



Biometric based Attendance Automation System for Workplaces

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ABSTRACT: The Biometric-based automated employee attendance automation system consists of modules, such as fingerprint sensor, Arduino Uno set-up, security entrance gate, ESP32 Wi-Fi module, and Android mobile App. It is implemented with the software languages such as Google Script, Java, and XML at the backend. When the attendance is marked, a buzzer beeps for a few seconds and at that time, the entry gate opens for six seconds so that the employee is allowed into the office by the security personnel. Attendance data uploaded (at the time of entry & exit) to the cloud is fetched and the full day attendance status will be displayed in the Android Mobile App.

KEYWORDS: XML, ESP32 Wi-Fi module, Arduino UNO, Android mobile App.

I. INTRODUCTION

This paper presents the automated employee attendance system using biometric technology in the workplace. This system is composed of two processes: enrolment and authentication. The user's fingerprint is captured during enrolment and its unique features are extracted, and these are stored in a database along with the user's identity as a subject template. The unique features called 'minutiae points' are extracted from the skeleton image using the Crossing Number method which extracts ridge ends and bifurcations. The user's fingerprint is collected again during authentication, and the extracted features are compared with the template stored in the database to determine a match before attendance is marked.

To automate the employee attendance procedure, by using the Biometric fingerprint recognition module, it is interfaced with Arduino UNO, to maintain the attendance data, and design an Android Mobile App, so that it is smartphone accessible. This system is used to reduce the time spent on manual attendance and improve protection, and the data can be accessed in the mobile App anywhere and anytime, by uploading data to the cloud. The small amount of storage is required for the biometric template so that it reduces the size of the database memory required and it is standardized. This system gives better security, system efficiency, reliability, and more accuracy.

II. HARDWARE DESIGN

The technique for achieving objectives of this project is depicted in the block diagram as shown in Figure 1. The system is created by integrating hardware and software systems. The entire system's block diagram contains following blocks:

1. R307 Fingerprint Sensor
2. Arduino UNO
3. ESP32 Wi-Fi Module
4. Gate Mechanism
5. Android App
6. Ngrok URL tunnelling &
7. Android mobile phone.

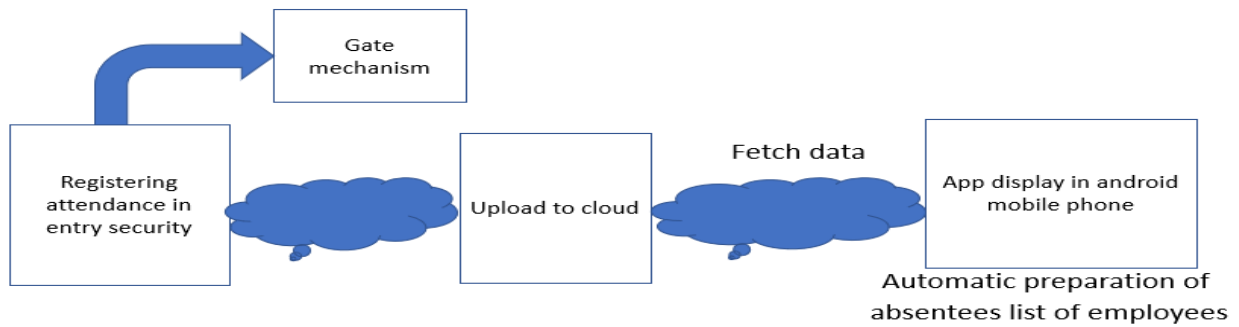


Figure 1: Block Diagram of the system.

Arduino is used as the main controller here, and it mainly collects data through serialcommunication with fingerprint sensor, and sends this data to the ESP32 Wi-Fi module. The ESP32 is used to create the Webserver, which contains the Fingerprint ID and time corresponding to fingerprint impression on the R307 fingerprint sensor, of the employees. When a proper, registered, fingerprint is placed on R307 Fingerprint sensor, the ID corresponding to that fingerprint is detected by Arduino and that ID is transferred to the Webserver via ESP32. To make a Webserver as a publicly accessible server, Ngrok URL tunnelling open source is used. Because of a publicly accessible URL, the server is accessed by the Android app and it collects the required information. To increase the security of the workplace, the door lock system is implemented. The Flowchart for Hardware Methodology is shown in Figure 2.

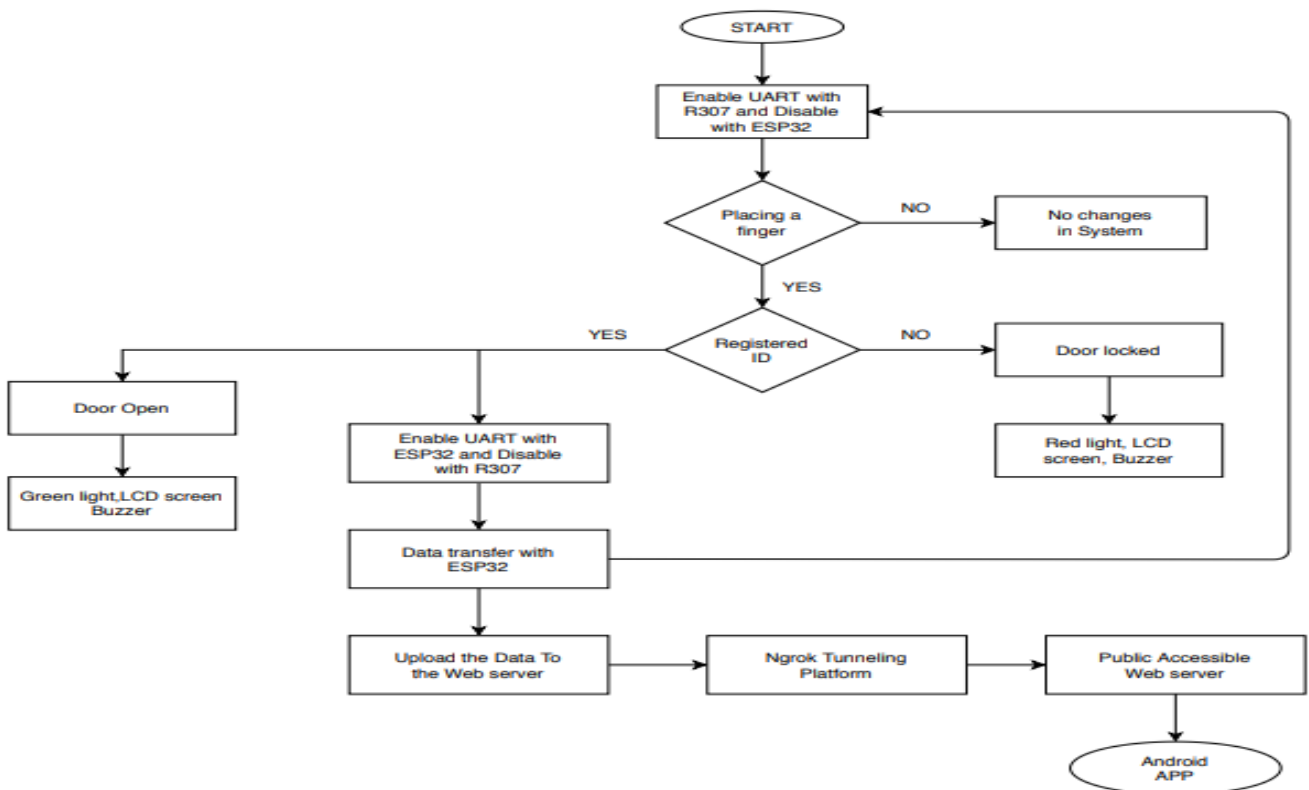


Figure 2: Flowchart for Hardware Methodology

The door mechanism includes servo motor, buzzer, LEDs and IR sensor. For authorized fingerprints, the servo motor is made to rotate by an angle of 90 degrees. To check whether the worker has entered the gate or not, the IR sensor is implemented. After passing through the IR sensor, then only their presence is updated to the webserver. Later, the door will close by rotating the servo motor to the zero degree position. If the worker makes his fingerprint impression and didn't enter the office, then his/her presence will not be updated. For that purpose, the IR sensor and servo motor will



wait up to 15-20 seconds for the worker’s entrance. If they walkaway, then motor will rest to normal position and the buzzer will start to beep continuously for 5-10 seconds. LCD display is also implemented, to known the attendance status running behind the system. It will display the Fingerprint ID, server updates and authorization status .

III. SOFTWARE DEVELOPMENT

Android studio is used to develop the android App using XML and java. In this App,the user must give his specificpassword to access the software. An anonymous personcannot access this application due to password protection and to avoid misuse of thesoftware. After the successful login of the user, username and ID are then shown on theapplication. After the device is connected successfully, it checks for the user profile. If theuser is employee, the App communicates with the spreadsheet and then data is fetchedfrom google server.The user profile is shown, and then the percentage of attendance isshown for that user. If the user is an employer, he has a privilege to check the listof employees working under him, if they are present or absent in a separate list. TheEmployer can also check his status. Google script is used to interface the applicationwith the database present in the server. The Software Methodology flowchart isshownin Figure 3.

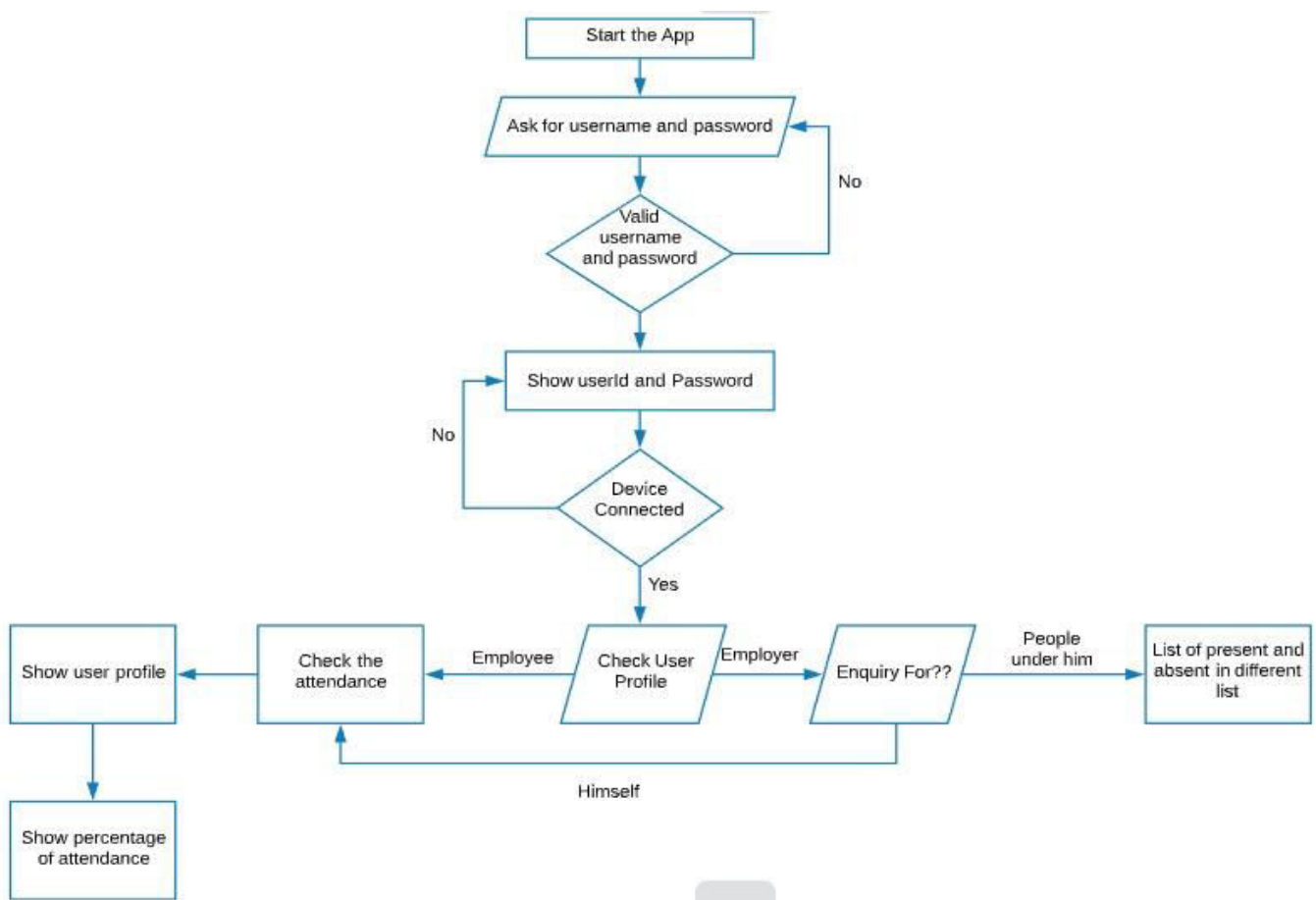


Figure 3: Flowchart for Software Methodology

The backend part of the App is developed with the help of Java language. It is the corelanguage for android threaddesign. Google Spreadsheet is used as the database, to storeUser-name, User-Id, and password. Google script helped us to connect the spreadsheetwith the App. Since the fingerprint data comes on the website,concepts of HTML are also needed so that a python code could be written to search for the correct dateand markthe attendance for the correct Person.



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IV. RESULT AND DISCUSSION

For the registration, need to give the ID numbers manually in Serial Monitor, and the sensor will ask to place the same finger 2-3 times, to register that fingerprint pattern properly in the sensor's memory unit. Once if register that pattern on the sensor memory unit until we delete that pattern the ID will be stored permanently irrespective of time and microcontroller. For one fingerprint, cannot give more than one ID. After the registration of some fingerprint templates of the employees, the sensor is ready to recognize the person by identifying their fingerprint ID. The amount of fingerprint matching is displayed by the parameter called 'Confidence level'. For proper recognition, this confidence level value will be more than 150. The Serial monitor result for the identification of fingerprint is shown in Figure 4.

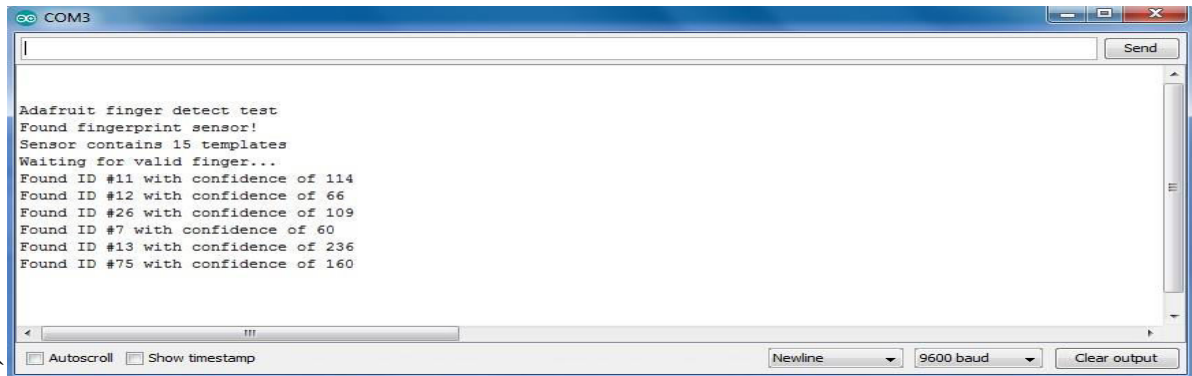


Figure 4: Serial monitor output for Identification.

For the visual representation of fingerprint impression status and ID, corresponding to that impression, is displayed on the LCD screen. When the R307 sensor is ready to take the fingerprint impression, the LCD will display status of the fingerprint for the employee's understanding is shown in Figure 5.

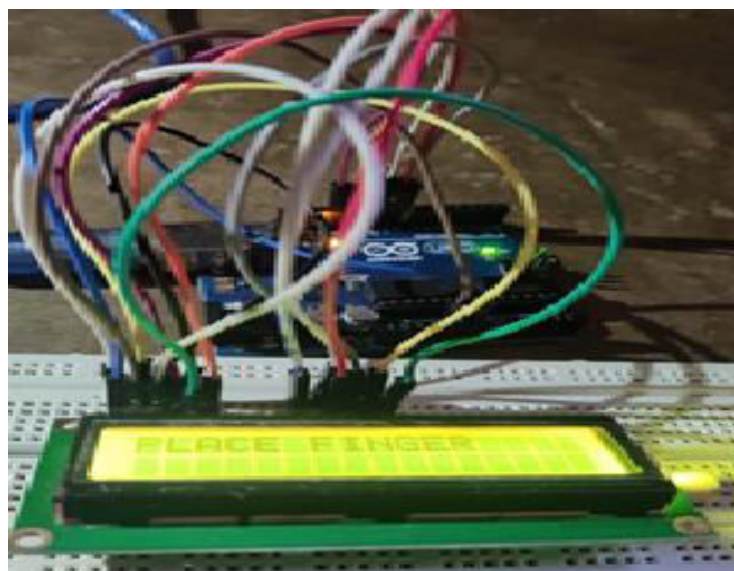


Figure 5: Display the Fingerprint Status in LCD.

The authorized employee's finger ID is displayed along with the status corresponding to the data transfer between ESP32. If the data is transferred to the ESP32 successfully, then it will be uploaded to the webserver irrespective of Arduino and R307 configuration. Therefore, for that purpose, the data transfer status is displayed on the LCD screen as 'Pending' or 'Saved' depending on the condition. For the Unauthorized employee's fingerprint impressions, the LCDs the message 'Unauthorized'.



Fingerprint ID	Response Time for Enrolment (in sec)	Response Time for Identification (in sec)
1	0.867	0.912
2	0.882	0.894
3	0.871	0.920
4	0.925	0.905
5	0.905	0.952
6	0.945	0.947
7	0.890	0.963

Table 1: Response Time versus Person ID for both Enrolment and Identification.

In the door mechanism, for authorized fingerprint door will open and wait for the worker to enter the office through the IR sensor. Then only his/her presence is updated to the webserver. After this, the door will close and the fingerprint sensor is ready to take the next employee’s fingerprint. Until the worker passes through the IR sensor his/her presence will not be updated, for that, the IR sensor and servo motor will wait for a certain time duration. IF not, later the door will close automatically and the buzzer will start beeping continuously.

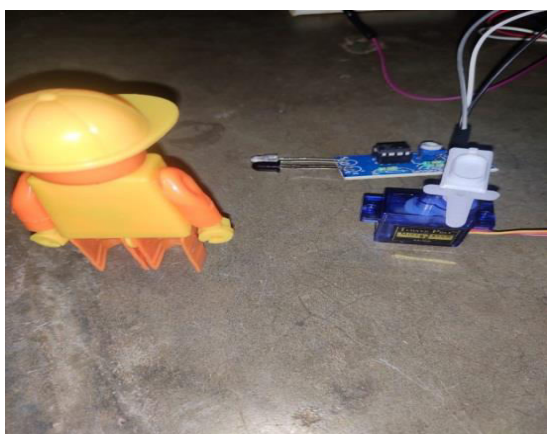


Figure 6: Before the attendance marked.



Figure 7: After the attendance marked.

Here data transferring to the webserver is done by ESP32. Here the server created by the ESP32 is accessible by only local networks. That means, the webserver can be accessed only if the accessing device is connected to the same network, which is connected by ESP32. For the Android Application and all the public access to the server is essential. For that purpose, Ngrok URL tunnelling software is used. It will create a publicly accessible URL. The created URL corresponding to the local network. The URL created by Ngrok can be accessed from anywhere and anytime until the server is running behind in one computer having a common network with ESP32. The created server is automatically accessed by Android Application and it will collect the required information. The created webserver is mentioned in Figure 8 along with its URL.



Figure 8: The Created Webserver with its URL

For displaying employees' attendance status firstly, the App directs the user to the page asking to login. If the user is already registered, he/she can login instantly, else the user can register to create a fresh account by sign up method. A new account can be created with their username and password. At this time a UserId will be assigned to him/her. When the user creates the account, his/her details will be stored in the database. So, correct credentials are required to access the Application. User will have many options like, go to the organization page directly from the App and see the updates and notifications from the organization administration. Users can refresh the page. Also, the Logout button will be provided if the user wants to log in with a different Username. The new registration option is also provided. Username and id of the user will be shown at the top of the activity. Below this, there is an option to choose your department. After clicking on the correct department, the attendance will be shown with date and time on the excel sheet beside the name and Id. But before that, the attendance should be updated by the administration department. The results are as shown in Figure 9.

	A	B	C	D	E	F	G	H	I
1	Name	Id	17/5/2020	18/5/2020	19/5/2020	20/5/2020	21/5/2020	Total Attended	Attendance percentage
2	vinay	1			P			1	20
3	prasanna	2	P		P		P	3	60
4	ramprasad	3		P		P		2	40
5	ayyanna	4				P		1	20
6	charan	11	P			P		2	40
7	manojj	12		P	P			2	40
8	shankar	26	P					1	20
9	sonu	7			P		P	2	40
10	vinayews	13	P	P	P	P	P	5	100
11	priya	75				P	P	2	40
12	ram	23			P			1	20
13	Total students present on the day		4	3	6	5	4		

Figure 9: Display of attendance in the App with Total attendance percentage

V.CONCLUSION AND FUTURE SCOPE

The fingerprint sensor captures the new fingerprints and the templates are produced. To fit fingerprint, a user must place the finger (or thumb) on the sensor to scan the image of the thumb, which is then compared to the models already stored in the database. The employee attendance status is generated in the Fingerprint sensor and is stored in Arduino UNO, which is then uploaded to the cloud. From the cloud, the employee attendance data is retrieved which will be displayed on the Android mobile App so that the employee can check the attendance status anywhere and anytime. The execution time for the developed system is less compared to the existing systems. We added the notification panel from college website into the App, so that all the users are aware of the present activities of the institution. This system also shows better security, system efficiency, reliability, and capable of preventing impersonation. Apart from the workplace, fingerprint recognition technology can also be used in homes, where there is much-needed protection. It will help the



company to keep track of its employees, whether or not they have met the required working hours in a day. This may be used as a security measure for door locks, secure locks, or for digital devices. This system will in future, help in the development of such diverse useful applications.

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