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IoT Assisted Fingerprint Based Door Security System using Raspberry PI 4

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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 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.

KEYWORDS: *Internet of Things (IoT), Raspberry PI 3 processor, R307 Finger Print Sensor, FTDI board*

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I. INTRODUCTION

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 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. 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 legit users 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.

II. HARDWARE DESCRIPTION

All The major hardware components used in the development of this work are the optical fingerprint scanner, web camera, and Raspberry PI 4 and door locking mechanism with servo motor. The Raspberry PI 4 fetches the input from the fingerprint module and when the verification information are legit then the system automatically provides access to the user by opening the rotating door using a Servo motor. The system also captures the image of the users who provides the wrong verification of fingerprint and subsequently sends an alerting message with the face image of the unauthorized user to the authorized user with a predefined email ID using the IoT based Wi-Fi technology it also inform to predefine mobile number by text SMS. The hardware components are described in the subsequent sections. 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. 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. 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.

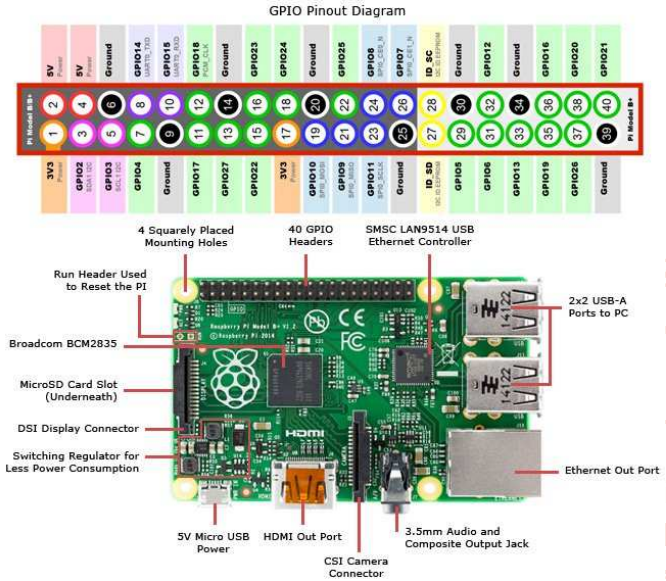

Fig1. Raspberry Pi 4 Pin Configuration

III. LIQUID CRYSTAL DISPLAY (LCD)

LCD is a type of display used in digital watches and many portable computers. LCD displays utilize to sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. LCD technology has advanced very rapidly since its initial inception over a decade ago for use in lap top computers. Technical achievements has resulted in brighter displace, higher resolutions, reduce response times and cheaper manufacturing process. The liquid crystals can be manipulated through an applied electric voltage so that light is allowed to pass or is blocked. By carefully controlling where and what wavelength (color) of light is allowed to pass, the LCD monitor is able to display images. A backlight provides LCD monitor's brightness. Over the years many improvements have been made to LCD to help enhance resolution, image, sharpness and response times. One of the latest such advancement is applied to glass during acts as switch allowing control of light at the pixel level, greatly improving LCD's ability to display small-sized fonts and image clearly. Other advances have allowed LCD's to greatly reduce liquid crystal cell response times. Response time is basically the amount of time it takes for a pixel to "change colors", in reality response time is the amount of time it takes a liquid crystal cell to go from being active to inactive. An intelligent LCD display of two lines, 20 characters per line that is interfaced to the Raspberry pi board in 4 bit mode. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU to keep displaying the data. Ease of programming for characters and graphics. Most of the LCD modules conform to a standard interface specification. A 14-pin access is provided having eight data lines, three control lines and three power lines. The connections are laid out in one of the two common configurations, either two rows of seven pins, or a single row of 14 pins.

Fig2. Pin diagram

IV. SERVO MOTOR

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through **servo mechanism**. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity.

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit. First of all we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

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.

V. 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**

VI. CONCLUSION

This system provides efficient solution to the security system. If we implemented security systems with Internet of Things technology, we can access, monitor from any place to this system.

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