SMARTGUN EMPLOYING BIOMETRIC SENSORS

In the partial fulfilment of the requirement for the award of the degree of

Bachelor of Engineering in Electronics and Communication Engineering

Submitted by

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Year 2019-20

Declaration

We do declare that the project work **SMARTGUN EMPLOYING BIOMETRIC SENSORS** submitted in the department of Electronics and Communication Engineering (ECE), Chaitanya Bharathi Institute of Technology, Hyderabad in fulfilment of degree for the award of **Bachelor of Engineering** is a bonafide work done by us, which was carried under the supervision of Dr. K. SAI KRISHNA.

Also, we declare that the matter embedded in this report has not been submitted by us in full or partial thereof for the award of any degree/diploma of any other institution or University previously.

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Date:

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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HYDERABAD-500075

C E R T I F I C A T E

This is to certify that the Project work entitled **"SMARTGUN EMPLOYING BIOMETRIC SENSORS"** is a bonafide work carried out by **PRANAV TEJASVI ADIRAJU (160116735102), B. SRINIVAS TEJA (160116735112), MALEPATI TARUNENDRA (160116735114)** in partial fulfilment of the requirements for the degree of Bachelor of Engineering in Electronics and Communication Engineering, Osmania University, Hyderabad during the academic year 2019-20. The results embodied in this report have not been submitted to any other University or Institution for the award of any diploma or degree.

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ABSTRACT

A firearm is a portable weapon with a barrel that launches either projectile/s and is often driven by the action of an explosive force. A smart gun is a firearm which can be fired only when activated by an authorized user. The authorized and unauthorized users are diagnosed in several different ways which includes the use of RFID chips, fingerprint recognition devices, mechanical locks etc. This paper showcases the details of integrating fingerprint biometric system with the firearm to improve the safety of accessing it, which in turn reduces accidental firings and gun thefts. By implementation of this technology, only license will be accessible to the firearm which further reduces crimes. Smart gun technology has the potential to prevent stolen guns from being used and, will additionally create a space for investigation during crimes by providing firearm usage statistics such as time, date and location. Fingerprint reader and location recorder are integrated with a microprocessor, the motherboard of the weapon, which authorizes the user and sends signals to location recorder to store the location of a place immediately after firing. Additionally, this data along with date and time stamp is stored to a central cloud database which can be accessed by the police and investigation departments whenever required. The other important thing to be noted is that this smart weapon is no longer mechanically operated; elements such as the hammer, spring, and lock are all replaced by an electromagnetic solenoid.

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ABBREVIATIONS

S.NO	ABBREVIATION	DESCRIPTION
1	USB	UNIVERSAL SERIAL BUS
2	UART	UNIVERSAL ASYNCHRONOUS RECEIVER AND TRANSMITTER
3	OS	OPERATING SYSTEM
4	GPIO	GENERAL PURPOSE INPUT/OUTPUT
5	IR	INFRARED RAY

CHAPTER 1: THE INTRODUCTION

1.1 INTRODUCTION

Smart guns are firearms which can recognize the authorized user(s). Smart guns have one or more systems which allow them to fire only when activated by an authorized user. Smart guns are generally intended to stop unauthorized personal from accessing or firing the firearm.

There are two kinds of existing technologies capable of reliably identifying authorized users.

- Radio frequency identification (RFID) tokens activate a firearm when they are in close proximity to it. These tokens can be integrated into bracelets, watches, rings, or other wearable devices.
- Biometric recognition technology activates a firearm after identifying biological features like a fingerprint, palm print, or grip.

Firearms fall under the category of things which people generally don't use extensively in daily activities. As per the Draft Arms Act 2016 issued by The Ministry of Home Affairs, Government of India, a firearm is any barrelled weapon which discharges a projectile due to the action of internal explosive. They are mainly categorised as Prohibited, Restricted and Permissible arms. Only permissible arms shall be used by the public and most of manual and semiautomatic arms fall under this category.

In order to prevent gun violence, Indian government set up a licensing authority which facilitates responsible gun ownership by requiring a person to obtain a gun license before purchase. It is issued/renewed by the authority only after providing proper justification for its requirement by the applicant & undergone background check and safety training of the firearm. The applicant has to abide by Rule 10 of the Arms Act 2016 completely to acquire the license.

SMART GUN TECHNOLOGY:

Smart arms in simple terms are weapons which can identify their owners. The main purpose of a licensing system is to have a record of people using the weapons and to avoid unlicensed user usage; and these smart arms can help achieve the purpose more efficiently. They fire only with restricted permission and it acts as a major feature which could prevent misuse and accidental firing. An American survey showcases that majority of the firearm suicides occur with the weapons of the parents or other family members.

According to the survey- 82% of the youths attempting to commit suicide used a firearm belonging to a family member and 84% of the accidental shooting deaths occurred in the home or car of the victims' family. Further, between 2005 and 2010, 1.4 million guns were stolen from their owners. This smart gun technology has the potential to prevent stolen guns from being used. This technology also prevents police officers, constables, security officials and all those people who carry firearms from being killed or injured by their own weapons (either by self or by the influence of another person). A number argued to be roughly 1 out of every 6 police officers gets killed in the line of duty in US. Though this is not the case in a country like India, it is always desirable to evolve and advance the technology. Currently in the US, there are about as many weapons as there are people, and as we know smart gun technology will only affect newly purchased weapons, (crimes with the old weapons will still continue). But in the case of developing countries like India, Myanmar, and Ireland etc. is different. Neither the public is allowed to freely use a firearm nor are they allowed to buy the firearm without prior permission of the licensing authority – the District Magistrate. It is easier and advisable to implement this technology in such countries and shall also be widely accepted and supported by the government. It is very essential to modernize our firearm security before such state of affairs exists.

1.2 AIM OF THE THESIS

To design a smart gun employing biometric security that can recognize and provide access to its registered users.

1.3 MOTIVATION OF THESIS

- Understanding basic working of a smart gun.
- Studying about raspberry pi microprocessor.
- Creating database consisting of user data to assist law enforcements.
- To develop an efficient algorithm for reducing unauthorized users and preventing friendly fires.
- Implementing and Testing of biometric security and GSM module.

1.4 LITERATURE SURVEY

Many law enforcement agencies agree that a need does exist for a technology that would help prevent misuse of law enforcement firearms [2]. This is a problem that has been in need of a solution [2]. This problem can be addressed through the integration of modern sensors with control electronics to provide authorized user firearms for law enforcement and even recreational uses [2]. A considerable benefit to law enforcement agencies, as well as society as a whole, would be gained by the application of recommended Smart Gun Technologies (SGT) as a method of limiting the use of firearms to authorized individuals [2]. Sandia National Laboratory has been actively involved in the research and design of technologically sophisticated surety devices for weapons for the DOE and DOD [2]. This experience is now being applied to criminal justice problems by transferring these technologies to commercial industry [2]. In the SGT project Sandia is developing the user requirements that would limit a firearm use to its owner and/or authorized users [2]. Various technologies that are capable of meeting the requirements are being investigated, these range from biometrics identification to radio-controlled devices [2]. Research is presently underway to investigate which technologies represent the best solutions to the problem [2]. Proof of concept demonstration models are being built for the most promising SGT with the intent of technology transfer [2]. Different solutions are recommended for the possible applications: law enforcement, military, and commercial (personal protection/recreational) use [2].

1.5 TECHNICAL APPROACH

COMPONENTS:

- AIRSOFT GUN
- ELECTROMAGNETIC SOLENOID
- GSM/GPRS:
  - SIM 900A is used.
  - The baud rate is configurable from 1200-115200 through AT commands.
  - This is a complete GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core.
- FINGERPRINT SENSOR:
  - R307 Fingerprint module is used.
  - It consists of optical fingerprint sensor, high speed DSP processor, high performance fingerprint alignment algorithm and high capacity FLASH chips.
- IR SENSOR
- USB TO TTL CONVERTER
- RASPBERRY PI PROCESSOR
  - RASPBERRY PI 3 GEN processor is used.
- SINGLE POLE RELAY

BLOCK DIAGRAM**:**

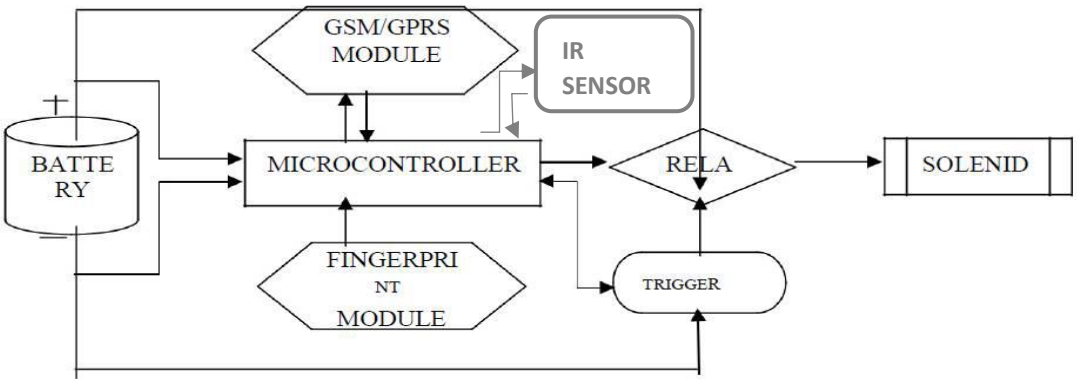


Fig: 1.1 BLOCK DIAGRAM OF SMART GUN

AS SHOWN IN THE ABOVE FIG1.1 THE STEPS INVOVLED ARE:

- First the solenoid need to be placed in conventional hand gun and need to be tested.
- Then it has to be interfaced to raspberry pi board .
- The fingerprint has to interfaced to board and the fingerprints need to enrolled for recreating a database.
- The enrolled fingerprints prints have to be given a separate id for identification.
- Using commands the fingerprint module has to be tested for verification.
- Gsm module has to interfaced and has to be tested .
- The IR sensor has to be interfaced by downloading the libraries in Raspbian stretch os.
- After interfacing of all devices with pi then the solenoid will be placed in its position and the gun is tested.

1.6 APPLICATION OF THESIS

- Though this technology becomes very essential in near future, unless the government takes certain serious measures, it cannot be widely implemented.
- When smart guns are in use, after making certain small modifications in the system, there can be locations set by the government where the usage of guns can be restricted. Such locations might include any public places, government premises, educational institutions etc.
- This in turn creates an atmosphere of security among the people and unnecessary panic in the crowd could be avoided.
- If manufactured on large scale, all components can be integrated into a single chip to further reduce the space consumption and ensures proper placement.

1.7 ORGANIZATION OF THESIS

Chapter 2 gives the information about all the components used in this project and also working of each component is discussed in detail.

Chapter 3 includes the software and hardware implementation of the smart gun prototype.

Chapter 4 includes the results and discussions.

Chapter 5 deals with the future scope, conclusion and references of the project.

CHAPTER-2 THERORETICAL BACKGROUND

2.1 RASPBERRY PI MODULE:

2.1.1 INTRODUCTION:

Raspberry pi is soc(system on chip). It is a series of small single board computers. It also has built-in wireless connectivity; this makes it more flexible for internet of things applications. This is a low cost, credit-card sized computer. It can be plugged into a computer monitor or tv using HDMI cable and also its screen can be shared using putty or remote desktop connection by connecting it to laptop using micro USB cable. It doesn't have keyboard and mouse but can be connected to any standard peripherals using USB cable. It works on python and scratch programming languages. It's capable of doing everything that a desktop computer can do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. The raspberry pi is a very cheap computer that runs on Linux, it also provides a set of GPIO (General Purpose Input/Output) pins that allow you to control electronic components for physical computing and explore the Internet Of Things (IOT). Its main supported operating system is Raspbian OS. It is open source and runs a suite of open source software. It's now widely used even in research projects, such as for weather monitoring, because of its low-cost and portability.

2.1.2 HISTORY OF RASPBERRY PI MODULE:

The raspberry pi was first launched in 2012. It is developed by raspberry pi foundation in the united kingdom. Their mission was to promote teaching of basic computer science in schools and in developing countries. The original model of raspberry pi became far more popular than anticipated. Its market was even expanded to users of robotics. There are several iterations and variations release by raspberry pi foundation.

Most of pi's are made in Sony factory in Pencoed, wales, while others are made in china and japan. The raspberry pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras.

The raspberry pi foundation is a registered educational charity based in the United Kingdom. Their foundation's goal was to advance the education of adults and children, particularly in the field of computers, computer science and related subjects. The raspberry pi 3 model b is the earliest model of the third-generation raspberry pi. It replaced the raspberry pi 2 model b in February 2016.

2.1.3 ABOUT RASPBERRY PI 3:

The quad-core raspberry pi 3 is both faster and more capable than its predecessor. For those interested in benchmarks, the pi 3's CPU–the board's main processor–has roughly 50-60 percent better performance in 32-bit mode than that of the pi 2, and is 10x faster than the original single-core raspberry pi. Compared to the original pi, real-world applications will see a performance increase of between 2.5x–for single-threaded applications–and more than 20x–when video playback is accelerated by the chip's neon engine. The new board is capable of playing 1080p mp4 video at 60 frames per second (with a bit rate of about 5400kbps), boosting the pi's media centre credentials. However, it depends on the player used and bitrate. The pi 3 also supports wireless internet out of the box, with built-in wi-fi and Bluetooth. The latest board can also boot directly from an USB-attached hard drive or pen drive, as well as supporting booting from a network-attached file system, which is useful for remotely updating a pi and for sharing an operating system image between multiple machines. The performance being almost indistinguishable from running a modern windows 10 pc, save for the very slow transfer of data to USB sticks. The latest version of the raspberry pi's official OS has the chromium browser, the open-source browser that chrome is based on. Its performance is reasonable, as long as you don't open too many script-laden websites.

The pi 3 has the added advantage of a slightly faster graphics processor, which the raspberry pi foundation has said is able to play local h.264-encoded video recorded at 1920x1080 resolution and 60 frames per second. Another advantage is built-in support for wi-fi makes it easier to stream content to the pi, while native Bluetooth simplifies the hooking up peripherals.

2.1.4 WORKING WITH RASPBERRY PI:

- For developing and testing of program in raspberry pi , we need to use Raspbian stretch OS.
- The program is dumped into raspberry pi board by connecting to pc/ laptop by using putty / vnc or by connecting it to desktop using HDMI.
- Using various libraries of the device can be installed and accessed.
- Using python programming language the program can be coded.
- And by using pi commands / linux commands the code can be tested.

2.1.5 FEATURES OF RASPBERRY PI:

- CPU: Quad core 1.2ghz Broadcom bcm2837 64bit CPU
- Memory: 1gb lpddr2-900 SDRAM (i.e. 900mhz)
- GPU: 400mhz video core iv multimedia
- Video outputs: HDMI, composite video (pal and ntsc) via 3.5 mm jack
- Bcm43438 Wireless LAN and Bluetooth low energy (BLE) on board
- 100 base ethernet
- 40-pin extended GPIO
- 4 USB 2 ports
- 4 pole stereo output and composite video port
- Full size HDMI
- Csi camera port for connecting a raspberry pi camera
- Dsi display port for connecting a raspberry pi touchscreen display
- Micro SD port for loading your operating system and storing data
- The new bump to a 2.5 amps power source means it will be able to power more complex USB devices without the need for a second power cable.

LABELLING OF RASPBERRY PI 3:

The FIG 2.1.1 gives the information about the raspberry pi 3 module. The below is the photo of raspberry pi 3 module with labelled parts. It has USB ports, GPIO pins, SD card slot, ethernet slot, HDMI port, camera module port, Audio jack and also micro USB power slot.

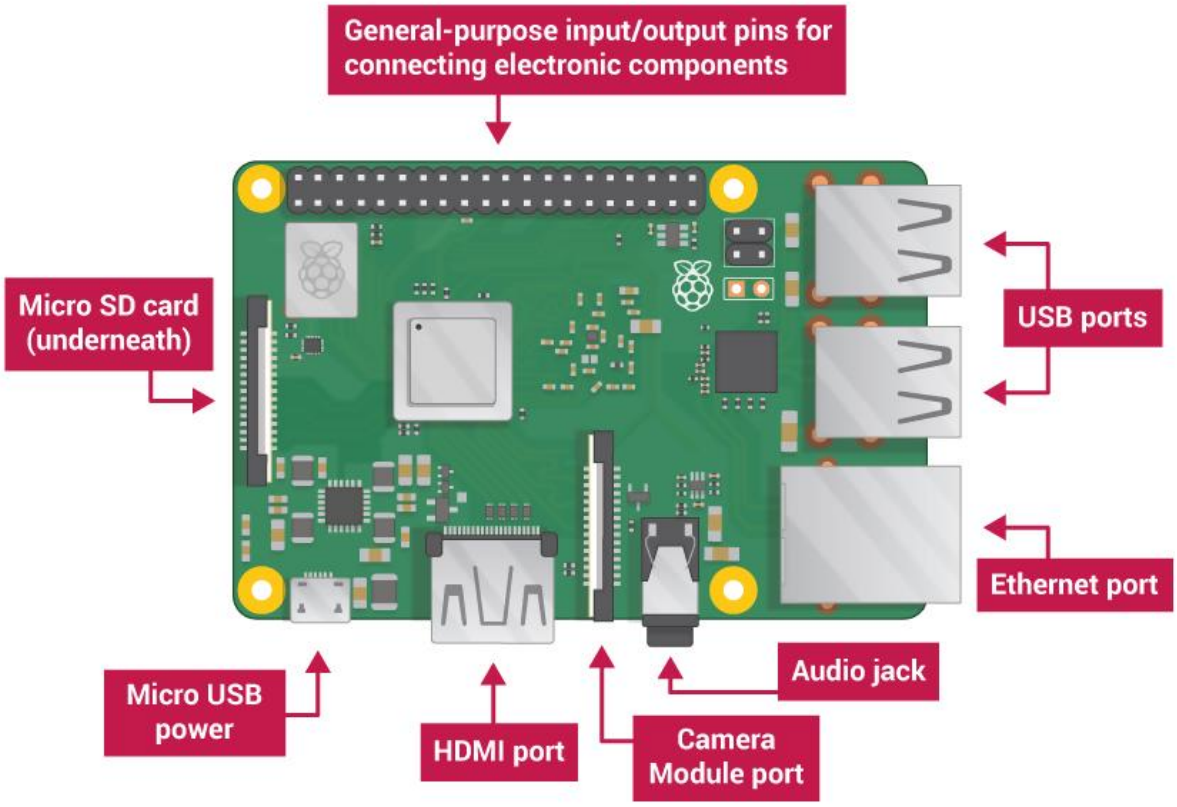


FIG 2.1.1: RASPBERRY PI LABELLED DIAGRAM

RASPBERRY PI PIN CONFIGURATION:

GPIO#	NAME				NAME	GPIO#
	3.3 VDC Power	1		2	5.0 VDC Power	
8	GPIO 8 SDA1 (I2C)	3		4	5.0 VDC Power	
9	GPIO 9 SCL1 (I2C)	5		6	Ground	
7	GPIO 7 GPCLK0	7		8	GPIO 15 TxD (UART)	15
	Ground	9		10	GPIO 16 RxD (UART)	16
0	GPIO 0	11		12	GPIO 1 PCM_CLK/PWM0	1
2	GPIO 2	13		14	Ground	
3	GPIO 3	15		16	GPIO 4	4
	3.3 VDC Power	17		18	GPIO 5	5
12	GPIO 12 MOSI (SPI)	19		20	Ground	
13	GPIO 13 MISO (SPI)	21		22	GPIO 6	6
14	GPIO 14 SCLK (SPI)	23		24	GPIO 10 CE0 (SPI)	10
	Ground	25		26	GPIO 11 CE1 (SPI)	11
30	SDA0 (I2C ID EEPROM)	27		28	SCL0 (I2C ID EEPROM)	31
21	GPIO 21 GPCLK1	29		30	Ground	
22	GPIO 22 GPCLK2	31		32	GPIO 26 PWM0	26
23	GPIO 23 PWM1	33		34	Ground	
24	GPIO 24 PCM_FS/PWM1	35		36	GPIO 27	27
25	GPIO 25	37		38	GPIO 28 PCM_DIN	28
	Ground	39		40	GPIO 29 PCM_DOUT	29

FIG 2.1.2: RASPBERRY PI PIN CONFIGURATION

The above FIG 2.1.2 is about the GPIO pins of raspberry pi 3 module. They are 40 GPIO pins in which there are 8 ground pins , 2 5v pins, 2 3.3v pins and other are for GPIO purpose.

2.2 FINGERPRINT SENSOR:

2.2.1 INTRODUCTION:

R307 Fingerprint Module consists of optical fingerprint sensor, 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.

2.2.2 FEATURES:

- Perfect function: independent fingerprint collection, fingerprint registration, fingerprint comparison (1: 1) and fingerprint search (1: N) function.
- Small size: small size, no external DSP chip algorithm, has been integrated, easy to install, less fault.
- Ultra-low power consumption: low power consumption of the product as a whole, suitable for low-power requirements of the occasion.
- Anti-static ability: a strong anti-static ability, anti-static index reached 15KV above.
- Application development is simple: developers can provide control instructions, self-fingerprint application product development, without the need for professional knowledge of fingerprinting.
- Adjustable security level: suitable for different applications, security levels can be set by the user to adjust.
- Finger touch sensing signal output, low effective, sensing circuit standby current is very low, less than 5Ua.
- It has a level 5 security system.

2.2.3 INTERFACE DESCRIPTION:

The R307 fingerprint module shown in FIG 2.2.1 has two interface TTL UART and USB2.0, USB2.0 interface can be connected to the computer; RS232 interface is a TTL level, the default baud rate is 57600 , can be changed, And can communicate with microcontroller, such as ARM, DSP and other serial devices with a connection, 3.3V 5V microcontroller can be connected directly. Needs to connect the computer level conversion, level conversion note, embodiments such as a MAX232 circuit. Fingerprint module board marked with 3.3V – 2 contacts short circuit, you can use DC 3.3 V.

FIG 2.2.1: R307 FINGERPRINT SENSOR

2.2.4 WORKING:

Fingerprint processing includes two parts, fingerprint enrolment and fingerprint matching (the matching can be 1: 1 or 1: N). When enrolling, user needs to enter the finger two times. The system will process the two-time finger images, generate a template of the finger based on processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library.

If it is previously stored it gives template number in which it is stored. And if the two processed finger images don't match an exception is generated and user has to place finger again 2 times. The enrolment of finger starts from 0 and goes up to 999, a total of 1000 fingerprints.

For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1: N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.

The scanning mechanism in this is optical i.e. it uses optical sensor to read the data. The way an optical scanner works is by shining a bright light over your fingerprint and taking a digital photo. The light-sensitive microchip makes the digital image by looking at the ridges and valleys of the fingerprint, turning them into 1's and 0's, and creates the user's own personal code.

The FIG 2.2.2 shows how the light source reads the fingerprint and where that information goes.

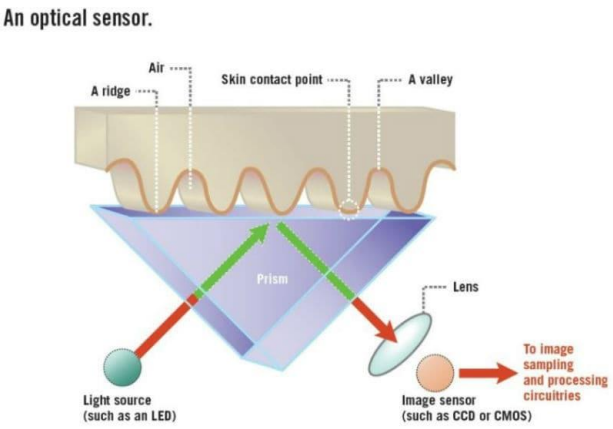


FIG 2.2.2: OPTICAL SENSOR

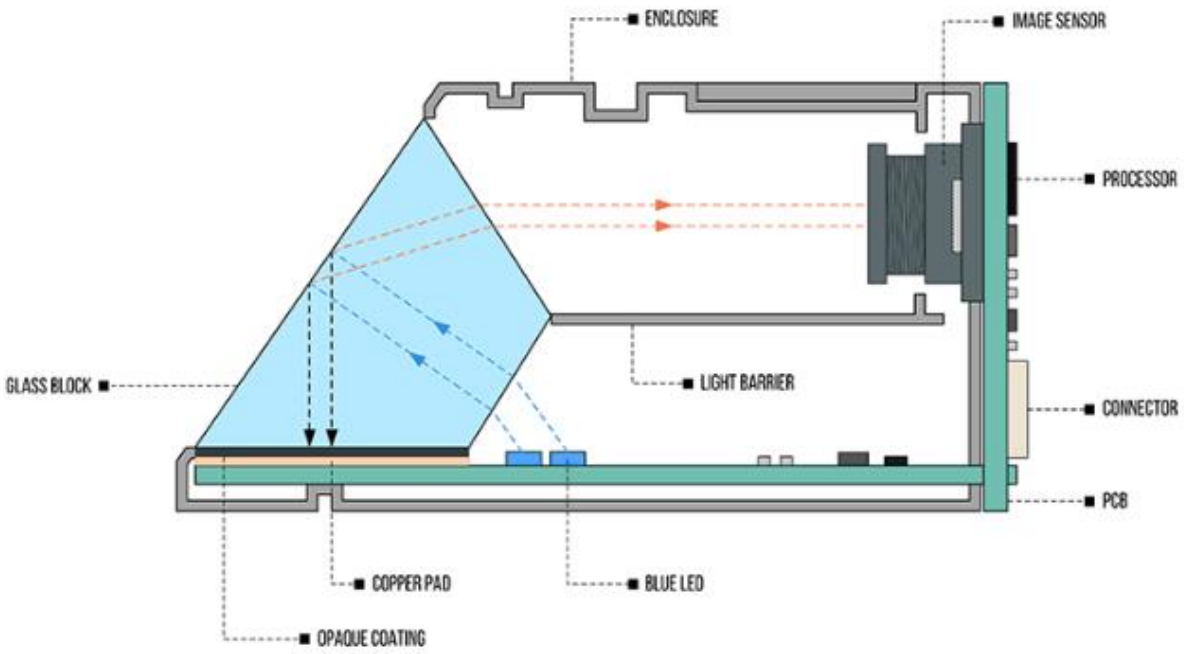


FIG 2.2.3: R307 LABELLING

The above FIG 2.2.3 is about r307. it displays how the light is being focussed on the glass for reading the image and also has all r307 parts labelled

2.2.5 TECHNICAL PARAMETERS:

- Supply voltage: DC 4.2 ~ 6.0V
- Supply current: Working current: 50Ma (typical) Peak current: 80Ma
- Fingerprint image input time: <0.3 seconds
- Window area: 14x18 mm
- Matching method: Comparison method (1: 1)
- Search method (1: N)
- Characteristic file: 256 bytes
- Template file: 512 bytes
- Storage capacity: 1000 pieces

- Security Level: Five (from low to high: 1,2,3,4,5)
- Fake rate (FAR): <0.001%
- Refusal rate (FRR): <1.0%
- Search time: <1.0 seconds (1: 1000 hours, mean value)
- Host interface: UART \ USB1.1
- Communication baud rate (UART): (9600Xn) bps Where N = 1 ~ 12 (default N = 6, ie 57600bps)
- Working environment: Temperature: -20 ℃ - +40 ℃ Relative humidity: 40% RH-85% RH (no condensation)
- Storage environment: Temperature: -40 ℃ - +85 ℃ Relative humidity: <85% H (no condensation) Suitable for fingerprint lock, fingerprint safes and other purposes.

TABLE 2.2.1: this table describes about the pin configuration of R307 and also gives the details about the pin.

PINOUTS:

Pin#	Pin Name	Details
1	5V	Regulated 5V DC
2	GND	Common Ground
3	TXD	Data output – Connect to MCU RX
4	RXD	Data Input – Connect to MCU TX
5	TOUCH	Active Low output when there is touch on sensor by finger
6	3.3V	Use this wire to give 3.3V to sensor instead of 5V

USB Cable Connections are 5V/D+/D-/GND (Optional)

DIMENSIONS:

The FIG 2.2.4 gives the detailed dimensions of r307 in all the angles. This sensor is light in weight and also is very small because of this dimension it can be easily soldered with any devices.

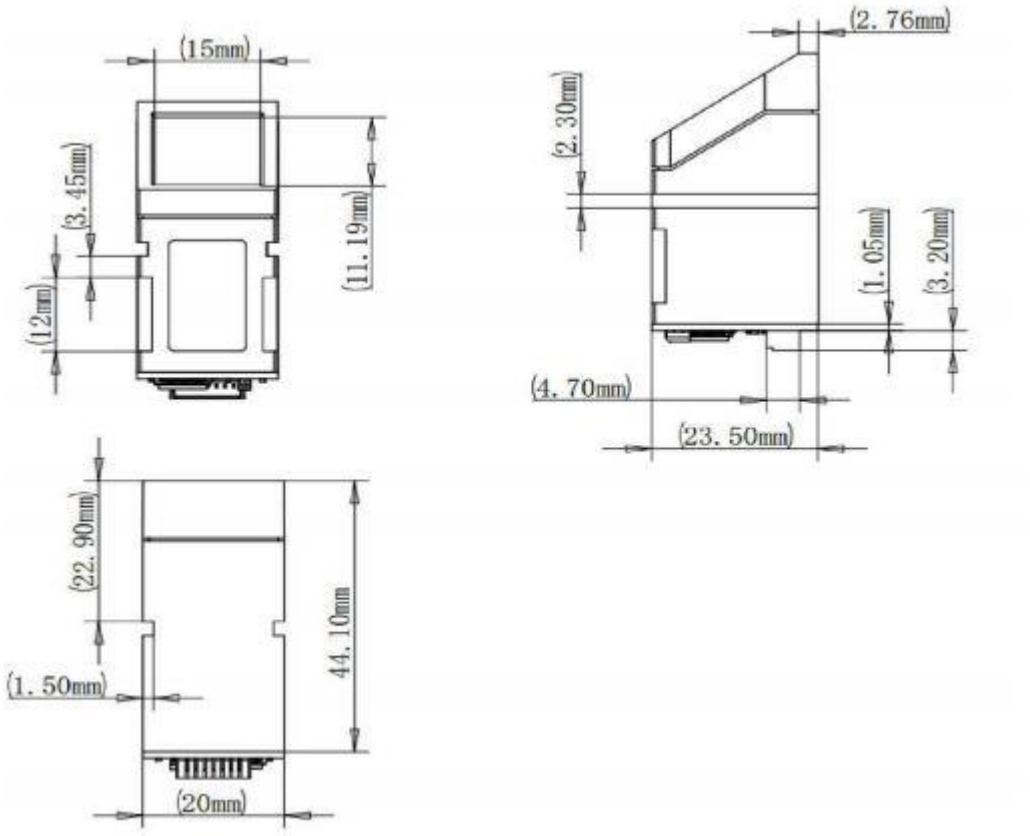


FIG 2.2.4 R307 DIMENSIONS

2.3 SOLENOID:

2.3.1 INTRODUCTION:

Solenoids are simple components that can be used for various applications. The name solenoid is derived from the Greek word “Solen” which means a channel or a pipe. Solenoids are used in both domestic and industrial equipment, they are available in various designs, each of them has their own specific applications. Although the application changes, their working principle always remains the same. A solenoid is a long piece of wire which is wound in the shape of a coil as shown in FIG 2.3.1. When the electric current passes through the coil it creates a relatively uniform magnetic field inside the coil.

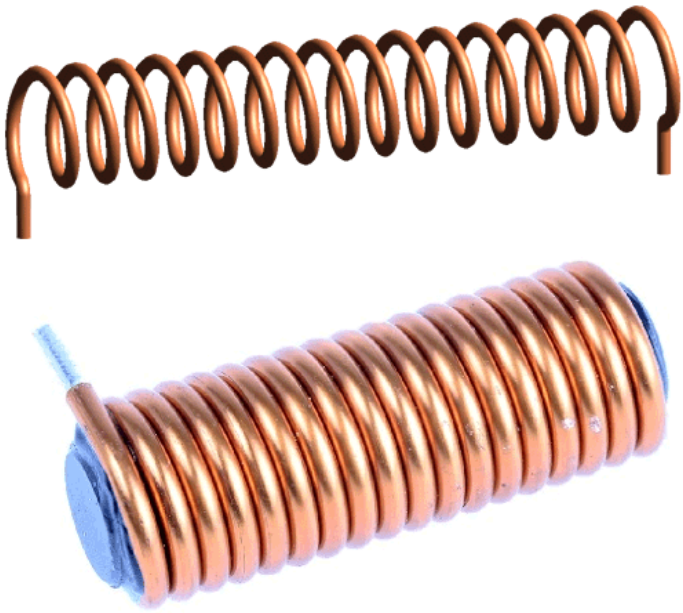


FIG 2.3.1 SOLENOID

The solenoid can create a magnetic field from electric current and this magnetic field can be used to generate a linear motion with the help of a metal core. This simple device can be used as an electromagnet, as an inductor or as a miniature wireless receiving antenna in a circuit.

2.3.2 SOLENOID WORKING PRINCIPLE:

The solenoid simply works on the principle of “electromagnetism”. As shown in FIG 2.3.2 when the current flow through the coil magnetic field is generated in it, if you place a metal core inside the coil the magnetic lines of flux is concentrated on the core which increases the induction of the coil as compared to the air core.

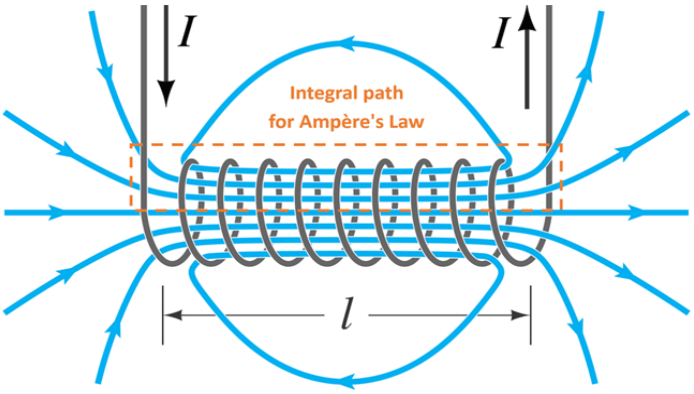


FIG 2.3.2: SOLENOID WITH MAGNETIC FLUX

Most of the flux is concentrated only on the core, while some of the flux appears at the ends of the coil and a small amount of flux appears outside the coil.

The magnetic strength of the solenoid can be increased by increasing the density of the turns or by increasing the current flow in the coil.

Like all other magnets the activated solenoid has both Positive and Negative poles, through which an object can be attracted or repelled.

2.3.3 TYPES OF SOLENOIDS:

There are different types of solenoids available in the market, the classification is made based on material, Design and function.

- AC- Laminated Solenoid
- DC- C Frame Solenoid
- DC- D Frame Solenoid
- Linear Solenoid
- Rotary Solenoid

AC Laminated Solenoid:

The AC laminated Solenoid consist of a metal core and a coil of wire. The core is constructed with a laminated metal in order to reduce the stray current, this helps in improving the performance of the solenoid. The below FIG 2.3.3 is a AC laminated solenoid.

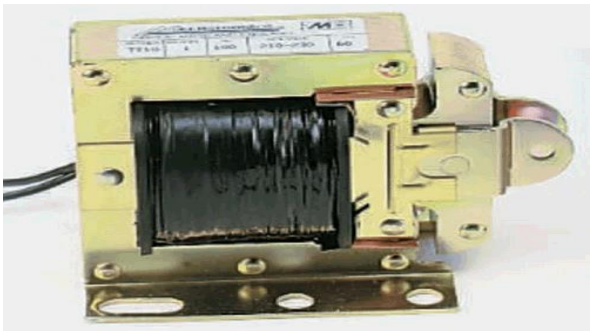


FIG 2.3.3 AC LAMINATED SOLENOID

DC C-Frame Solenoid:

The C frame refers to the design of the solenoid. The DC C-Frame solenoid has only a frame in the shape of the letter C which is covered around the coil.

The DC C-Frame solenoid is used in multiple day to day applications because of it more controlled stroke operation. Although it is said to be DC configuration but they can also be used in equipment designed for AC power. The FIG 2.3.4 is a DC C-frame solenoid.

FIG 2.3.4 DC C-FRAME SOLENOID

DC D-Frame Solenoid:

This type of solenoid has a two-piece frame covering the coils. They have similar function like a C-frame solenoid hence the D-frame can also be used with AC power and has a controlled stroke operation. The below FIG 2.3.5 is DC D-frame solenoid.

FIG 2.3.5 DC-D FRAME SOLENOID

Linear Solenoid:

The linear solenoids are more familiar among the people. It consists of a coil of wire which is wrapped around a movable metal core which helps us to apply pulling or pushing force to a mechanical device. The FIG 2.3.6 is linear solenoid.

FIG 2.3.6: LINEAR SOLENOID

Rotary Solenoid:

A rotary solenoid is a unique type of solenoid which is used for various applications where there is a need for easy automatic control process. It works on the same principle as the other solenoids and has the same elements, a coil and a core, but they have a different operation. The FIG 2.3.7 is rotary solenoid.

FIG 2.3.7: ROTATORY SOLENOID

2.3.4 APPLICATIONS:

The solenoids are the simple and effective solution for controlling the valves and electromagnetic switches or mechanical interlocks.

Their operation principle and instantaneous response made them a better solution for applications that needs a large amount of power into a small space and where there is a need of quick, consistent and robust operation.

Here are few applications which uses solenoid along with its driver circuit:

- Solenoid Driver Circuit
- How to control a Solenoid Valve with Arduino
- Automatic Water Dispenser using Arduino

2.4 SIM 900A GPS/GPRS MODULE

2.4.1 INTRODUCTION:

SIM900A Modem is built with Dual Band GSM/GPRS based SIM900A modem from SIMCOM. It works on frequencies 900/ 1800 MHz SIM900A can search these two bands automatically. The frequency bands can also be set by AT Commands. The baud rate is configurable from 1200-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. SIM900A is an ultra-compact and reliable wireless module. This is a complete GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions.

2.4.2 SPECIFICATION:

- Dual-Band 900/ 1800 MHz
- GPRS multi-slot class 10/8GPRS mobile station class B
- Compliant to GSM phase 2/2+
- Dimensions: 24*24*3 mm
- Weight: 3.4g
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- Supply voltage range: 5V
- Low power consumption: 1.5Ma (sleep mode)

2.4.3 APPLICATIONS:

- Industrial automation.
- GPRS based data logging.
- GPRS and GPS application.
- Home automation.
- Health monitoring.
- Agriculture automation.
- Vehicle tracking.
- Remote monitoring and controlling.
- GPRS based Weather report logging.
- GSM GPRS based Security alert.
- GPRS based remote terminal for file transfer.

DESIGN:

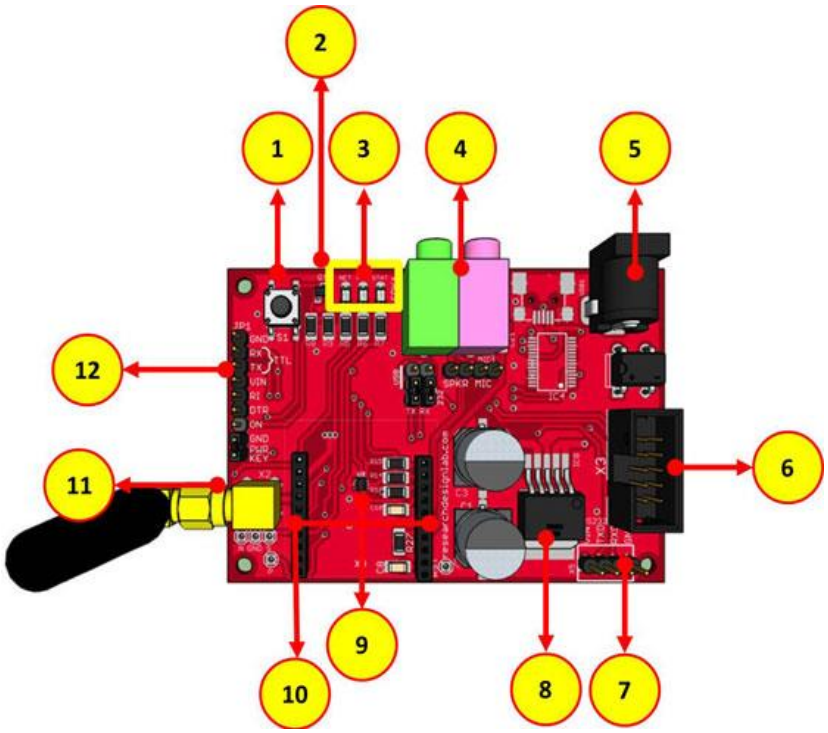


FIG 2.4.1: LABELLED SIM 900A

The above FIG 2.4.1 is the labelled SIM 900A module. The components labels as per numbers written are :

1. Power ON reset switch.
2. Sliding SIM holder.
3. Network, Power and Status indicator.
4. MIC and Speaker Socket.
5. Power supply 12V/2A
6. FRC Connector.
7. RS232 header.
8. DC to DC Converter (29302WU IC).

9. ESD Protection enabled.

10. SIM900A stack on header.

11. Stub antenna with SMA connector.

12.General GPIO SIM900

2.4.5 INSTALLATION:

Power on GPRS MODULE:

- User can power on the GPRS module by pulling down the PWR button or the P pin of control interface for at least 1 second and release.

- This pin is already pulled up to 3V in the module internal, so external pull up is not necessary.

- When power on procedure is completed, GPRS module will send following URC to indicate that the module is ready to operate at fixed baud rate.

- The red light indicates it has power supply and the green light indicates the signal to the sim card placed in the sim slot of the module.

Indicator LED and Buttons:

TABLE 2.4.1:

NETSTATUS:

The status of the NETSTATUS LED is listed in following table:

Status	Description
Off	SIM900 is not running 64ms On/800ms
Off	SIM900 not registered the network
64ms On/3000ms Off	SIM900 registered to the network
64ms On/300ms Off	GPRS communication is established

STATUS: Power status of SIM900.

PWR: Power status of GPRS module.

PWR: After the GPRS module power on, you need to press the POWER button for a moment to power on the SIM900 module.

RESET: Reset the SIM900 module.

2.5 IR SENSOR

2.5.1 INTRODUCTION:

Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region, mid infrared region and far infrared region.

The wavelengths of these regions and their applications are shown below.

- Near infrared region — 700 nm to 1400 nm — IR sensors, fibre optic
- Mid infrared region — 1400 nm to 3000 nm — Heat sensing
- Far infrared region — 3000 nm to 1 mm — Thermal imaging

The frequency range of infrared is higher than microwave and lesser than visible light.

For optical sensing and optical communication, photo optics technologies are used in the near infrared region as the light is less complex than RF when implemented as a source of signal. Optical wireless communication is done with IR data transmission for short range applications.

An infrared sensor emits and/or detects infrared radiation to sense its surroundings. The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver. There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength can be used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibres. Optical components are used to focus the infrared radiation or to limit the spectral response.

Optical lenses made of Quartz, Germanium and Silicon are used to focus the infrared radiation. Infrared receivers can be photodiodes, phototransistors etc. some important specifications of infrared receivers are photosensitivity, detectivity and noise equivalent power. Signal processing is done by amplifiers as the output of infrared detector is very small.

2.5.2 LAWS GOVERNED:

The working of any Infrared sensor is governed by three laws: Planck's Radiation law, Stephen – Boltzmann law and Wien's Displacement law.

Planck's law states that "every object emits radiation at a temperature not equal to 0^0K".

Stephen – Boltzmann law states that "at all wavelengths, the total energy emitted by a black body is proportional to the fourth power of the absolute temperature".

According to Wien's Displacement law, "the radiation curve of a black body for different temperatures will reach its peak at a wavelength inversely proportional to the temperature".

2.5.3 TYPES OF IR SENSORS:

Infrared sensors can be passive or active. Passive infrared sensors are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detects energy emitted by obstacles in the field of view. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat and are independent of wavelength. Thermocouples, pyroelectric detectors and bolometers are the common types of thermal infrared detectors.

Quantum type infrared detectors offer higher detection performance and are faster than thermal type infrared detectors. The photosensitivity of quantum type detectors is wavelength dependent. Quantum type detectors are further classified into two types: intrinsic and extrinsic types. Intrinsic type quantum detectors are photoconductive cells and photovoltaic cells.

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include a LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector.

2.5.4 IR TRANSMITTER:

Infrared Transmitter shown in FIG 2.5.1 is a light emitting diode (LED) which emits infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

FIG 2.5.1: IR TRANSMITTER

2.5.5 IR RECEIVER:

Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. IR receivers as shown in FIG 2.5.2 come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. The picture of a typical IR receiver or a photodiode is shown below.

FIG 2.5.2: IR RECEIVER

2.5.6 PRINCIPLE OF WORKING:

The principle of an IR sensor working as an Object Detection Sensor can be explained using the following figure. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Opto – Coupler.

The FIG 2.5.4 displays the mechanism of working of infrared sensor. As shown the receiver and transmitter are attached to pcb board.

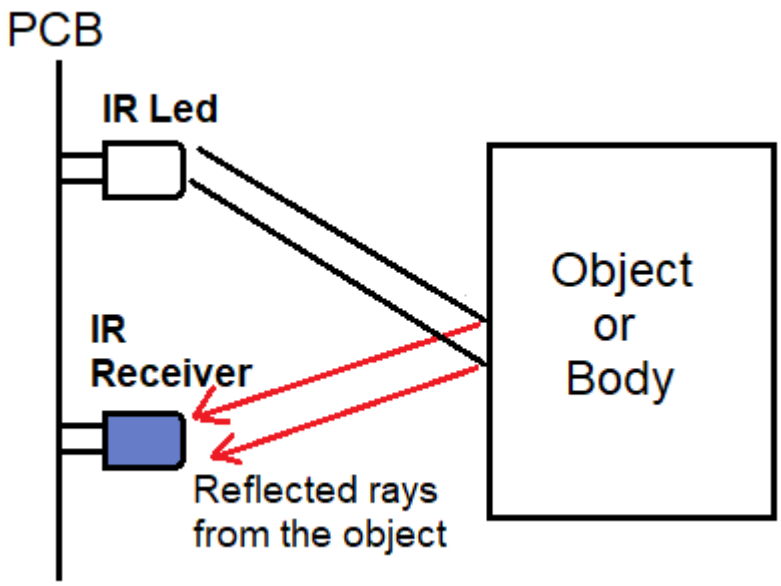


FIG 2.5.3: IR MECHANISM

When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

2.6 RELAY:

2.6.1 INTRODUCTION:

Relay is an electro-mechanical switch used to control high power application through low power signal electronic circuits, for an example a simple timer circuit working under 5V DC bias cannot control high voltage light bulb, by introducing Relay component we can easily control light bulb.

Typical Relay:

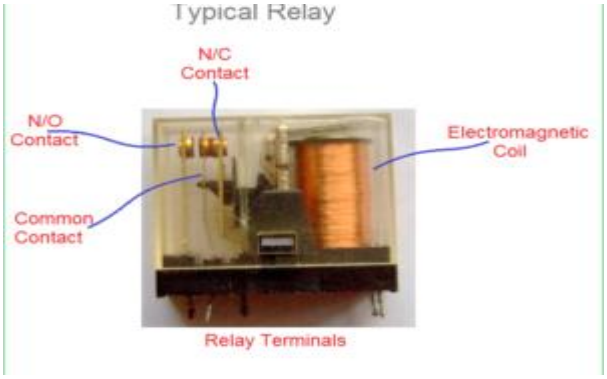


FIG 2.6.1: TYPICAL RELAY

Typical Relay as shown in FIG 2.6.1 contains Electromagnetic coil, N/O contact, N/C contact and Common contact, electromagnetic coil accepts low voltage DC bias and becomes electromagnet to attract the common terminal lever and interchanges the connection between N/C, N/O contacts.

2.6.2 TYPES OF RELAY:

Different types of Electrical Relay Switches are available in market

1. SPST – Single Pole Single Throw
2. DPST – Double Pole Single Throw
3. SPDT – Single Pole Double Throw
4. DPDT – Double Pole Double Throw

Most frequently used Relays are SPDT Relay and DPDT Relay both are acts as Electromechanical switch. The below FIG 2.6.3 shows all the types of relay switches. This also shows the difference between the realy switches.

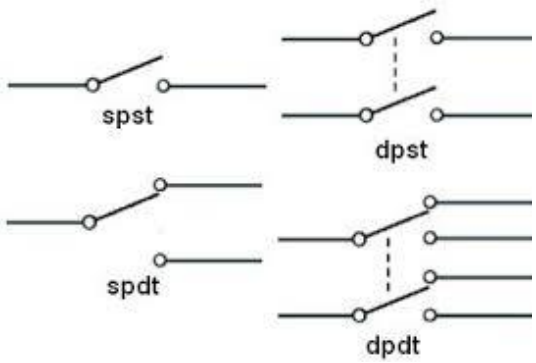
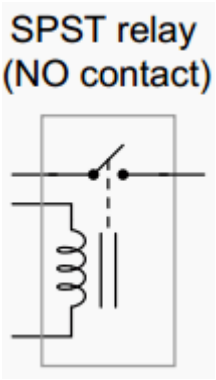


FIG 2.6.2: TYPES OF RELAY SWITCHES

SINGLE POLE SINGLE THROW RELAY:



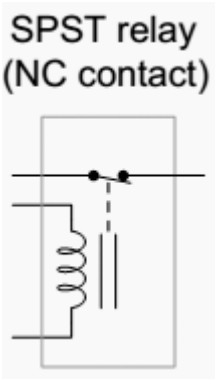


FIG 2.6.3: SPST RELAY(OFF) FIG 2.6.4: SPST RRELAY(ON)

A coil of wire wrapped around a laminated iron core provides the magnetic field necessary to actuate the switch mechanism. This particular relay is equipped with normally open (NO) switch contacts, which means the switch will be in the open (off) state when the relay coil is de-energized as in FIG 2.6.3. When the circuit is energizes the it becomes a closed loop allowing the charge to pass through it as in FIG 2.6.4.

SINGLE POLE DOUBLE THROW RELAY:

Single Pole Double Throw (SPDT) Relay contains two coil terminals and common terminal, then two switching terminals N/O (Normally Open), N/C (Normally Close)

FIG 2.6.5: SPDT RELAY

The FIG 2.6.5 is the SPDT relay switch. If there is not enough DC supply in coil terminals then Relay represents idle condition that is common terminal connected in N/C terminal. When the coil gets required DC supply then coil gets Magnetically Energized and this magnetic flux force attracts common terminal lever which is made of iron and makes the connection to N/O terminal, now the N/C becomes open.

WORKING OF RELAY:

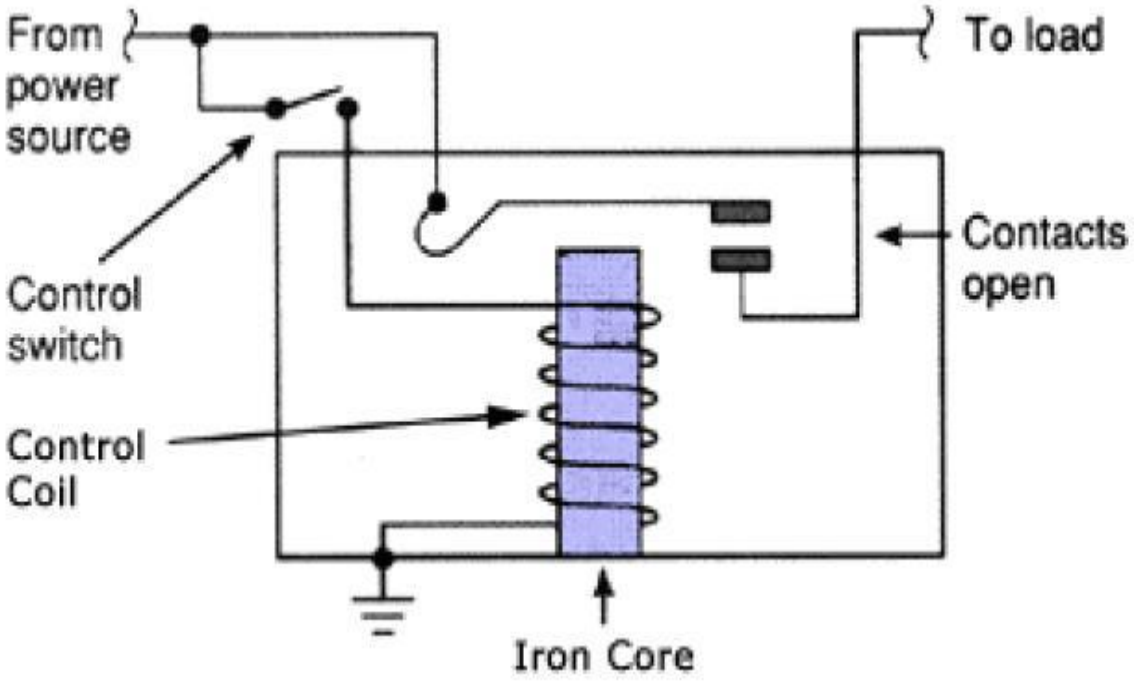


FIG 2.6.7: RELAY WORKING

The above FIG 2.6.7 shows the working of relay. The iron core is surrounded by a control coil as shown above, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil i.e. when the control switch is closed, the electromagnet starts energizing and thus intensifies the magnetic field. So, the upper contact arm starts to be attracted to the lower fixed arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed i.e. the control switch is open and the contact switch is closed due to which there is flow of charge between power and load, then the contact move oppositely and make an open circuit. As soon as the coil current is off, the movable armature will be returned by a force back to its initial position. This force will be almost equal to half the strength of the magnetic force. This force is mainly provided by two factors. They are the spring and also gravity.

2.7 USB TO TTL CONVERTER:

2.7.1 INTRODUCTION:

USB to TTL converters are an essential for prototyping – they provide a direct interface with the target device. This module connects to your computer USB port and there are 4 wires which connect with your target device. This PL2303HX USB to TTL converter module is a must for simple serial communication. This module supports 3.3V and 5V output.

2.7.2 APPLICATION:

TTL stands for Transistor Transistor logic this is a type a serial communication between two devices. This converter helps the system to communicate a serial device. TTL is most common UART transmission method. The data sent by system like laptop, or any other device is converted in serial data which is read by the device. And similar the data sent by device is received and converted.

PIN DIAGRAM: the FIG 2.7.1 is the pin diagram. It displays the pins of the converter.

FIG 2.7.1: TTL TO USB CONVERTER PIN DIAGRAM

2.7.3 FEATURES:

- Easy to use headers
- LEDs to visual display of TXD / RXD lines
- Board enclosed with transparent heat shrink tube
- Pre-installed right-angle headers for ease-of-use
- Built-in PL2303HX designed to be used for USB to TTL electronic projects
- TTL interface output, easy to connect to your MCU
- Dual 3.3V and 5V Power output (pins marked on the bottom of the board)
- Can independently power the circuit with 5V or 3.3V upto 500Ma
- Compact design

2.8 CONCLUSION

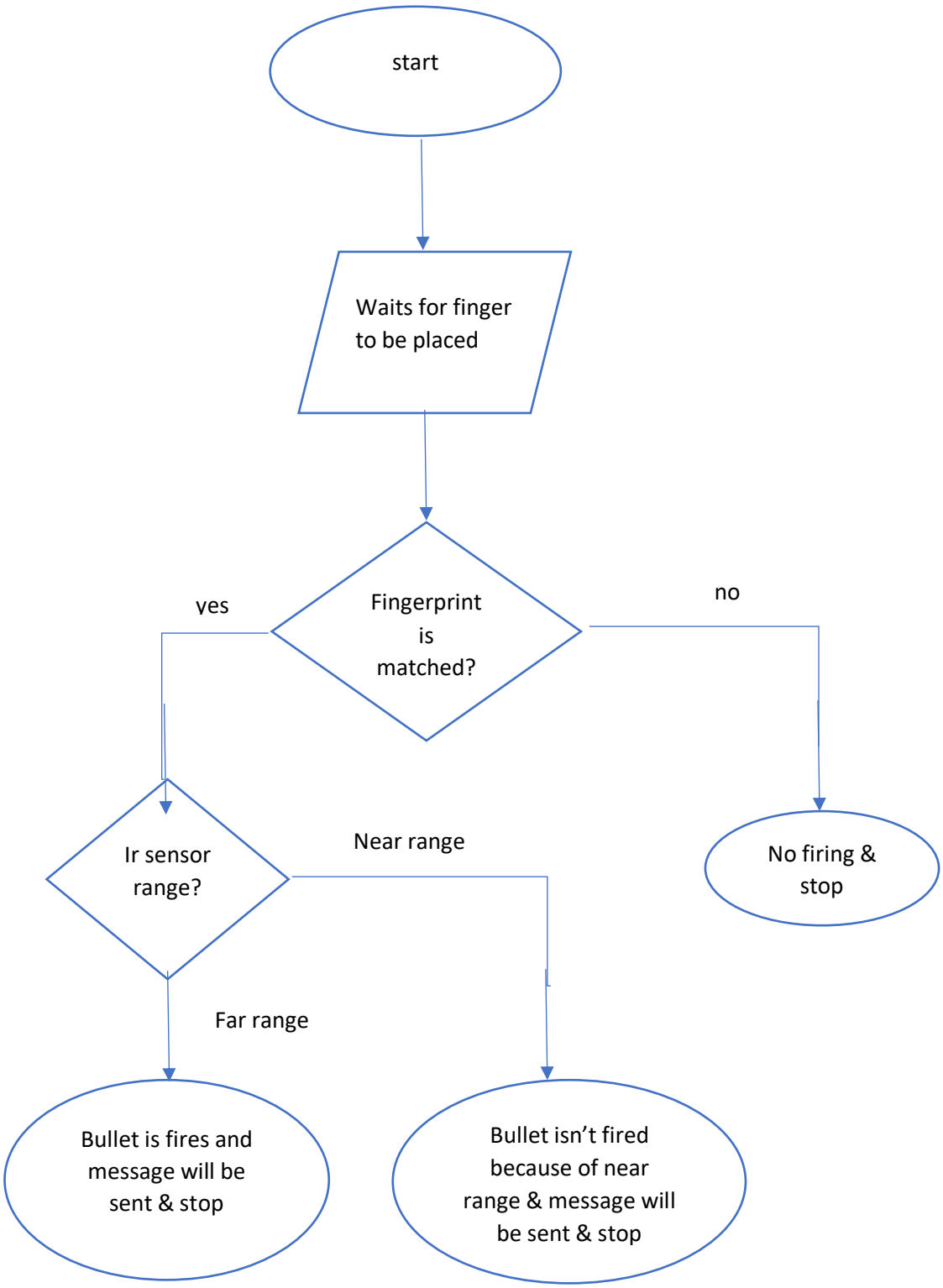
These components have been used in our project and their complete details along with their features and working methodology was also described in this chapter. In the next chapter, we have mentioned how these components are interfaced to build our project.

CHAPTER-3 METHODOLOGY

3.1 WORKING OF SMARTGUN:

Smart gun works in a simple way. Unlike conventional weapons, they are powered by a battery. Smart elements like electromagnetic solenoid, fingerprint reader, IR sensor and location sensor are integrated with the weapon. A central motherboard controls the whole process and power supply. The user has to first register his/her fingerprint into the system. Post registration, a template of authorized person's fingerprint is stored in the system's memory. Each time before firing, the user has to place his/her finger on the module and the fingerprint has to match with the stored template. After fingerprint matching with the stored template, the trigger is pulled. The system sends the power to the solenoid only on the acceptance of the fingerprint, and solenoid operates only when it receives the power. Hence, fingerprint authorization is very essential for firing. On successful verification of the fingerprint, the processor checks for the range of the shot. If it is far, then the solenoid circuit gets the power by which the gun fires is triggered, because trigger acts as a switch. Meanwhile, the system sends signals to the user with date and time stamp. If the shooting range is too close, the firing doesn't happen and system will send message stating the firing was in too short range, by the message the person who tried to shoot the gun is identified but the shooting did not occur.

3.2 FLOW CHART:



The methodology of the smart gun can be divided into:

1) Hardware implementation
2) Software implementation.

Hardware Implementation consists of design a smart gun from a conventional hand gun and all components interfacing like interfacing of fingerprint sensor with raspberry pi, interfacing GSM/GPRS module, connecting solenoid with relay and making it a circuit then interfacing this circuit to raspberry pi and also interfacing IR sensor to raspberry pi. The wiring and also pin connection are to be implemented.

In software implementation after interfacing of all devices the code has to developed that functions according to the logic that is shown in the flow chart. Various libraries and commands are also required to run the code and also to verify the working of the gun.

3.3 HARDWARE IMPLEMENTATION:

Step-1: Designing of smart gun:

For designing a smart gun, we had to study about the mechanism of conventional handgun.

In the FIG 3.3.1 the gun shown is an AIRSOFT TOY GUN. This gun mechanism is similar to that of a conventional handgun. The gun has been disassembled so that its mechanism of this gun could be seen and understood properly.

FIG 3.3.1 DISASSMBLED HAND GUN

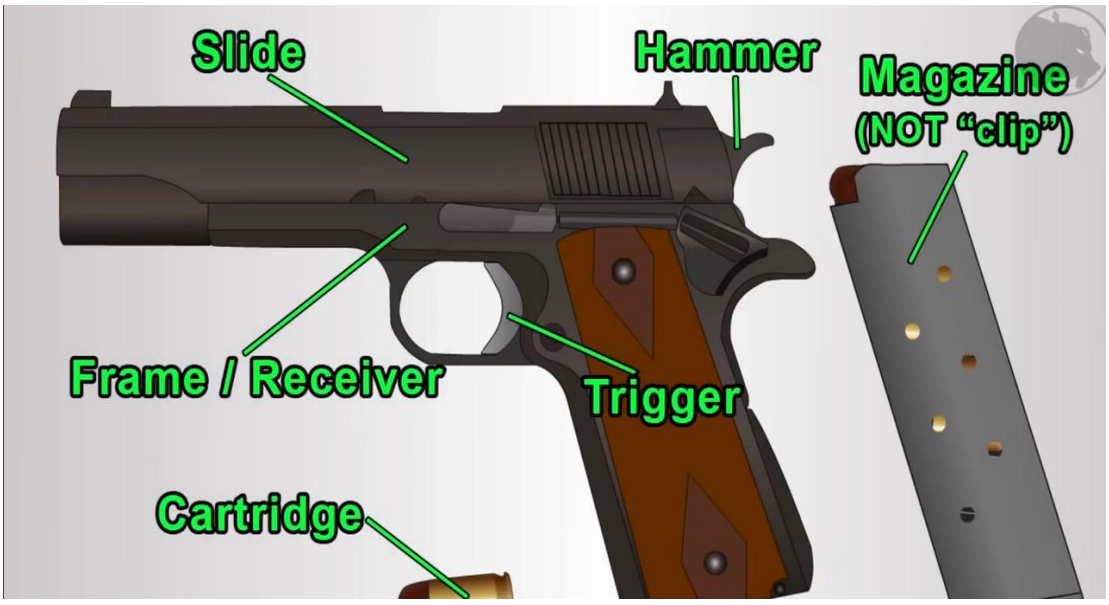


FIG 3.3.2: LABELLED CONVENTIONAL HAND GUN

The FIG 3.32 is a labelled diagram of a conventional hand gun. This figure gives a better understanding of the gun. As the part are being labelled the explanation of working of the gun can be explained in a better mode.

Mechanism of conventional hand gun:

Firstly, there is a cartridge (Bullet)which is stored inside a magazine. Magazine consists of a spring which pushes the bullet forward. When we push the slider of the handgun backwards it tilts the hammer, the barrel spring and slider spring are also compressed. At the same time the cartridge is also loaded into the barrel. When the trigger is pulled the hammer hits the barrel backwards and the bullet is fired. The hammer is hit because of the spring attached to it is being pulled (when trigger is pulled) and released (when the trigger is released). But for this gun when the hammer is hit by pulling the trigger, then the barrel back which is locked in it is released, by releasing that it moves forward because of spring action, the slider spring is released that gives the push for the bullet to be fired (for this gun). All springs are released and also the bullet is fired. So, the gun is back to normal state. To shoot next bullet the trigger has to be pulled back and the bullet gets loaded and when trigger is pulled bullet is fired and this mechanism repeats.

For converting this to smart gun we need to convert the firing mechanism into digital i.e. it has to be replaced by elements that will shoot the bullet only when the fingerprint matches. So, the hammer can be replaced by the electromagnetic solenoid. Electromagnetic solenoid fires only when power supply is given to it.

Step-2: Activating solenoid using fingerprint sensor:

For making solenoid work at correct time we need a device that gives it power only when required.so we a device to control it and interface fingerprint module to it. Here we are using a raspberry pi 3 module for interfacing all the devices.

Fingerprints are to be stored and authenticated. While using the gun the fingerprint will be verified with the fingerprint database stored before and if the fingerprint matches with any of the fingerprints in the database then solenoid can be activate using the raspberry pi module.

Step-3: Interfacing IR sensor:

Our objective was to even suicides and also friendly fires, during majority of the cases these occur by placing gun near to the body of the person. By interfacing a IR sensor we can check whether the gun is placed near to body or is it away from the body. The bullet will be only shoot when the fingerprint of the person matches anyone in the database and also when the gun is away from the body of the person.

Step-4: Sending a message alert:

By sending a message describing the particulars of the gun shot, like person who shot the gun (with help of database) and during which time and day of the week the bullet is shot. These details help law enforcements, and even alerts them. For this we are using a GSM / GPRS module (sim 900a). the message will be sent when the fingerprint of person is matched with database and also listing either the gun was in shot range and not fired or the gun was away and was being fired.

3.4 SOFTWARE IMPLEMENTATION:

STEP-1: RASPBERRY PI INTERFACING:

For operating using raspberry pi, the pi was connected to a hotspot and laptop was connected to same hotspot. Then pi was connected to laptop for power supply using micro usb cable. With the pi id and using remote desktop connection, raspberry pi screen was been projected in laptop. And by downloading and installing required libraries programming is done. Python language was used for programming. Using command prompt and various keywords the program is edited and implemented.

Interfacing fingerprint sensor:

Fingerprint module r307 has a chip embedded in it, the pins are connected to serial to usb converter and then the usb is plugged to raspberry pi usb port. And then the programming was done.

For storing or enrolling of fingerprint the code is:

FINGERPRINT ENROLLMENT:

```
                                                    #IMPORTING
LIBRARIES
import time
from pyfingerprint.pyfingerprint import PyFingerprint


                                                    ## ENROLLS NEW FINGER
                                                ## TRIES TO INITIALIZE THE SENSOR
try:
   f = PyFingerprint('/dev/ttyUSB0', 57600, 0Xffffffff, 0x00000000)
print('Currently used templates: ' + str(f.getTemplateCount()) +'/'+
str(f.getStorageCapacity()))
   print('Waiting for finger…')
                                                ## WAITS TILL FINGER IS READ
   while ( f.readImage() == False ):
      pass
```

```
## CONVERTS READ IMAGE TO CHARACTERISTICS AND STORES IT IN CHARBUFFER 1
f.convertImage(0x01)

## CHECKS IF FINGER IS ALREADY ENROLLED
result = f.searchTemplate()
positionNumber = result[0]

if ( positionNumber >= 0 ):
    print('Template already exists at position #' + str(positionNumber))
    exit(0)

print('Remove finger…')
time.sleep(2)

print('Waiting for same finger again…')

## WAIT THAT FINGER IS READ AGAIN
while ( f.readImage() == False ):
    pass
```

```
    ## CONVERTS READ IMAGE TO CHARACTERISTICS AND STORES IT IN CHARBUFFER 2
    f.convertImage(0x02)

                                                    ## COMPARES THE CHARBUFFERS
    if ( f.compareCharacteristics() == 0 ):
       raise Exception('Fingers do not match')

                                                        ## CREATES A TEMPLATE
    f.createTemplate()

                                                ## SAVES TEMPLATE AT NEW POSITION NUMBER
    positionNumber = f.storeTemplate()
    print('Finger enrolled successfully!')
    print('New template position #' + str(positionNumber))

except Exception as e:
    print('Operation failed!')
    print('Exception message: ' + str(e))
    exit(1)
```

EXPLANATION:

In the above code few libraries time and pyfingerprint have been imported. The device (fingerprint module) port number is given it can be viewed by using pi commands and the baud rate of 57600 is set and also the start and end of memory is given. Then the number of currently stored templates are given. Then a message “waiting for finger” is printed and the devices waits for the finger (uv light is used as it is optical sensor) after reading the finger it prints a message to remove the finger converts the fingerprint to a template and verifies with previously stored templates if the data is matched it display a message that already stored template else it asks to again place the same finger, after again reading the finger it displays a message to remove finger and convert that into template the converted image is verified with previous templated and if two matches the fingerprint is stored as a new template else it print s a message “two fingerprints does not match ” and if in between any exception arises then the program prints exception message and exits from the program.

STEP-2: INTERFACING SIM 900A:

Even this module is connected to pi using usb port. In this only 3 pins are connected to usb to serial converter because the power supply required for sim 900a is 11amp dc it has to be connected separately.

GSM CODE:

```
# IMPORTING LIBRARIES

import serial

import os, time

# ENABLE SERIAL COMMUNICATION

port = serial.Serial(“/dev/ttyUSB1”, baudrate=9600, timeout=1)
```

```
# TRANSMITTING AT COMMANDS TO THE MODEM  '\R\N' INDICATES THE ENTER KEY
def send(z):                                                    # INTIALZING A
FUNCTION
   print("sending…….")
   port.write('AT'+'\r\n')                                      # CHECKING THE STATUS
OF DEVICE
   rcv = port.read(10)                                  # READING STATUS OF CONNECTION( OK)
   print rcv
   time.sleep(5)
   for x in range(1):                                           # INFINITE LOOP
      port.write('AT+CMGF=1'+'\r\n')       # SELECT MESSAGE FORMAT AS TEXT MODE
      rcv = port.read(100)                                      # STORING THE RESULT
      print rcv
      time.sleep(1)
      port.write('AT+CMGS="+918519999300"'+'\r\n')          # SENDING THE MSG TO
NUMBER
      print rcv
      time.sleep(1)
      port.write(z+' triggerd '+time.ctime()+'\r\n')                # MESSAGE
      rcv = port.read(10)
```

```
print rcv
time.sleep(1)
port.write("\x1A")                                    # ENABLE TO
SEND SMS
time.sleep(1)
```

EXPLANATION:

In this code as we need time we are importing time and os libraries. Then gsm port is defined and the baud rate Is set and the memory start and finish address are also given.in this program we are using at commands to communicate with sim9000a. A function name "send" is defined and the device connection is checked. If the status is "ok" then the device is configured to text mode and again is status is checked. Then mobile number to which the data has to be sent is given. The text which has to be entered is is given and along with time stamp the message is sent. Then the device will enter into exit mode by the commands given.

STEP-3: INTERFACING SOLENOID:

Electromagnetic solenoid needs high power to work, more than 11v dc so we are connecting a relay to solenoid as it acts as a switch. Relay is connected to pi board. It has 3 pins to be connected. Data, power supply and ground pins. The power and ground pins are connected to the respective pins and data pin Is connected to one of the gpio pin. When the device needs to be activated the data pin becomes high and the loop is closed so the solenoid gets power supply and it is shoot by which bullet is fired.

STEP-4: INTERFACING IR SENSOR:

IR sensor has 3 pins data, power and ground. Here the data is the input data required by the pi. They are also connected to gpio pins and are configured. Whenever an object is near the transmitter then the led glows and also the data pin becomes active and this will stop the solenoid from firing.

The main code imports the above programs so that all devices are initialized and the device connections are also verified. This even consists of gpio pin configuration because the solenoid and IR sensor are connected to gpio pins.

The devices connected to raspberry pi board through its USB port have identity and while the code is being executed these connections are primarily checked. If the connection fails between these devices then the program can't be executed as the pi needs data from the device. So the device has to be reconnected. If the same happens with the output devices the output result can't be obtained.

MAIN CODE:

```
                                                    #IMPORTING LIBRARIES
import time
import hashlib
from pyfingerprint.pyfingerprint import PyFingerprint
import gsm
import Rpi.GPIO as IO
                                                    #CONFIGURING IO PORTS
IO.setmode(IO.BOARD)
```

```
IO.setwarnings(False)                                    #DISABLING
WARNINGS

IO.setup(11,IO.IN)

IO.setup(13,IO.OUT)

IO.output(13,False)

                                        ## TRIES TO INITIALIZE THE FINGERPRINT SENSOR

try:

   f = PyFingerprint('/dev/ttyUSB0', 57600, 0Xffffffff, 0x00000000)

                                                ## GETS SOME SENSOR INFORMATION

print('Currently used templates: ' + str(f.getTemplateCount()) +'/' +
str(f.getStorageCapacity()))


while True:

                print('Waiting for finger…')

                time.sleep(5)


                                                ## WAIT THAT FINGER IS READ

                while ( f.readImage() == False ):

                pass


    ## CONVERTS READ IMAGE TO CHARACTERISTICS AND STORES IT IN CHARBUFFER
                                                                        1

                f.convertImage(0x01)
```

```
                                                    ## SEARCHES TEMPLATE
result = f.searchTemplate()


positionNumber = result[0]

accuracyScore = result[1]

if ( positionNumber == -1 ):

print('No match found!')

else:

print('Found template at position #' + str(positionNumber))

print('The accuracy score is: ' + str(accuracyScore))


if(positionNumber==1):

        if(IO.input(11)==1):

                print("its near don't  fire")

    gsm.send("tarun it's too close not ")

        else:

                print("fire")

                IO.output(13,True)

                time.sleep(2)

                IO.output(13,False)

                gsm.send("tarun ")
```

```
if(positionNumber==2):
        if(IO.input(11)==1):
                print("its near don't  fire")
    gsm.send("pranav it's too close not ")
        else:
                print("fire")
                IO.output(13,True)
                time.sleep(2)
                IO.output(13,False)
                gsm.send("pranav ")
if(positionNumber==3):
        if(IO.input(11)==1):
                print("its near don't  fire ")
    gsm.send("teja it's too close not ")
        else:
                print("fire")
                IO.output(13,True)
                time.sleep(2)
                IO.output(13,False)
                gsm.send("teja ")
```

EXPLANATION:

Here along with time library even pyfingerprint, gsm libraries are also required. As the devices ir sensor and relay are connected using GPIO pins they have to configured. Then the program enters into an infinite loop and first checks the device connections and if the status is good then it ask for the user to place the finger it verifies the finger with the data and prints the template in which the data is stored and also the accuracy of the current fingerprint with the template. If template doesn't match then again ask for placing finger. It will enter into for loop according to the template number and checks for the ir sensor data if it is low it means the gun is away from the object and it is good for firing. Then the relay pin is made high so that it becomes closed loop and solenoid will be activated and also the same message is sent. If ir sensor data is active(high) then it indicates that the object is too close and firing shouldn't happen so the firing is not activated.

Steps to execute the program:

1) First connect the raspberry pi board to laptop and by its ip address open remote desktop connection
2) Then click on command prompt.
3) Open the directory in which the program has been saved and by using sudo or vim commands execute the program
4) Then it asks for placing the finger. If the fingerprint is matched.
5) It checks for IR sensor data, if the object is away from the gun then bullet is fired and also the message will be sent.
6) Else bullet will not be fired and also message will be sent.

3.5 CIRCUIT DIAGRAM:

The FIG 3.5.1 is the photocopy of all devices that are used in our project with there connection as per the method shown and the connections have also been discussed in the table below.

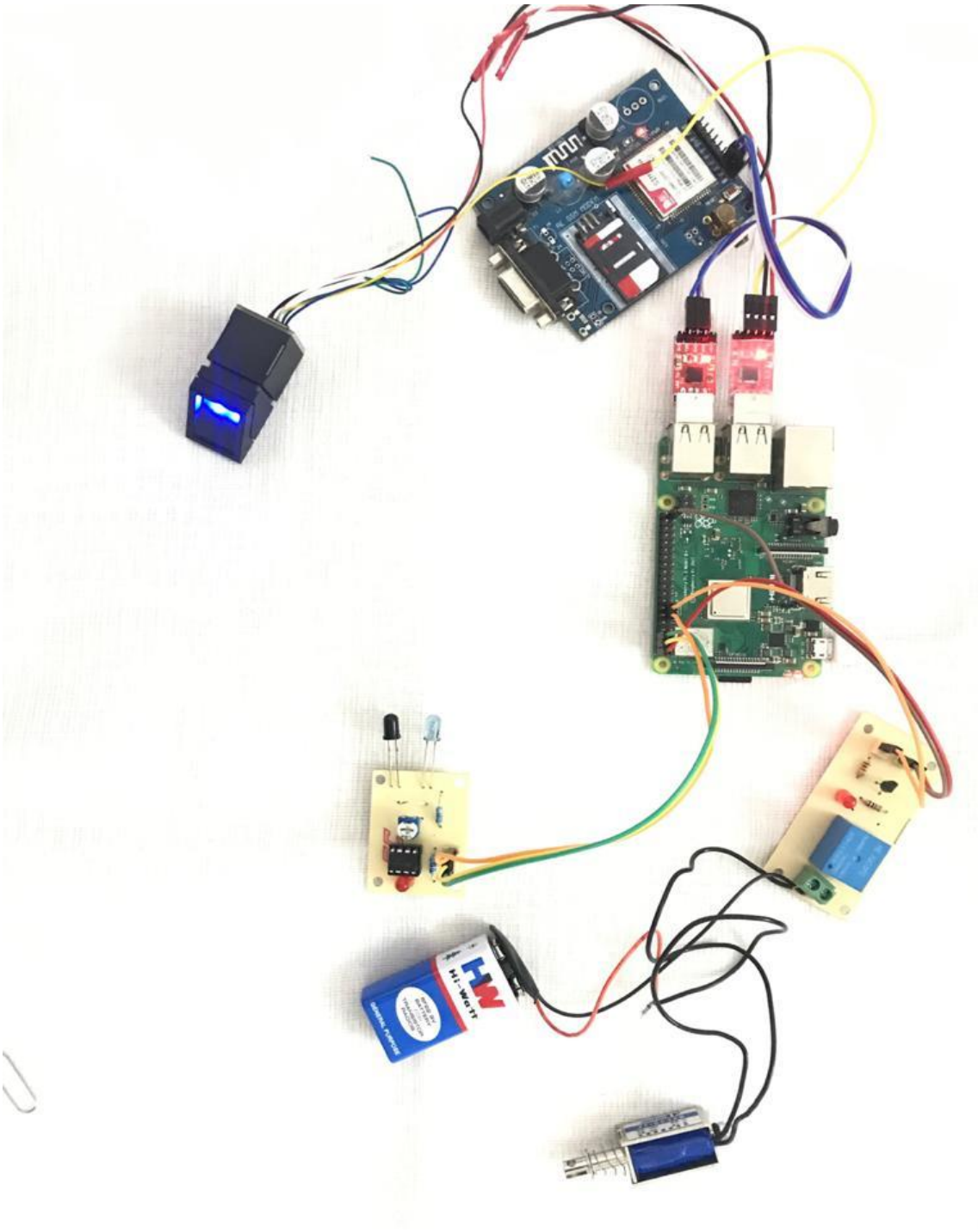


FIG 3.5.1: CIRCUIT DIAGRAM

TABLE 3.5.1:

CIRCUIT CONNECTIONS:

This table describes about the circuit connection that have been done for implementing the project.

SL.NO.	DEVICE	PINS	GPIO CONNECTION
1	FINGERPRINT MODULE	TX, RX, GND, 5V	THIS IS CONNECTED TO USB SLOT BY TTL TO USB CONVERTER.
2	SIM 900A	TX, RX, GND, 11V	CONNECTED TO TTL TO USB CONVETER AND TO USB SLOT OF RASPBERRY PI.
3	IR SENSOR	GND, 5V, DATA	GND- 6 5V- 4 DATA-11
4	RELAY	GND, 5V, OUTPUT	GND- 39 5V- 2 OUTPUT- 13

3.6 CONCLUSION

In this chapter we have discussed how our project was being implemented. The interfacing of hardware components is being discussed and also how the code was developed for designing a smart gun along with the work carried out and the smart gun photo is also shown. In the next chapter we have discussed about the results that are obtained after implementing this procedure.

CHAPTER 4

Results and discussions

Results discussions:

According to the project there are 3 results cases that can be generated during the operation.

They are:

If the fingerprint is correct and Ir sensor is at a distance from the object.

If the fingerprint is correct and the sensor detects a object close to firing range.

If the fingerprint Is wrong.

CHAPTER-5

Conclusion:

Firearms are one of the major concerns in the field of security. They have the potential to damage the economy and at the same time are very essential for personal protection. If noticed, in most of the crimes committed through firearms, the gun used is unknown. It is also almost impossible to know if the gun was owned by the person who fired it or was it stolen from the user. The proposed smart gun technology shall be the biggest step against gun violence and helps in reducing gun thefts and also in tracking down the weapons used during crime. This gives a complete security as each and every weapon is monitored. But there will be a huge restriction by the people for its wide scale implementation. Only if the government of the nation takes serious steps, can it be efficiently implemented. The project is focussed towards implementation of one weapon-one-person method using biometric authentication for firing. As the whole system is electronic, provision is also made to store location data on firing and in turn sending the data to a central cloud server handled by the police department to monitor the usage.

Future scope:

Convincing people to accept new smart gun technology is not an easy task. It creates a barrier to the freedom of usage of a firearm to the people. The mentality, attitude and mind-set play a major role.

Though this technology becomes very essential in near future, unless the government takes certain serious measures, it cannot be widely implemented. In countries like United States, the total number of guns are almost equal to total number of people, and before such state of affairs exists in any country, the government needs to be equipped with such smart technology to control crimes.

Further, when smart guns are in use, after making certain small modifications in the system, there can be locations set by the government where no guns can be fired. Such locations might include any public places, government premises, educational institutions etc. Guns of police officers, military personnel, security agencies and all other authorized forces could be exempted. This in turn creates an atmosphere of security among the people and unnecessary panic in the crowd could be avoided.

And if manufactured on large scale, all the components can be integrated into a single chip to further reduce the space consumption and ensures proper placement. This also reduces the power losses and therefore low capacity battery could be used.

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