

# Internet of Things-Based Monitoring and Mapping of Absentee Visualization on the Shop-Floor

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## ABSTRACT

In all the companies, attendance of the employee is taken after the employee enters the factory through their signature or biometrics which would consume a lot of time. The main objective is if the attendance of the operators is taken even before they enter the premises, the supervisor gets to know if a particular employee is absent. This can be done by virtually connecting the finger-print sensor output to the cloud and so that the supervisor can access the cloud and get the information of the operators who have boarded the buses. The R-307 fingerprint sensor is used as the main input. The Raspberry Pi will process the data and the global system for mobile communication (GSM) will send the text message to the respective supervisors. The finger-print sensor can determine the finger-print stored in the database with an average response time of 0.8 seconds.

**Keywords:** Attendance system, Cloud server, Finger-print sensor, General packet radio service (GPRS), Global system for mobile communication (GSM), Raspberry Pi.

*SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology* (2020); DOI: 10.18090/samriddhi.v12iS2.8

## INTRODUCTION

In the automobile industry, the entire production is usually done manually—from wire cutting to final assembly of the wiring inside the car. For this, the company needs both skilled and unskilled workers/operators in their shop-floor. If a skilled operator is not present in the line, the entire conveyor belt cannot start its functionality. The supervisor of the line has to find a substitute for that skilled operator. This process takes a minimum of 30–45 minutes. Due to this delay, the production gets affected. Thus, if the supervisor gets prior information about the operators who will not be coming for the day, he can find a substitute and start the belt at the assigned time.

Employee attendance checking systems are usually finger-print based. Biometric can be defined as the physiological and behavioral characteristics that can be used to verify a person's identity. The use of the fingerprint sensor and the GSM/general packet radio service (GPRS) will help in producing an efficient and effective system to record the attendance. The aim of this research was to build the system of absentee visualization that integrates biometric, GSM/GPRS, and a Raspberry Pi.

By starting the production unit at the assigned time, the production rate per day can be increased. Since 90 to 95% attendance has been marked before entering the premises itself, there is a remarkable reduction in the time consumed for punching. It will also help in tracking the details of all the employees working under different shifts or the specific bus, which are allotted to employees. This would ultimately

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**How to cite his article:** Jadhav P, Pote J, Pisharody A, Dhekale, S.B. (2020). Internet of Things-Based Monitoring and Mapping of Absentee Visualization on the Shop-Floor. *SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology*, 12(SI-2), 36-40.

**Source of support:** Nil

**Conflict of interest:** None

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help the supervisor to decide the substitute for the absent employee and start the work on time. Hence, this will be beneficial for the companies in terms of production and time.

## LITERATURE SURVEY

Jisha *et al.*,<sup>1</sup> an Android application for school bus tracking and student monitoring system has used technologies, like GPS and GPRS and Firebase to develop an Android application for school bus tracking. Its implementation is done cost-effectively as it needs mobile's GPS and internet connection only.

Lia *et al.*,<sup>2</sup> real-time online attendance system based on fingerprint and GPS in the smartphone uses a finger-print sensor, which recognizes the finger-print stored in the database with an average response time 1.39 seconds, with GPS—latitude, and longitude with an average error 0.007352, and 0.0003%, respectively.

Tiwari *et al.*,<sup>3</sup> Internet of things (IoT)-based attendance log system using Raspberry Pi successfully authenticates the student's identity from his fingerprint and database from the server. The algorithm detects the finger-print and is capable of matching with the right database.

Pradeep *et al.*,<sup>4</sup> smart attendance system using Raspberry Pi discusses the standardized authentication model which is capable of extracting the fingerprints of individuals and store that in the database. Then, the employment of the final fingerprint to match with other fingerprints present within the database is done to point out the capability of this model and also update the database obtained to the organization by creating an application through the cloud.

Dhanya *et al.*,<sup>5</sup> student attendance tracking system using a portable biometric device presents the development of a portable attendance system which is based on the fingerprint mechanism to handle the attendance status of the students, like calculating the shortage of attendance automatically to ease the burden of the lecturers.

Thus, combining literature,<sup>1,2</sup> we will be able to monitor the bus and take the attendance in the bus using a biometric machine that can be installed in the bus itself. Also, in this system, we will be able to achieve a better average response time of the fingerprint sensor.

## SYSTEM DESIGN

The main block consists of a fingerprint sensor and a Raspberry Pi for the collection of the data on the bus. The second component is the GSM module for transmitting the text messages to the supervisors.

### Fingerprint Sensor

The fingerprint sensor is the main component in this system. Fingerprint sensors are security systems of biometrics. Everyone has marks on their fingers. They cannot be removed or changed because of which it is the ideal means of identification. There are multiple types of fingerprint sensors, such as, optical sensors, CMOS sensors, ultrasound fingerprint sensors, and thermal sensors.

The fingerprint sensor used here is R-307. It consists of an optical fingerprint sensor and a high-speed Digital Signal Processing (DSP) processor with a high-performance fingerprint alignment algorithm. It has a perfect function— independent fingerprint collection, fingerprint registration, fingerprint comparison (1:1), and fingerprint search (1: N) function. It is small in size which is easy to install with ultra-low power consumption. The average response time for this

**Table 1:** Comparison between R305 and R307

Parameters	R305	R307
Storage capacity (fingerprints)	250	1,000
3.3V operation	No	Yes
USB operation	No	Yes
Finger detect output	No	Yes

sensor is 0.8 seconds. In comparison with the older model R305 and R307, it has the following advantages as shown in Table 1.

### Raspberry Pi

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi foundation. It is a very cheap computer that runs Linux but also provides a group of general-purpose input/output (GPIO) pins that permit controlling of electronic components for physical computing. The Raspberry Pi is provided with generic USB ports for connecting a computer keyboard and a mouse.

The Raspberry Pi 3 Model B+ uses a Broadcom BCM2837 system-on-chip (SoC) with an integrated 64-bit quad-core ARM Cortex-A53 processor with a speed of 1.4 GHz. It is a 40-pins GPIO header with a memory of 1 GB SDRAM. It offers 2.4/ 5 GHz dual-band IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, and Wi-Fi onboard. The Raspberry Pi has an updated control administration wellspring of 5V USB control supply up to 2.5A. The ethernet port provided is a built-in ethernet adapter using SMSC LAN9514 chip. With the expansion of gigabit ethernet over USB 2.0, the wired ethernet execution is additionally supported, with an extraordinary throughput of around 300 MB.

### Global System for Mobile Communication (GSM)/ General Packet Radio Service (GPRS)

GPRS is a packet-oriented mobile data standard on the second generation (2G) and third generation (3G) cellular communication network's GSM. In 2G systems, GPRS provides data rates of 56 to 114 kbit/sec. It provides moderate-speed data transfer by using unused time division multiple access (TDMA) channels. The GPRS core network allows 2G, 3G, and wide-band code division multiple access (WCDMA) mobile networks to transmit IP packets to external networks, such as, internet.

GPRS extends the GSM packet circuit-switched data capabilities and offers a number of services like Short Message Service (SMS) messaging and broadcasting, internet applications for smart devices through wireless application protocol (WAP), point-to-point, and point-to-multipoint services, etc. An SMS transmission speed of about 30 SMS messages per minute can be achieved, if SMS over GPRS is used, which is faster than the ordinary SMS over GSM, whose SMS transmission speed is about just 6 to 10 SMS messages per minute. SIM 800A quad-band GSM/ GPRS module has been used for this system. Brand Omatom Power input voltage 9 to 12V DC quad-band 850/900/1,800/1,900 MHz DC.

### Database

A database is an organized collection of data, generally stored and accessed electronically from a computer system. When the databases are more complex, they are often developed using formal design and modeling techniques. The database management system (DBMS) is the software that interacts

with the end-users, applications, and also the database itself to capture, and analyze the information. In the relational database model, the data structures including data tables, indexes, and views remain separate from the physical storage, allowing administrators to edit the physical data storage without affecting the logical data structure. The standard user and application interface (API) of a relational database is the structured query language (SQL).

We have used MySQL which is a relational database management system supported SQL. It is free and open-source software under the terms of the GNU General Public License and is also available under a variety of proprietary licenses.

## METHODOLOGY

### Proposed Methodology

As shown in Figure 1, the fingerprint sensor takes the fingerprint and identifies the person with the help of the database which is stored in the cloud. The adapter for the Raspberry Pi works as a power supply for the controller. The Wi-Fi router will provide the internet required for the Wi-Fi module in the controller to send the data to the server. The data in the cloud can be accessed by the user using a mobile, tablet, laptop, etc.

### Enrollment of the Fingerprint

Input will be taken from the employee by giving his/her fingerprint through the fingerprint scanner. A person's captured fingerprint image is converted to an electronic biometric data format. When a person is enrolled in any biometrics system including a biometric time and attendance, he has to present his fingerprints for the initial biometrics

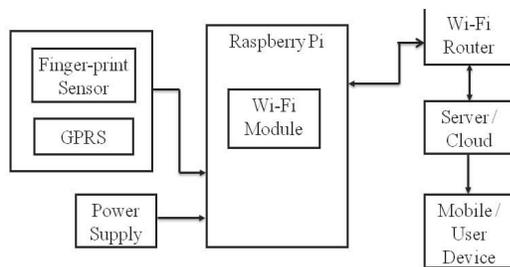


Figure 1: Proposed block diagram

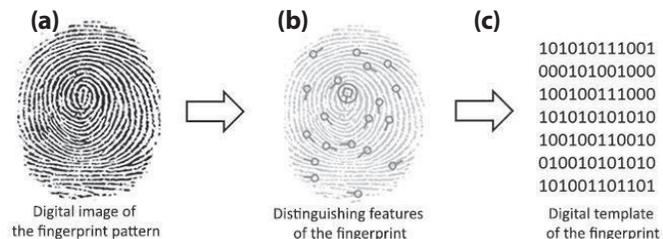


Figure 2: (a) Digital image of the fingerprint pattern; (b) Distinguishing features of the fingerprint; (c) Digital template of the fingerprint

capture. This initial biometrics fingerprint capture is also called biometric enrollment. Figure 2 (a) depicts the image of the fingerprint once it gets enrolled. As each fingerprint is unique, the fingerprint sensor identifies some distinguishing features of the fingerprint (an example is depicted in Figure 2 (b)) which can be used for identification of the person.

### Fingerprint Template

After the fingerprints are captured by a fingerprint sensor/ biometric fingerprint scanner (also known as biometric reader), the fingerprint image is further processed into electronic data that is called a fingerprint template as shown in Figure 2 (c). A fingerprint template has a reduced size than the initial image captured. After the biometric fingerprint image has been captured, the collectible and measurable biometric data are extracted. Fingerprint scanner data is extracted. This is the data that uniquely differentiates a particular person from any other person's fingerprint. This data can now be saved into a database somewhere remotely or within the internal database of the biometrics time and attendance system.

### Compare and Match with the Database

During fingerprint comparison, an equivalent sequence of events takes place again, only that now the extracted fingerprint data is not saved into the unit's database but compared with the already existing data in the biometrics time and attendance unit using fingerprint identification and fingerprint verification software logic built into its onboard firmware. Using the match and compare block, if the fingerprint matches with the fingerprint in the database, it is a "Match" and the attendance will be processed. If the fingerprint does not match with any fingerprints in the database, it will display "No Match".

### Capturing of the Data

As the employees will give the input through biometric, the attendance will be updated and the data will also be stored in the cloud. Before the bus reaches its final destination, the supervisor gets the message of which of the employees is absent so that he can find a substitute that particular employee and start the work on the conveyor belt on time.

sr.no	first_name	last_name	employee_id	bus no	skills	supervisor
1	jayanti	pote	YI001	1	skilled	anuj singh
2	arpita	shinde	YI002	2	not skilled	anuj singh
3	om	kshirsagar	YI003	3	not skilled	anuj singh
4	mahesh	ghate	YI004	4	skilled	anuj singh
5	arya	pisharody	YI005	5	skilled	anuj singh
6	prafulla	ingale	YI006	1	skilled	aniket mane
7	pranali	jadhav	YI007	2	skilled	aniket mane
8	poorwa	kaggate	YI008	3	skilled	aniket mane
9	vaishnavi	khawale	YI009	4	skilled	aniket mane
10	rohan	kamte	YI010	5	not skilled	aniket mane

Figure 3: Sample database



## Creation of Database

In our project, we have used MySQL for database creation. We have made a database of 25 employees in a company as shown in Figure 3. The database is named as Employee\_Data, in which we have created a table as employee data. This table contains the required information of the employees, like full name, employee ID, bus number, name of supervisor, and also states whether the employee is skilled or unskilled.

## ALGORITHM

There are various software that can be used according to the controller used. We used Python to program the Raspberry Pi. The following are the algorithms that are used for the required project.

### Part 1: Registering the Fingerprint

- Step 1—Initialization of the controller.
- Step 2—Connect the fingerprint module.
- Step 3—Open the fingerprint\_demo graphical user interface (GUI) in the controller.
- Step 4—Register the fingerprint and save the image template.
- Step 5—Conversion of the image template to binary form.
- Step 6—Save these fingerprints in the MySQL Database.
- Step 7—Now comparison of the various templates can be carried out by Python.
- Step 8—The accurate matching points will be found in between the images.
- Step 9—After the initial comparing and matching of the fingerprint is done, the overall database is stored in an excel file that can be uploaded to the cloud.

### Part 2: Attendance of the Employee

- Step 1—Employee punches his fingerprint on the fingerprint sensor.
- Step 2—This fingerprint is scanned through the database to find its match.
- Step 3—If the fingerprint does not find a match, it shows "No Match."
- Step 4—If the fingerprint matches with the one in the database, it shows "Match."
- Step 5—The data of this employee will be stored and marked as present.
- Step 6—Now, before the bus reaches its destination, the employees who are marked absent, and their details will be sent to their respective supervisor.

## EXPERIMENTAL RESULTS

As shown in Figure 4, in fingerprint\_demo, there are four parts—Enroll, Verify, Identify, and Image Capture. The actual fingerprint that is enrolled is depicted in Figure 5. This image is processed to form a fingerprint template (as shown in Figure 6) which is further processed into binary form. Each employee has to enroll in his fingerprint and get it verified.

Once the enrollment of the fingerprint is done, the fingerprint is verified which is stored in the database. After this when

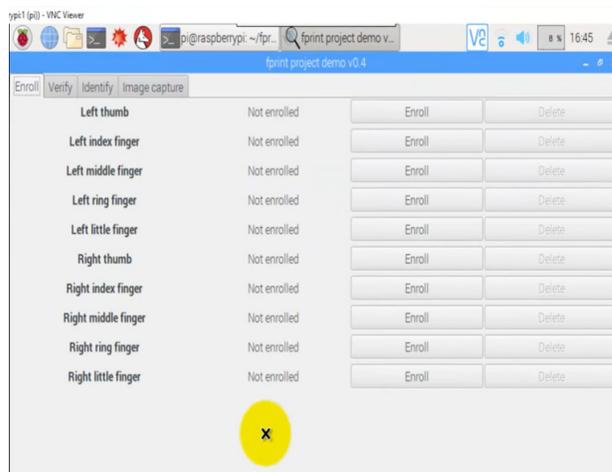


Figure 4: Enrollment



Figure 5: Enrolling the fingerprint



Figure 6: Fingerprint template prepared

the employee punches and the fingerprint is matched, the attendance gets recorded. The employees who are not present, their supervisors will receive an SMS regarding that employee.

## CONCLUSION AND FUTURE SCOPE

This paper is regarding improving the current attendance systems in the industries and provides the supervisor with prior information regarding his employees or operators under him. The accuracy and average searching time of the fingerprint is improved to 0.8 seconds. SMS messages sent over GPRS can transmit 30 messages per minute, which are better than the ordinary SMS messages over GSM which can send only 6 to 7 SMS messages per minute. By implementation of the hardware, the production of the company would increase in a significant manner. Also, the time required by the supervisor to decide a substitute for the absent or skilled employees will decrease.

The fingerprint sensor module used in the project is with the

Transistor Transistor Logic (TTL) Universally Asynchronous Receiver/ Transmitter (UART) interface. The user can store the fingerprint data within the module and can configure it in 1:1 or 1: N mode for identifying the person. It would also be used in preventing impersonation, like fraud detection and to verify individuals' identity. Regarding performance and efficiency, this project will provide a better approach to check absenteeism compared with the traditional method of marking the attendance manually.

In the future, this attendance system can also be implemented by iris scanning instead of fingerprint scanning. Another change that can be done in this system is that the supervisor can be suggested an employee with the same skills as a substitute to the employee in his conveyor belt.

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