in the workplace.

To reduce the misuse of the hardware, an android application can play a powerful role. As the android application system has made our life smooth and comfortable. In recent years, mobile phones have become one of the popular gadgets and people can't think of their lives without mobile phones for a minute. So, we have developed a fusion of wireless network and fingerprint authentication system as a mobile application.

A mobile application can't ensure the physical presence of an employee inside his workplace. To ensure the physical presence, we need the workplace to be connected to a

router. An employee can be able to give his attendance only if he is connected to that specific router. This ensures the physical presence of an employee. A counter will be there in the system which will calculate the time of being present in the workplace as long as someone is connected to the router. When an employee leaves, the device will get disconnected and as soon as it comes into the range of the router (Working place) it will be reconnected again and resume the counting process where it left. The whole system is a fusion of fingerprint authentication system and wireless router where the attendance will be started counting only after an employee is in the router range and gets logged in through fingerprint authentication at the same time. This is a session based log-in system which will randomly get signed out at any time of the working hour and needs the employee to get logged in again through fingerprint authentication within a given time to resume the attendance process. The log in process is session based so that an employee cannot leave the place without the device (Smart ID) as he does not know when the device gets signed out and needs a quick log in to resume the process. Our proposed system can supersede the traditional attendance system through fingerprint technology as it has many advantages such as high accuracy, optimize time complexity and router system [2]. Our proposed advanced attendance system would be ideal for implementation in different organizations for identification and authentication.

The rest of the paper is organized as follows. The literature work of our work is presented in Section II. In Section III, we discuss the need findings, the conceptual architecture of the proposed system. The development of the system is given in Section IV. The result of evaluation of our system is demonstrated in Section V. The discussion, implications, and idea for future work are presented in Section VI. Finally the conclude the paper in Section VII.

II. LITERATURE REVIEW

The manual attendance tracking system for any system is a very tedious and cumbersome process. It consumes a lot of time. Our advanced attendance system will help to get rid of this problem. In this section we have briefly discussed those works which are related to automatize the attendance system.

Some studies have been found that especially focused on the attendance system using biometric fingerprint authentication. J.Chandramohan et al. [3] discussed the system which was basically a micro-controller based prototype which used fingerprint sensor and in order to track individual missing person's location it used GSM technology. They only dealt with biometric authentication using micro-controller which is a hardware concept. A study conducted by Jennifer C et al. [4] introduced an advance attendance system. It was basically an Arduino based system which combined with MATLAB. They developed a fingerprint identification system using Adafruit Fingerprint algorithm with the help of Arduino. To detect and recognize the face, they used Viola-Jones Face Detection Method and Principal Component Analysis (PCA) with the help of MATLAB.

Sarkar et al. [5] designed and implemented smart attendance system using multiple steps. They focused on to overcome the inconveniences due to manual attendance system by using radio frequency identification, biometric fingerprint sensor, and password based technologies. They developed a C based desktop application to monitor the attendance system which gives a better solution because they developed a software application. Adeoye Temitope Onaolamipo [6] adopted a biometric access control techniques. A system was designed with an extended graphical user interface by using Microsoft visual studio 2010 and merged with Microsoft fingerprint reader. In the users computer or server, the student information was stored on the server with the help of MySQL.

Parul Wadhwa [7] focused on an android application. She developed a system where a student could give their attendance with the help of a fingerprint sensor and later on the data would be stored in a centralized database. An Android application would use this database and from that application, students would be able to view their attendance. Another study has been conducted where Akshay A. Kumbhar et al. [8] focused on storing the attendance information in an Attendance Monitoring System (AMS) using the Android platform. The system consisted of two apk files, one was for the teacher and another was for the students. Just with the help of a click, students would able to give their class attendance and just with the help of a click, the teacher would generate a report of all the students.

There are some studies which focus on the wireless network. A study conducted by Sharma and Jain [9] where they introduced a system where they used only a smartphone to identify a person's location with the help of Global Positioning System (GPS), Wireless Fidelity (Wi-Fi) and Network signals. In another study, Shermin st al. [10] included a location-based time and attendance system where employees used an android application. When an employee entered his workplace area, the system connected to the office internet and sent the employee id and local time to the server. Then the server stored the information in the database. When the employee left the system, a notification

would be generated by the system.

In sum, most of the system introduced a different kind of methods to eliminate the manual attendance system so that the working time is optimized. But some of them considered a hardware approach which will create a queue in front of the device which will be another reason for wasting the working time. Few other consider this factor but again ends up with a desktop application which means the solution is not handy and available to everyone. Others have implemented an android application which is handy but again cannot able to track after giving attendance employees still remain in their working place. This study will dwindle this research gap to some extent by introducing a system which will keep track of an employee with time intervals.

III. DESIGN OF THE PROPOSED ARCHITECTURE

In this section, we have discussed how this system is designed. For this, we have done two processes 1. Finding the necessity of this system, 2. Developing the conceptual design.

A. Finding the Necessity

This system can supersede the traditional attendance system through fingerprint authentication. We have found some major issues that led us to develop this system. To collect need findings we have visited 5 private and 3 government organizations. We have talked with their head of HR (Human Resource) and asked them some question regarding our traditional bio-metric fingerprint attendance system and the faults of the system. We have also asked them about the necessity of any changes in this traditional fingerprint attendance system. Based on their answer many inconveniences caused by the existing attendance system has been found which are stated below.

- 1) The traditional fingerprint attendance system is time-consuming. It takes a lot of time to take the attendance accurately.
- 2) It often creates a queue in front of the entrance and exit door where in general fingerprint sensors are set.
- 3) If the hardware system disturbs, the entire traditional bio-metric attendance system collapses for that day until the hardware problem resolves. At that time, the whole organizations maintain the old attendance system by taking attendance in a paper.
- 4) An employee uses his own fingerprint to open the door for someone else to leave.
- 5) A common thing that all of them said that employees do not remain in the workplace for the whole working time. After giving the attendance many employees go out through the exit door with the help of other employee and do their personal work in working hour. This creates a huge loss to that organization.

Our respected heads of the organizations also agreed that there should be a system that can take attendance in a short time efficiently and accurately. They also want that their employees should work properly in the working hour.

B. Developing the conceptual design

In this sub-section, the conceptual design of the system is stated which is the representation of the system to understand it better. The block diagram of the system is given in Figure 1

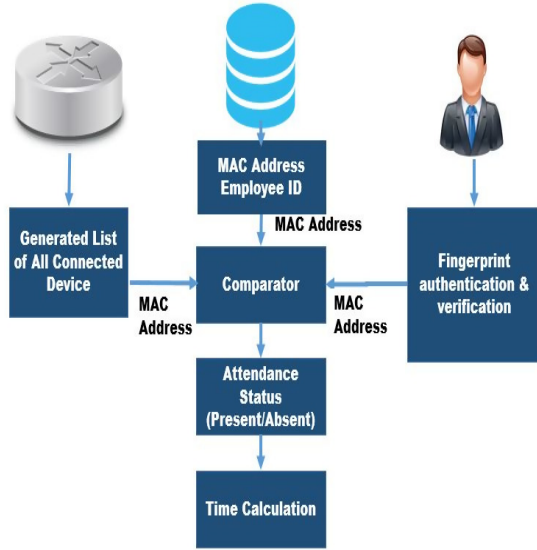


Fig. 1: Block Diagram of The Proposed System

User authentication is one of the major factors of our proposed system. To make sure the user is authentic, we use their fingerprint. Bio-metric fingerprint uniquely represents a person. Fingerprint authentication will ensure the physical presence of an employee inside the working place. At first, the employee needs to install the required APK files of the system to their android phones. Then an employee needs to register himself in our system with his fingerprint and additional information such as name, employee id, phone number, email id and address. The whole registration process will be done in front of the administrative supervisor of the organization to maintain the accuracy.

Thereafter, an employee's mobile phone is registered in this system through its MAC address. The android application will fetch the MAC address from the device and send it to the server.

The counter in the system server gets initialized before starting of a working hour and it will continue the counting process till the working hour ends. To ensure the presence, an employee needs to give his fingerprint through his mobile phone's fingerprint sensor which will be allowed only after he is in the range of the router. After getting connected to the router, the counter in the system server will get initialized and it will start counting the amount of time the device is connected to the router. By accessing the router, authority of the organization will see the devices connected to the router which implies the presence of those respective employees. This is a session based log in system. If an employee is working in an organization for 8 hours, his mobile phone will be randomly logged out from the system 3/4 times in a day

and it will pause the counter. Then the system will ask him to log in within a limited time(2-3 minutes). If he fails to log in within the limited time the system will interpret as he is not present in the office during his working hour. After he logs in by giving his fingerprint within the given time, the counter will resume again for counting. At the end of the working hour, the system will show how much time a device is connected to the router.

The whole process is summarized in Table I.

TABLE I: Summary of the Log In process

Is the device in WIFI range?	Fingerprint Authentication?	Account Status
No	No	Logged Out
No	Yes	Logged Out
Yes	No	Logged Out
YES	YES	Logged In

The flowchart of the system and the flow chart of the session based login is given in Figure 2 and Figure 3 respectively.

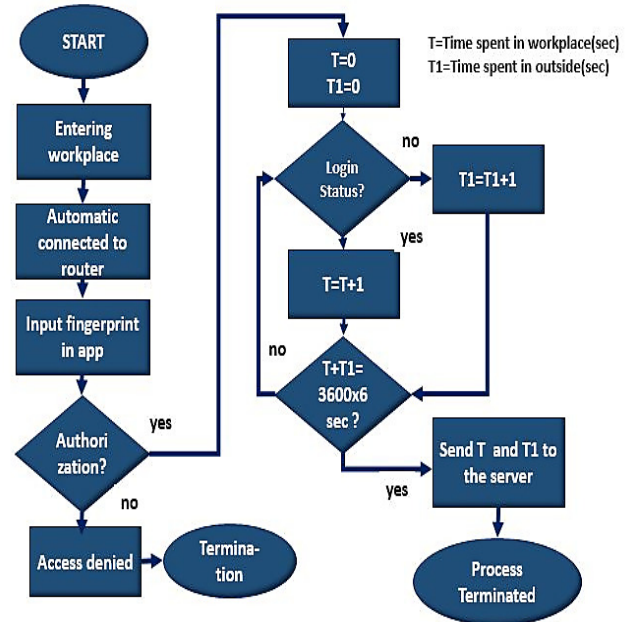


Fig. 2: Flow Chart of The Proposed Architecture

At the end of the working time, the status column of each employee will show the attendance of every employee. The attendance will be sent to the server. This attendance will be automatically updated into the profile of each employee.

IV. DEVELOPMENT OF THE PROPOSED SYSTEM

In this section, we have discussed how we have developed our proposed system.

A. User Interface

The layouts of the UI design are taken care of by Extensible Markup Language (XML) which is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. We have

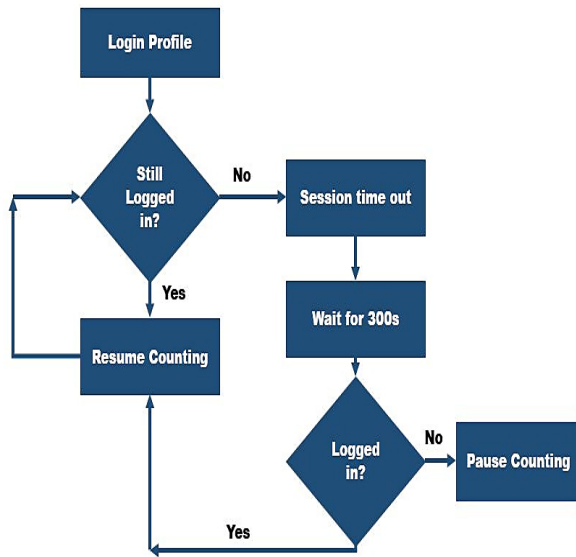


Fig. 3: Flow Chart of The Session Based Login

used the android platform to develop the whole development system in Android Studio. We have also used Java for the development purpose which is the official language of Android development and is well supported by Android Studio. The UI design of our mobile application is given in Figure 4.

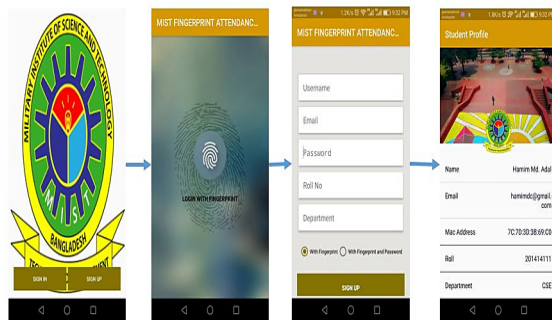


Fig. 4: UI of the Mobile Application

B. Database

We have used MySQL database, the most widely used open source server to store employee's information and the timing of arrival and departure. After registration of the employees into the system, their identity is tracked by a unique key in MySQL server and we considered that as MAC ADDRESS. In the MySQL server, several rows have been allocated for different employees where they have information like name, employee ID, device's MAC ADDRESS (Principle key), Fingerprint sample etc.

C. MAC Address Access

The MAC Addresses of the devices are kept in the same MySQL server where attendance procedure is authorized

depending upon whether it is matched with the MAC ADDRESS of the employee on the same server. Information about the amount of time a device is connected to the router is retrieved from the WNetWatcher software and sent to the server for further process.

D. Server

We have used PHP as server sided scripting language to connect the MySQL database server to the Android Studio.

E. Session Based Log In

Session-based log in is handled using random number generator in Java which is kept random for the development purpose of the system.

F. Android Based Mobile Application

Android-based built-in security features like Android Application Sandbox (which isolates the app data and code execution from other apps), application framework (Cryptography and permissions) are used so that it can significantly reduce the frequency and impact of application security issues. The development of the app is designed in such a way with the default system and file permissions so that it can take difficult decisions about security such as User-granted permissions to restrict access to system features and user data.

For better understanding the whole technical process is depicted in Figure 5

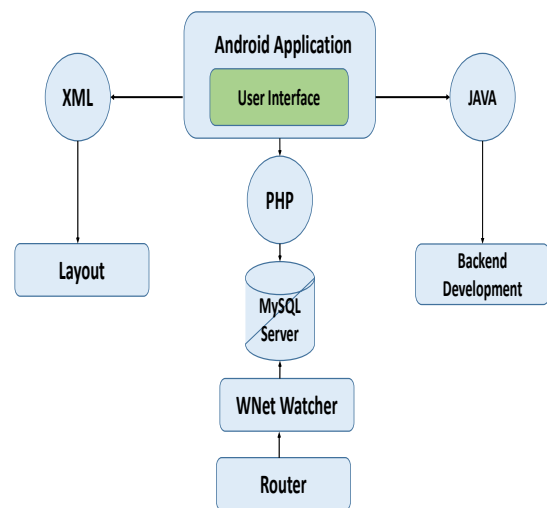


Fig. 5: Block Diagram of the Technical Part of the System

V. EVALUATION

After developing the system, we have done an evaluation for measuring the accuracy and correctness of the system. We have also measured the rate how much it is better than the traditional ones.

We have done the evaluation system in two steps. At first, we have gone to 5 different organizations where the employees gave attendance in the traditional way where fingerprint

sensors have been set in the entrance and exit doors. Some employees gave the attendance in front of the door. After 1 hr we saw some of the employees go outside from their working place to do their personal job. When we asked them some employees said that they went to the bank for some transaction. A few of them told that they went to the hospital. We have also observed that one employee uses his own fingerprint to open the door for others to leave the place. After watching so much violation of rules on the above stated(Method -1), we decided to experiment our proposed system(Method-2). We registered all the employees of 5 different organizations with their fingerprint and additional information. We have installed one router in those working places respectively. When an employee is in the working place, he is automatically connected to the router as he is in range, and later on, he logged in through fingerprint authentication to initialize the attendance process for the day. As the procedure follows unique fingerprint authentication, there is no scope for the proxy. They had to remain in working place as they did not know when the account gets logged out itself and they need to log in immediately, as it is a session based login system. As a result, we found out only 2 employees in an organization went outside the working place during work time but they had taken permission from their senior. The summary of the evaluation result is given in Table III. In Table III method 1 is the traditional fingerprint attendance taking method and method 2 is our proposed system.

In Table III, it is stated that no one could help each other to escape the workplace before the working time because the attendance was taken through the fingerprint and the device must have to be connected to the router. From the above experimental results, it is assured that this system has the following benefits-

- Accuracy: This system can accurately take the attendance of the employees as it is fingerprint-based and no one can give the proxy of others.
- Time Consuming: This system reduces the time of taking attendance as the employees only need to give the fingerprint through the mobile phone.
- Maximizing number of employees in the working place: As the mobile phones of the employees need to be connected to the router, it counts the time they remain present in the working place. As a result, the employees barely leave the working place.

Thus the system has advantages which make it separate from the existing attendance taking method. The difference between this method and the existing method are given in Table II.

VI. FUTURE EXTENSION

We have tried to make this system error-free and accurate, but still, there is some accuracy that needs to be developed. We want to add head counting through a camera in this system. Every organization should contain CCTV cameras. We will take sequential CCTV footage of the working place. There will be differences in the images as people move and their positions are not fixed. By continuously subtracting the image

TABLE II: Difference between the existing system and the proposed system

Existing Systems	Our Proposed System
1. Most of the existing attendance taking systems are only fingerprint based.	1. This attendance taking system consists of fingerprint and wireless network (router).
2. The existing fingerprint system is usually placed in front of the working place or at the entrance of the institution, so it can only detect if an employee has entered into the working place but it can not detect whether an employee tries to escape from the working place or not.	2. This system has a router which counts the amount of time an employee spends in the workplace.
3. An employee can leave the workplace after giving the attendance through this system.	3. An employee has to remain in the workplace because the system counts the amount of time the device is connected to the router. So he chooses not to leave the place.
4. In existing systems, an employee can let others enter and leave using his fingerprint.	4. In our proposed system it is not possible.

from one another, we can calculate how many employees are present in the working place while the attendance procedure is going on. Then we can cross-check this number to the number of mobile phones connected to the router network. This will add more accuracy to this system and if the number does not match, the system server will receive an alert.

The system is currently developed for the android platform but we are focusing to develop it on iOS platform as well in near future. Besides, in any organization there are employees who have to perform field work on different occasions. As our proposed system consists of router, so it is not eligible for the employees who are responsible for field work. So including GPS tracker to ensure the presence of the employees in their respective fields is also one of our future aspects.

VII. CONCLUSION

The proposed vigilance system has been developed using the existing technology. This system automates the process of attendance monitoring, thus saves a lot of time. It is also a cost-effective system because it relies only on a smartphone. As this completely automates the attendance system, it leaves no room for any kind of error. This system will surely increase employee's efficiency at work and also help in the progress of any organization.

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TABLE III: Summary results of the evaluation

Organization (n=5)	No. of Employees	(Method 1) Total Time Taken (Min.)	(Method 1) One employee uses others fingerprint to escape	(Method 1) Take permission from senior to go outside	(Method 2) Total Time Taken (Min.)	(Method 2) One employee uses others fingerprint to escape Given	(Method 2) Take permission from senior to go outside
Organization No. 1	52	10	Yes, 4 employees have taken help from others to leave the place	2 employees	3	No	3 employees
Organization No. 2	50	9	Yes, 6 employees have taken help from others to leave the place	2 employees	3	No	3 employees
Organization No. 3	56	15	Yes, 5 employees have taken help from others to leave the place	2 employees	4	No	5 employees
Organization No. 4	47	8	No	2 employees	2	No	2 employees
Organization No. 5	54	10	Yes, 2 employees have taken help from others to leave the place	No	3	No	2 employees

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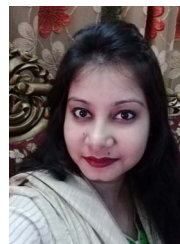


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