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# IoT Assisted Finger Print Based Door Lock Security System Using Raspberry PI4

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**ABSTRACT**

***The ongoing progress in the field of Internet of Things (IoT) permits to embed security system as a part of it. In order to deal with security, authentication of legit users and in turn warning of unauthorized person plays an essential task. This report proposes to design an intelligent entrance control system based on biometric train in terms of fingerprint which also incorporates IoT functionality for indication of illegitimate users. The proposed system utilizes fingerprint module for authentication procedure and uses servo motor to control rotating door locking system for door entrance using Raspberry PI 3 processor. The system is also incorporated with a web camera-based image capturing technique when any unauthorized fingerprint is detected and simultaneously alerts the authorized user through an SMS using the IoT based Wi-Fi connectivity using Raspberry PI 4 and SMS gateway. They have not only overcome the problems of previous security systems in remembering the PIN but also provide a very high level of security. The fingerprints are, one of the old stand most universally used biometric trait which are applied in our research. The skin on our fingers reveals a flow like a pattern known as friction ridges. The patterns of these ridges on each finger are inimitable and unassailable which formulate fingerprint a distinctive form of identification for each individual. It does not comprise an integrated hard-disk or but uses a SD card for booting and continual storage. The foundation of Raspberry PI provides Debian and Arch Linux ARM distributions for download. Researchers have been going on to develop systems utilizing a combination of biometrics and low cost embedded systems with IoT capability such as Raspberry PI 4.***

***Keyword:*** *- Raspberry PI, Fingerprint module, Internet of Things (IoT), Servo motor, Biometrics*

## 1. INTRODUCTION

In recent competitive world, security is an enormous apprehension and personnel are persistently looking for trustworthy modes to make certain the security of their material as well as logical assets. Therefore, a variety of sensors, small embedded systems and home appliances have been implemented and designed continuously through numerous companies, universities and research institutions .One safe way presented by more modern systems use a password or PIN as an authenticating means where the PIN of the legit users is stored for validation which provides substantial safety. But this structure also has shortcoming as illicit users can hack passwords by incessantly trying all feasible permutation using various contemporary software methods. The newest form of home access control systems deals with biometric trait such as fingerprints and faces.

The Internet of Things (IoT) is the set of connections of physical items or "things" embedded with electronics, software, sensors and their hook up to internet to enable it to achieve services by exchanging data with the manufacturer, operator or other connected devices around the globe. The ‘thing’ in IoT could be a individual with a ECG based heart monitor or an home with sensors and actuators installed, i.e. things that have been allocated an IP address and have the potential to receive and transfer data over a network without human support or involvement . The IoT demonstrate ability to describe the way we secure devices and systems. It signifies the capability of equipments to collect data and control its use. Due to its extensive benefits and implementation of various applications IoT involves promising adaptive perception. Thus every ‘thing’ associated with the internet, some involves controlling and some involves monitoring the parameters from anywhere around the form the IoT applications .Thus motivated by the ongoing research in IoT and to provide secure access to legitusers using biometric, in this article we develop an application embedding the concept of IoT with biometrics and implementing the algorithm in Python 3 using Raspberry PI 4.

## 2. METHODOLOGY

In this Raspberry Pi Finger Print sensor interfacing project, we have used a 4 push buttons. One for enrolling the new finger ring, one for deleting the already fed finger prints and rest two for increment/decrement the position of already fed Finger prints. A LED is used for indication that fingerprint sensor is ready to take finger for matching. Here we have used a fingerprint module which works on UART. So here we have interfaced this fingerprint module with Raspberry Pi using a USB to Serial converter.

So, first of all, we need to make the all the required connection as shown in Circuit Diagram below. Connections are simple, we have just connected fingerprint module to Raspberry Pi USB port by using USB to Serial converter. A 16x2 LCD is used for displaying all messages. A 10k pot is also used with LCD for controlling the contrast of the same. 16x2 LCD pins RS, EN, d4, d5, d6, and d7 are connected with GPIO Pin 18, 23, 24, 25, 8 and 7 of Raspberry Pi respectively. Four push buttons are connected to GPIO Pin 5, 6, 13 and 19 of Raspberry Pi. LED is also connected at pin 26 of RPI.

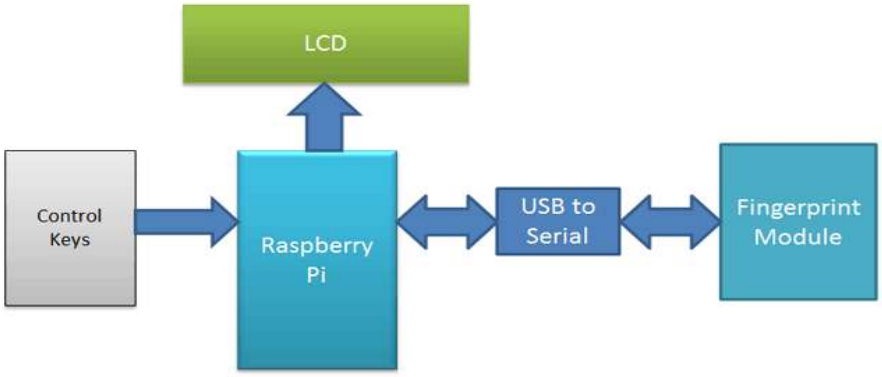


**Fig -1**: Block diagram of Proposed System

### 2.1 Fingerprint Sensor Operation

After making all the connections we need to power up Raspberry Pi and get it ready with terminal open. Now we need to install fingerprint library for Raspberry Pi in python language Operation of this project is simple, just run the python code and there will be some intro messages over LCD and then user will be asked to Place Finger on Finger Print Sensor. Now by putting a finger over fingerprint module, we can check whether our finger prints are already stored or not. If your fingerprint is stored then LCD will show the message with the storing position of fingerprint like 'Fount at Pos: 2' otherwise it will show 'No Match Found'**.**

### 2.2 Servo Motor Operation

A Servo Motor is a combination of DC motor, position control system and gears. Servos have many applications in the modern world and with that; they are available in different shapes and sizes. We will be using SG90 Servo Motor in this tutorial, it is one of the popular and cheapest one. SG90 is a 180 degree servo. So with this servo we can position the axis from 0-180 degrees. A Servo Motor mainly has three wires, one is for positive voltage, another is for ground and last one is for position setting. The Red wire is connected to power, Brown wire is connected to ground and Yellow wire (or WHITE) is connected to signal. Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on PWM (Pulse width modulation) principle means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. Potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on required angle.

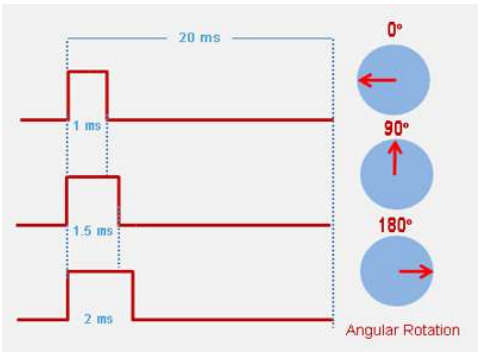


**Fig -2**: Timing diagram of Servo Motor

## 3. SOFTWARE DESCRIPTION

Raspberry Pi, a small development board minicomputer that runs the Linux operating system, was developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools in the UK and in developing countries. Raspberry Pi has USB sockets, which support various peripheral plug-and-play devices like the keyboard, the mouse, the printer, etc. It contains ports like HDMI (High Definition Multimedia Interface) to provide users with video output. Its credit-card-like size makes it extremely portable and affordable. It requires just a 5V micro-USB power supply, similar to the one used to charge a mobile phone.

Software Description Python is a programming language that is extensively used in education. As the Raspberry Pi was designed for educational purposes, it is of no surprise that Python is one of the most popular choices as a programming language. What is more, the Raspberry Pi Foundation promotes Python as the main programming language for the Raspberry Pi. One of the main advantages of Python is that it emphasizes indentation, which gets students accustomed to writing clear code. Another important advantage of Python is the result of its extensive use: a large number of available libraries.For programming the Raspberry Pi, we consider Python is a good choice for building educational applications that control some pins, retrieve data from a web service or include the Pygame module to build some simple games. In addition, we recommend Python for prototyping purposes, in building applications such as smart home systems, smart plants or others.

## 4. HARDWARE DESCRIPTION

Raspberry Pi 4 offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation boards, while retaining backwards compatibility and similar power consumption. The Raspberry Pi 4 provides desktop performance comparable to entry-level x86 PC systems. The Raspberry Pi 4 comes in three on-board RAM options for even further performance benefits: 1GB, 2GB and 4GB.

This product's key features include a high-performance 64-bit quad-core processor, dual-display output via two Micro HDMI ports, up to 4K resolution, hardware video decoding at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability.


**Fig -3**: Raspberry PI4 Module

Due to the higher power requirements, the Raspberry Pi 4 requires a 3.0A USB-C power supply (sold separately). If you have an existing power supply that is rated at 3.0A, you may utilize a microUSB to USB-C adapter to utilize your existing Micro USB power supply to power the Raspberry Pi 4.The standard HDMI port that were part of previous generation Raspberry Pi generation boards is replaced on the Raspberry Pi 4 by two Micro HDMI ports to provide dual monitor support. A 4K60P Micro HDMI to HDMI cable is required (or two cables for dual monitor operation).

### 4.1 R307 Fingerprint Module

R307 fingerprint module is a finger print sensor with TTL UART interface. The user can store the fingerprint data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The FP module can directly interface with 3.3 or 5v Microcontroller. A level converter (like MAX232) is required for interfacing with PC serial port. R307 Fingerprint Module consists of high-speed DSP processor, high-performance fingerprint alignment algorithm, high-capacity FLASH chips and other hardware and software composition, stable performance, simple structure, with fingerprint entry, image processing, fingerprint matching, search and template storage and other functions.

### 4.2 Serial Adapter Module

New FTDI board now uses a SMD 6-pin header on the bottom, which makes it smaller and more compact. Functionality has remained the same. This is a basic breakout board for the FTDI FT232RL USB to serial IC. The pin out of this board matches the FTDI cable to work with 5V boards. It can also be used for general serial applications. The major difference with this board is that it brings out the DTR pin as opposed to the RTS pin of the FTDI cable. The DTR pin allows a target to auto-reset when a new Sketch is downloaded. This is a really nice feature to have and allows a sketch to be downloaded without having to hit the reset button. This board will auto reset any board that has the reset pin brought out to a 6-pin connector. This board has TX and RX LEDs that make it a bit better to use over the FTDI cable. You can actually see serial traffic on the LEDs to verify if the board is working.

## 5. CONCLUSION

From the observations, this system provides efficient solution to the security system. A prototype for biometric based door security system using R307 and raspberry pi is implemented. Cost effective and very high speed in processing finger print and verifying. Further, we can extend the database size so that we can load more finger prints then it will applicable in attendance monitoring and security login/logout. If we implemented security systems with Internet of Things technology, it could be great flexibility and we can access, monitor from anywhere.

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