Visvesvaraya Technological University, Belagavi.

PROJECT REPORT

on

"RASPBERRY PI VEHICLE ANTI-THEFT FACE RECOGNITION SYSTEM"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

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in

Electronics and Communication Engineering

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CERTIFICATE

This is to Certify that the dissertation work **"Raspberry pi Vehicle Anti-Theft Face Recognition System"** carried out by Mirza Aqeel Raza, Pavan D, Raviraj P Shrivastava, Rohith V R, USN: 15EC106, 1CR17EC421, 1CR17EC428, 1CR17EC430, bonafide students of **CMRIT** in partial fulfillment for the award of **Bachelor of Engineering** in **Electronics and Communication Engineering** of the **Visvesvaraya Technological University, Belagavi,** during the academic year **2019-20**. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said degree.

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Chapter 1

INTRODUCTION

In this world, everyone and every industry likes to keep in pace with the advancement in the technology. Automobile industry is also not behind in this aspect. Nowadays almost everyone has a car. As purchasing a car is a big investment, people are really concerned about the advanced technologies in automobile industry. Therefore, automobile companies have witnessed a major boost in their technological aspects by introducing automation in the vehicles to provide user friendly and advance features to their customers.

As far as vehicle security is concerned many options are available depending upon the technology being adopted. Many auto theft alarms and devices are installed in cars but they didn't prove to be a solution to the customer's problems. GSM based car/vehicle security system is one of the possible technology solution and it is designed by several groups to identify the car/vehicle location upon getting it stolen. However, the issues in locking/unlocking and switching ON and OFF the car engine upon losing the keyless remote of the car are untouched. It is quite common that a person faces many difficulties in locking and unlocking the car upon losing the keyless remote of the car. Therefore, to tackle these issues an electronic system is developed and discussed in this paper. This system is basically using GSM technology to implement different features in a car. Through this system different operations like locking/unlocking and switching ON and OFF of the car can be performed just by sending a text message from user (specific) mobile number to the GSM modem installed in the car. Sending SMS with specific template can perform different operations of the car

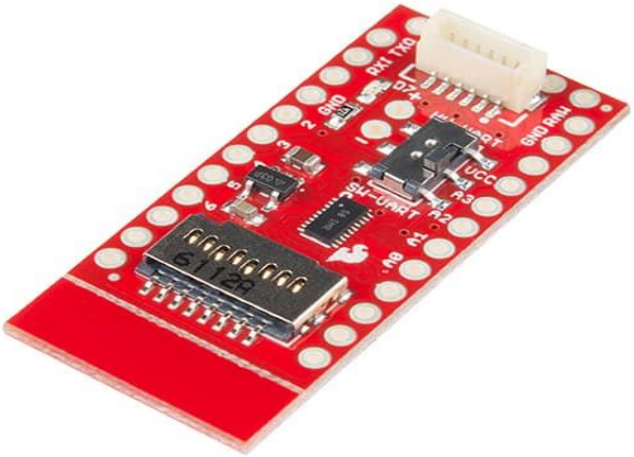
With the development and applications of many Raspberry pi techniques, car security system design and analysis are constantly improving. Many new techniques, such as biometric recognition technique, image processing technique, communication technique and so on, have been integrated into car security systems [1] [2]. At the same time, the amount of accident of cars still remains high, specially, lost. So, one practicable car security system should be efficient, robust and reliable. Traditional car security systems rely on many sensors and cost a lot. When one car is really lost, no more feedback could be valid to help people to find it back. We put forward the face detection technique to be applied in car security system because this kind of technique is effective and fast. Face detection techniques have been heavily studied in recent years, and it is an important computer vision

problem with applications to surveillance, multimedia processing, and consumer products. Many new face detection techniques have been developed to achieve higher detection rate and faster. Since Viola [3] introduced an boosted cascade of simple classifiers using Haar-like features capable of detecting faces in real-time with both high detection rate and very low false positive rates, which is considered to be one of the fastest systems in 2001, much of the recent work on face detection following Viola-Jones has explored alternative boosting algorithms such as Float-Boost [4], GentleBoost [5], and Asymmetric AdaBoost [6]. Most of those techniques were tested on PC platforms with several stand face or non-face databases [7]. The GPS module obtains the precise locality by parsing received GPS signal. The GSM module can send the information out by SMS (Short Message Service) message, including realtime position of the lost car and even the images of the driver. All process are controlled by the Raspberry pi control central module, include obtaining images, face detection, achieving GPS information, sending SMS messages.

1.1 GSM Module

To achieve important information of cars, one GSM module is added into the car security system. GSM modem can quickly send SMS messages to appointed mobile phone or SMS server. So the owner and the police can be informed at the first time. If another GPRS module is added in, the image data could also send to an information server, and the real-time circumstance in the car could be seen.

1.1.1 GPS MOodule



The **GPS** (Global Positioning System) is a "constellation" of approximately 30 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy is anywhere from 100 to 10 meters for most equipment.

GSM (Global System for Mobile Communications), is a standard developed by the European Telecommunication Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular network used by mobile phones. It became the de facto global standard for mobile communications. GPS technique has been widely used both in military equipments and civil devices in recent years. In this paper we use GPS module to obtain current location of the vehicle.

1.1.2 RASPBERRY PI 3

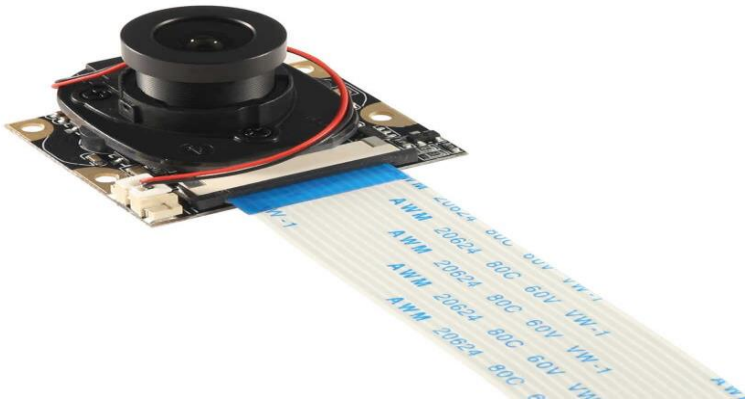
System uses **raspberry pi** circuit, it consists of an LCD display, a motor & a buzzer **alarm**, it also consists of a camera. When we turn on the system authority provided by 3 options that is registration, start and clear data, while registering, it first scans the owner's **face**.

The Raspberry Pi is a series of credit cardsized single-board computers. The first generation Raspberry Pi chip operated at 700 MHz by default, and did not become hot enough to need a heat sink or special cooling unless the chip was overclocked. The second generation runs at 900 MHz by default; it also does not become hot enough to need a heatsink or special cooling, although overclocking may heat up the SoC more than usual. Most Raspberry Pi chips could be overclocked to 800 MHz and some even higher to 1000 MHz. There are reports that the second generation can be similarly overclocked, in extreme cases, even to 1500 MHz (discarding all safety features and over voltage limitations). In the Raspbian

Linux distro the overclocking options on boot can be done by a software command running "sudo raspiconfi" without voiding the warranty. In those cases the Pi automatically shuts the overclocking down in case the chip reaches 85oC(185oF), but it is possible to overrule automatic over voltage and overclocking settings (voiding the warranty). In that case, an appropriately sized heatsink is needed to keep the chip from heating up far above 85oC. The Raspberry Pi does not come with a real-time clock, which means it cannot keep track of the time of day while it is not powered on.

As alternatives, a program running on the Pi can get the time from a network time server or user input at boot time. HDMI/DVI monitor or TV should work as a display for the Pi. For best results, use one with HDMI input, but other connections are available for older devices. Use a standard Ethernet cable for internet access. Any standard USB keyboard and mouse will work with your Raspberry Pi. Use a 5V micro USB power supply to power your Raspberry Pi. Be careful that whatever power supply you use outputs at least 5V; insufficient power will cause your Pi to behave in strange ways.

1.1.3 Raspberri pi Camera



The Raspberry Pi Camera Module v2 replaced the original Camera Module in April 2016. The v2 Camera Module has a Sony IMX219 8-megapixel sensor (compared to the 5-megapixel OmniVision OV5647 sensor of the original camera). The Camera Module can be used to take high-definition video, as well as stills photographs.

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The Camera Module can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users if you're looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion, and other video cleverness. You can also use the libraries we bundle with the camera to create effects.

You can read all the gory details about IMX219 and the Exmor R back-illuminated sensor architecture on Sony's website, but suffice to say this is more than just a resolution upgrade: it's a leap forward in image quality, colour fidelity, and low-light performance. It supports 1080p30, 720p60 and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi.The camera works with all models of Raspberry Pi 1, 2, 3 and 4. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Picamera Python library. See the Getting Started with Picamera resource to learn how to use it.The camera module is very popular in home security applications, and in wildlife camera traps.

1.1.4 DC motor

A **DC motor** is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Chapter 2

LITERATURE SURVEY

Presently, Most of the cars have GPS systems installed which help the owners track their cars, all the time. Few tracking systems can be activated only by the police when the car is reported to be stolen. Apart from the above mentioned techniques, several other methods are also proposed.

1. Using Internet of things to track the stolen car.
2. Installing keypad to enter the correct password to start ignite the engine.
3. Applying radio frequency technology to start the engine.
4. Drawing the right android pattern in air interface.
5. Can be few techniques that can be incorporated.
6. Going a step ahead, face recognition algorithms can also be consolidated as an enhanced security feature.
7. Propose that skin tone color in RGB and Viola-Jones algorithm can be implemented for a better face detection and recognition approach.

These techniques are excellent algorithms when face recognition has to be done irrespective of variations in background. On the other hand, these techniques are computationally expensive. Thus, situations where in the background can be plain simple image processing techniques would suffice the need. The paper deals with two face recognition algorithms that can be implemented where the background variations in minimum, as in the case of car, behind the driver in the car.

2.1 Psychophysics/Neuroscience issue relevant to ace recognition

Human recognition processes utilize a broad spectrum of stimuli, obtained from many, if not all, of the senses (visual, auditory, olfactory, tactile, etc.). In many situations, contextual knowledge is also applied, for example, surroundings play an important role in recognizing faces in relation to where they are supposed to be located. It is futile to even attempt to develop a system using existing technology, which will mimic the remarkable face recognition ability of humans. However, the human brain has its limitations in the total number of persons that it can accurately “remember.” A key advantage of a computer system is its capacity to handlelarge numbers of face images. In most applications the images are available only in the form of single or multiple views of 2D intensity data, so

that the inputs to computer face recognition algorithms are visual only. For this reason, the literature reviewed in this section is restricted to studies of human visual perception of faces.

2.1.1 FACE RECOGNITION FROM STILL IMAGES

In this section we survey the state of the art of face recognition in the engineering literature. For the sake of completeness, in Section 3.1 we provide a highlighted summary of research on face segmentation/detection and feature extraction. Section 3.2 contains detailed reviews of recent work on intensity image-based face recognition and categorizes methods of recognition from intensity images. Section 3.3 summarizes the status of face recognition and discusses open research issues.

Though fully automatic face recognition systems must perform all three subtasks, research on each subtask is critical. This is not only because the techniques used for the individual subtasks need to be improved, but also because they are critical in many different applications (Figure 1). For example, face detection is needed to initialize face tracking, and extraction of facial features is needed for recognizing human emotion, which is in turn essential in human-computer interaction (HCI) systems. Isolating the subtasks makes it easier to assess and advance the state of the art of the component techniques. Earlier face detection techniques could only handle single or a few well-separated frontal faces in images with simple backgrounds, while state-of-the-art algorithms can detect faces and their poses in cluttered backgrounds [Gu et al. 2001; Heisele et al. 2001; Schneiderman and Kanade 2000; Viola and Jones 2001]. Extensive research on the subtasks has been carried out and relevant surveys have appeared on, for example, the subtask of face detection [Hjelmas and Low 2001; Yang et al. 2002].

2.2 Face recognition and detection (PCA):

There are already many algorithms used in face recognition and detection, and many more have been developed. But PCA is the best and mostly used algorithm for face recognition. PCA is used for compression and to overcome many of the recognition queries like pose variations, illumination etc. The Linear Discriminate Analysis (LDA), Independent

Component analysis (ICA) and some other systems are developed by combining different algorithms. PCA is the simplest of the true eigenvector-based multivariate analyses that's why PCA is also known as "Eigen faces" algorithm. Eigen faces is the name given to a set of eigenvectors when they are used in the computer vision problem of human face recognition. In designing a system for automated face recognition using Eigen faces, they showed a way of calculating the eigenvectors of a covariance matrix in such a way as to make it possible for computers at that time to perform Eigen decomposition on a large number of face images.

2.2.1 Vehicle Security Systems

The IOT performs intelligent functions, which lead to avoid vehicle theft. Many authors have been working on vehicle security systems to provide the best mechanisms not only concerning with the theft of vehicle contents but also the loss of vehicles, and the personal security requirements of the vehicle's owner. According to their works; they have developed a vehicle security systems based on "Biometric Authentication" type such as eye, finger, face recognition, etc. This section describes some relevant collaborations which are proposed in recent years.

Authors in paper [1] propose anti-theft and driver surveillance embedded system. They used biometric authentication to access the vehicle. Authors claimed that the system deploy LBPH algorithm for face recognition. Also, they showed that the system was simple and provided better results in various light condition.

Summary and brief introduction

The most commonly used security systems for a car namely steering wheel lock where locks are placed on the steering wheels. Hood Locks which locks the hood and can be opened only with a key. Tire locks which are immobilizing locks for the tyres and are usually used by the policemen. Electronic immobilizers are electronic keys to ignite the engines of the cars these keys are usually driven by Radio frequencies (RFID). Kill switches are push buttons usually installed below the steering wheel of the cars. These get activated when the car is locked using electronic or RFID keys and shut down the ignition system completely. Car alarm systems can detect intrusions such as vehicle glass breakage, attempts to enter without a key and vibrations near the car. Once such invasion is detected, a huge alarm/noise is raised to alert the neighborhood.

Chapter 3

WORKING

3.1 Working principle

System uses raspberry pi circuit, it consists of an LCD display, a motor & a buzzer alarm, it also consists of a camera. When we turn on the system authority provided by 3 options that is registration, start and clear data, while registering, it first scans the owner's face.

This is an advanced system which can be utilized in many cars. Today, it is not difficult to make duplicates of vehicle keys and using such keys increases the risk of robbery. For such problems, we hereby propose an efficient and reliable solution. Our system uses face recognition system to identify the authorized users of the vehicles and only the authorized users are allowed to use the vehicle. This allows for a fast easy to use authentication system. System uses raspberry pi circuit, it consists of an LCD display, a motor & a buzzer alarm, it also consists of a camera. When we turn on the system authority provided by 3 options that is registration, start and clear data, while registering, it first scans the owner’s face. After successful registration, the owner can start the vehicle. To stop the vehicle, the owner needs to press the back command. If an unauthorized user tries to use the car, the system

scans the person's face, and checks whether face matches with the authorized face, if it does not match the system denies and the buzzer starts. In this way system helps to secure such intelligent vehicles.

Face recognition

Face recognition is a non-intrusive method, and facial attributes are probably the most common biometric features used by humans to recognize one another. The applications of facial recognition range from a static, controlled authentication to a dynamic, uncontrolled face identification in a cluttered background. While the authentication performance of the face recognition systems that are commercially available is reasonable, they impose a number of restrictions on how the facial images are obtained, often requiring a fixed and simple background with controlled illumination. These systems also have difficulty in matching face images captured from two different views, under different illumination conditions, and at different times. It is questionable whether the face itself, without any contextual information, is a sufficient basis for recognizing a person from a large number of identities with an extremely high level of confidence.

There are many algorithms used in face recognition and detection, and many more are being developed. PCA is the best and mostly used algorithm in face recognition. PCA is also known as Eigen faces algorithm. The main idea is to decor relate data in order to highlight differences and similarities by finding the principal directions (i.e. the Eigen vectors) of the covariance matrix of a multidimensional data. A part of the great efficiency of the PCA algorithm is to take only the best eigenvectors in order to generate the subspace (Face Space) where the gallery images will be projected onto, leading to a reduction of dimensionalities.

Here we use PCA algorithm, the major advantage of PCA is using it in Eigen face approach which helps in reducing the size of the database for recognition of a test images. The images are stored as their feature vectors in the database which are found out projecting each and every trained image to the set of Eigen faces obtained. PCA is applied on Eigen face approach to reduce the dimensionality of a large data set.

The Principal Component Analysis (PCA) is one of the most successful techniques that have been used in image recognition and compression. PCA is a statistical method under the broad title of factor analysis. The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature

space (independent variables), which are needed to describe the data economically. This is the case when there is a strong correlation between observed variables. The functions of PCA are prediction, redundancy removal, feature extraction, data compression, etc. Because PCA is a classical technique which can do something in the linear

as signal processing, image processing, system and control theory, communications, etc. Principal component analysis or simply "PCA", is a method used for the statistical pattern analysis in data, and expressing the data in such a way as to highlight the similarities and dissimilarities. Since patterns in the data can be hard to find in data of high dimensions, where the luxury of the graphical representation is not available, PCA is a powerful tool for analyzing the data. The other main advantage of the PCA is that, the data can be compressed without much loss of information by reducing the dimensions and identifying the patterns in the data. This technique is used in the image compression and image recognition. PCA algorithm involves face recognition and it compares the input image/face with images/faces in the data-base with fixed background such as white in color. The images/faces in the database are called authorized images/faces and the input image/face is called as un-known/unauthorized image/face. Ten images are stored in our database for testing purpose. The Eigen vectors are calculated from the images and the threshold values are determined. By using Euclidian distance between threshold values of authorized and unauthorized faces corresponding images are compared and persons will be identified accord ingly. Benefits of PCA:

- The reduction in the dimension of the data.
- No data redundancy, as components are orthogonal.
- Complexity of grouping the images can be reduced.
- Used for criminal investigation.
- Entrance control in buildings, access control for computers, for Automated Teller Machines, at the post office, passport verification, and identifying the faces in a given database.

PCA Feature:

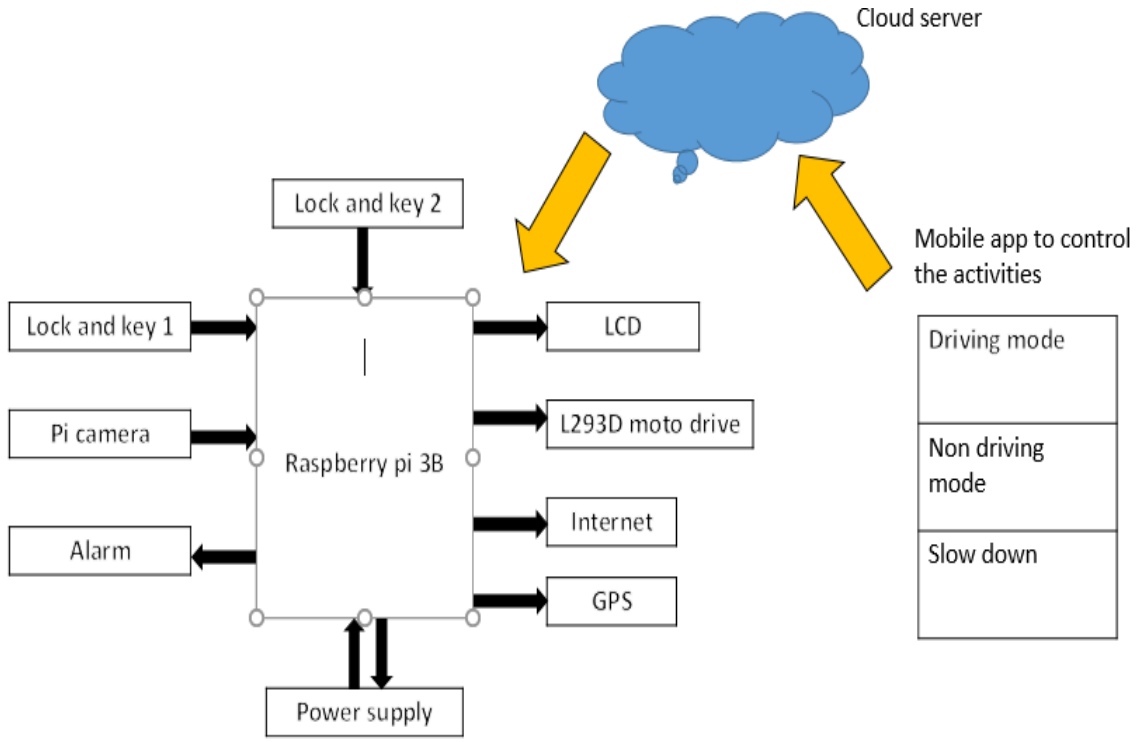
- PCA computes mean, variance, covariance, and correlations for large data set.
- PCA computes and ranks the principal components and their variances.

- Automatically transforms data sets. PCA can analyze datasets up to 50,000 rows and 200 columns

Principal component analysis or simply “PCA”, is a method used for the statistical pattern analysis in data, and expressing the data in such a way as to highlight the similarities and dissimilarities. Since patterns in the data can be hard to find in data of high dimensions, where the luxury of the graphical representation is not available, PCA is a powerful tool for analyzing the data. The other main advantage of the PCA is that, the data can be compressed without much loss of information by reducing the dimensions and identifying the patterns in the data. This technique is used in the image compression and image recognition. Using face recognition methods for security purposes is one of the best and accurate methods for law enforcement. It is also very useful for commercial applications. Although we can find many other identification and verification techniques, the main motivation for face recognition is because it is considered a passive, no intrusive system to verify and identify people. There are numerous methods employed in face detection.

A camera is kept at the main entrance, which takes the photo of the person trying to gain access to the building. The photograph needs to be taken properly to get proper result. This photo is then appropriately processed, according to the code based on a particular face recognition technique and then compared with each and every face in the database. The steps carried out and the time required for processing, as well as comparison, depends on the method employed. Different techniques employ different algorithms for the detection purposes. If the authorized person is present, his face gets detected and he is given entry into the building, while, an unauthorized person is denied entry.

3.2 Block Diagram



Stepper motor

A stepper motor is a brushless DC electric motor that divides full rotation into a number of equal steps. The motors position can then be commanded to move and hold at one of these steps without any feedback. sensor, as long as the motor is carefully sized to the application in respect to torque and speed.Stepper motor is a brushless DC motor that divides the full rotation angle of 360° into number of equal steps. ... Raspberry Pi's GPIOs can be used to control stepper motor rotation. We can generate sequence of control signals on the GPIO pins of Raspberry Pi.

- Stepper motor is a brushless DC motor that divides the full rotation angle of 360° into number of equal steps.
- The motor is rotated by applying certain sequence of control signals. The speed of rotation can be changed by changing the rate at which the control signals are applied.
- For more information about Stepper Motor, its control sequence and how to use it, refer the topic Stepper Motor in the sensors and modules section.

- Raspberry Pi's GPIOs can be used to control stepper motor rotation. We can generate sequence of control signals on the GPIO pins of Raspberry Pi. To know more about Raspberry Pi GPIO refer Raspberry Pi GPIO Access.

Rasp-pi Camera: -

OV5647 color CMOS QSXGA is a 5-megapixel camera, which is capable of capturing real time images and video. The fps (frames per second) of this camera is 120. Pi Camera Module. The Pi camera module is a portable light weight camera that supports Raspberry Pi. It communicates with Pi using the MIPI camera serial interface protocol. It is normally used in image processing, machine learning or in surveillance projects.

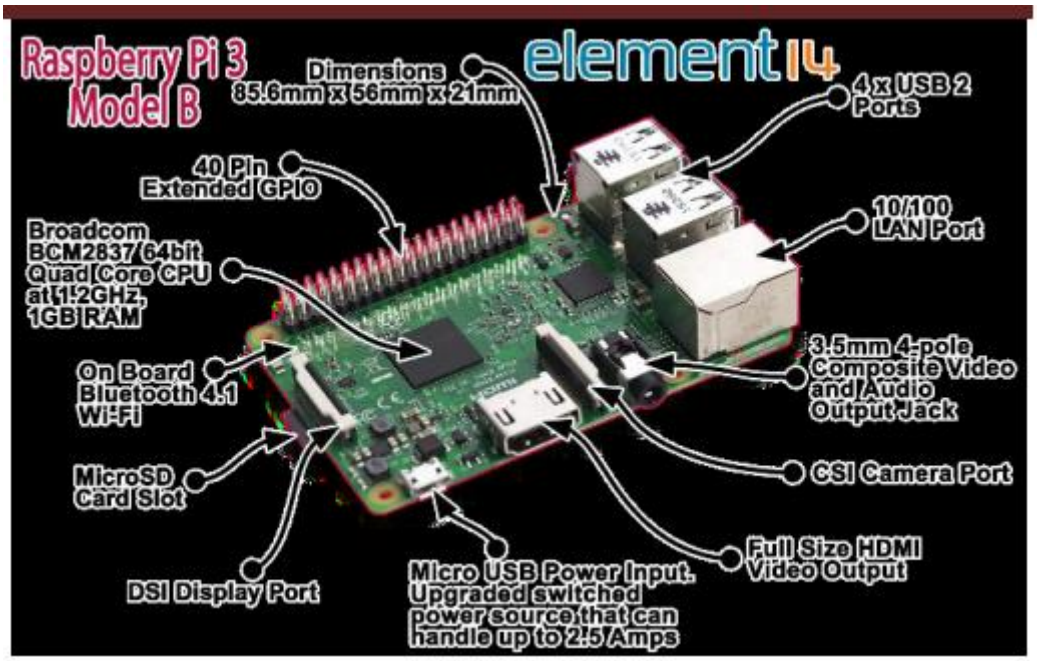
Picture formats	JPEG (accelerated), JPEG + RAW, GIF, BMP, PNG, YUV420, RGB888
Video formats	raw h.264 (accelerated)
Effects	negative, solarise, posterize, whiteboard, blackboard, sketch, denoise, emboss, oilpaint, hatch, gpen, pastel, watercolour, film, blur, saturation
Exposure modes	auto, night, nightpreview, backlight, spotlight, sports, snow, beach, verylong, fixedfps, antishake, fireworks
Metering modes	average, spot, backlit, matrix
Automatic white balance modes	off, auto, sun, cloud, shade, tungsten, fluorescent, incandescent, flash, horizon
Triggers	Keypress, UNIX signal, timeout

LOCK Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use

and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors

RASPBERRY PI3 (MODEL B)



Raspberry pi is Broadcom BCM2837 64bit ARMv7 Quad Core Processor powered Single Board Computer running at 1.2GHz Inbuilt

* BCM43143 Wi-Fi on board

*Bluetooth Low Energy (BLE) on board

*Micro SD port for loading your operating system and storing data

*1GB RAM

*40pin extended GPIO

*4 x USB 2 ports

*4 pole Stereo output and Composite video port

*Upgraded switched Micro USB power source (now supports up to 2.4 Amps)

*CSI camera port for connecting the Raspberry Pi camera.

Sound detector(Alarm)

The sound detector is a small board that combines Microphone and some processing circuitry. It provides not only an audio output, but also a binary indication of the presence of sound, and an analog representation of its amplitude.

The main module of the Project

1.Camera interfacing

2.Image capturing and storing

3.Hardware interfacing

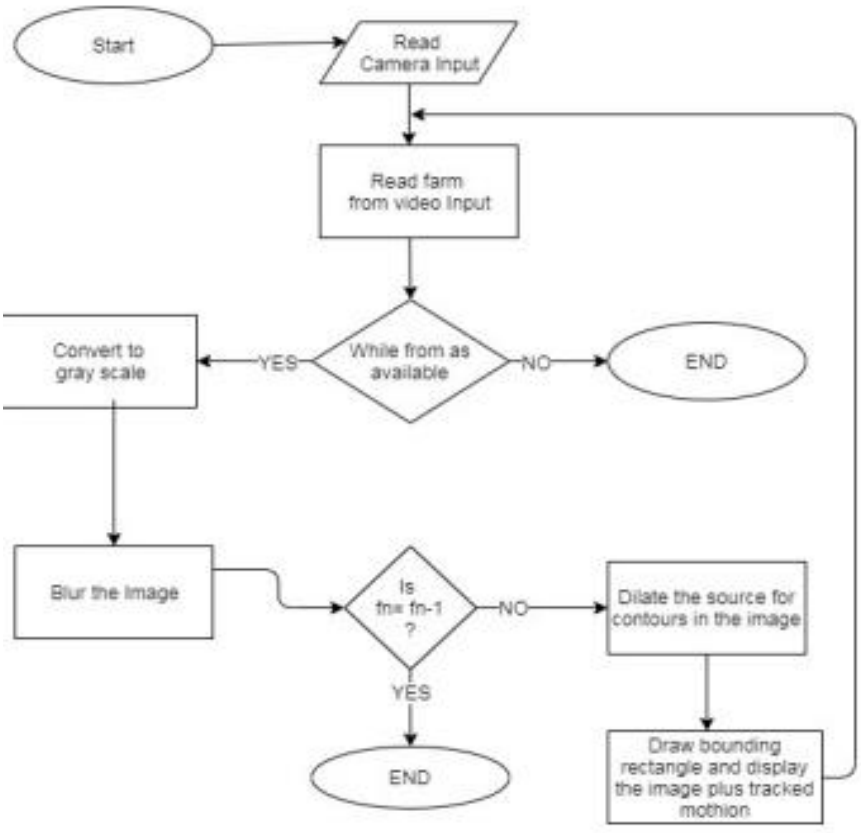
4.Motion Detection

5.Explosion Detection

6.Alaram Detection

3.3 System initialization and configuration

This subsection focuses on system initialization and configuration which all nodes are established to connect. The proposed system network should consist of the IEEE802.15.4 which used in the physical layer to provide wireless communications, such that the bits of data after they have been converted into signals can be transmitted to the vehicle's owner and/or police workstation. Moreover, in the data link layer, 6LoWPAN is used as (adaptation layer) where; the adjustment from IPv6 to IEEE 802.15.4 is done. Also, the Internet Protocol IPv6 is used for addressing and routing of data. In which, we can assign every node a unique IPv6 address. The next layer is a transport layer, where UDP is used for the carriage of the data. Finally, in the application layer, the CoAP protocol is used. The proposed system' network also connects to other networks via Wi − Fi.



Also, this system executes the following tasks:

- Importing python libraries and packages: These libraries are predefined and help to make the interface modules work properly.
- USB Camera setting and configuration: After these configuration settings of USB Camera, the system was rebooted. This was done to ensure that the camera was allocated enough space in memory. The camera takes 5MP image and it has a resolution of 640 × 480. The following command was used (webcam image.jpg) on the image. – GPIO settings and pin initialization: The channel was set using the BCM channel numbering. Passive infrared pin channel was set to read mode; so to read the value of any GPIO pin, simply type; GPIO.input(channel). While the led channel was set to drive/write mode. Therefore, to drive the channel of GPIO pin, type; GPIO.output(channel, status).
- Generating and sending e-mail : It is necessary to generate and send the Email to the predefined subscriber After configuring the system. Multipurpose Internet Mail Extension (MIME) package used to generate the attachment mail. MIME supports characters and non-text attachments like (audio, video and application programs),

etc. Also, the Simple Mail Transfer Protocol (SMTP) program is used to deliver the email from the Raspberry Pi 3 Model B+ to the configured mail hub. This can be summarized using the Algorithm below:

Start the system. Send out E−mail with boot IP assigned to a mail host.

Check the status of GPIO pin. IF (the input of GPIO pin is Low).

Then GPIO pin output 13 is Low and system is Idle. Else the input of GPIO pin suddenly goes HIGH. Then Interrupt event happened.

ENDIF WHILE (the value of input GPIO is High).

Set the output of GPIO pin 13 to be High. Call the function to start the Camera. Camera detect and Recognize the face. IF (An Authorized Person detect and recognize). Then Open the servo motor. Else Unauthorized Person detect and recognize. Close the servo motor and Check the Internet. ENDIF IF (Internet Available). Then (Close the servo motor and Generate the MIME message contract with attachment and mobile notification). Call SMIP server to send alert with attachment. Call ,rebase and pusher to push notification. GPIO clean up and repeat the loop. Else Rechecking again are 0.5 second. ENDIF ENDWHILE

Chapter 4

COMPONENTS DETAILS

This is an advanced system which can be utilized in many cars. Today, it is not difficult to make duplicates of vehicle keys and using such keys increases the risk of robbery. For such problems, we hereby propose an efficient and reliable solution. Our system uses face recognition system to identify the authorized users of the vehicles and only the authorized users are allowed to use the vehicle. This allows for a fast easy to use authentication system. System uses raspberry pi circuit, it consists of an LCD display, a motor & a buzzer alarm, it also consists of a camera. When we turn on the system authority provided by 3 options that is registration, start and clear data, while registering, it first scans the owner's face. After successful registration, the owner can start the vehicle. To stop the vehicle, the owner needs to press the back command. If an unauthorized user tries to use the car, the system scans the person's face, and checks whether face matches with the authorized face, if it does not match the system denies and the buzzer starts. In this way system helps to secure such intelligent vehicles.

4.1 Hardware system architecture

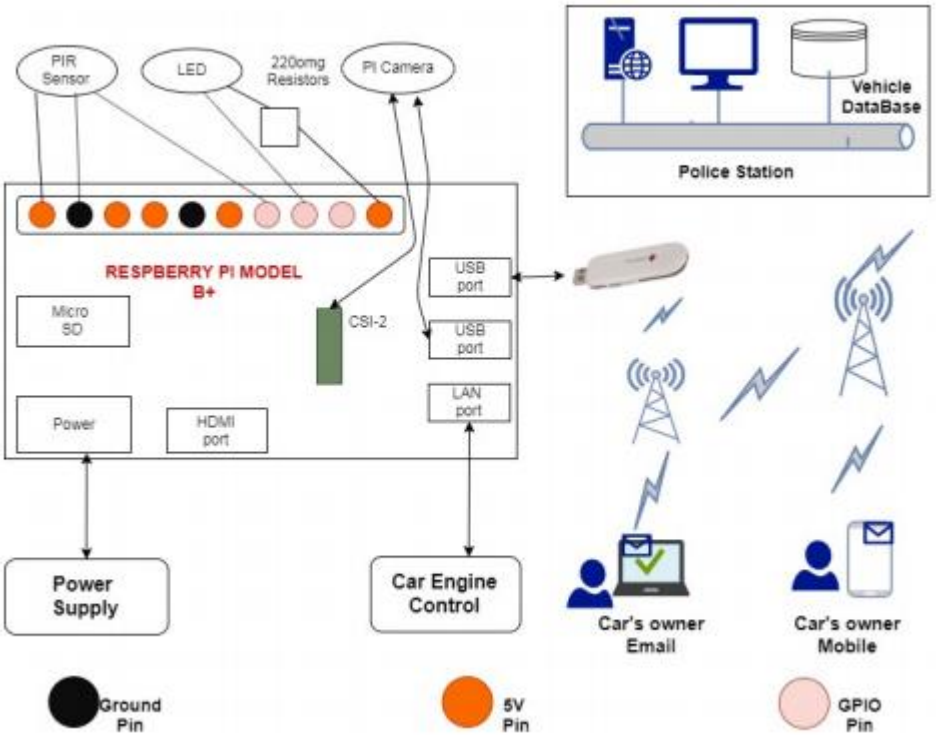
The hardware architecture of the proposed VSS − IoT composed of: Raspberry Pi 3 Model B+ controller, PIR motion sensor, USB 3G Modem Flash Pi USB camera module, MicroSD card, Servo Motor, power supply, owner mobile device, police workstation, and vehicle control unit. The proposed components connected wired and wirelessly, where the police workstation and actual owner terminals are connected wirelessly to Raspberry Pi 3 Model B+ controller, but the rest of all devices will be interfaced using wired media as shown in Figure 2.

The Raspberry Pi 3 Model B+ : This model has a lot of merits over other models. Since it has a large of USB ports and GPIO pins. Moreover, it uses "Raspbian" operating system which has a very good integration with the hardware and it has a GUI with development tools.

– The Internet connection: is a necessary component in this work; so that the Raspberry Pi 3 Model B+ can communicate over IoT-network protocols. The architecture in 2, show that it was necessary to change the IP address of the Raspberry Pi 3 Model B+ from static to dynamic. This was done by editing the network interfaces file using the command (sudo nano /etc/network/interfaces).

– USB Camera : This is the camera made specifically for the Raspberry Pi 3 Model B+. It was hooked to the Raspberry Pi 3 Model B+ through the USB port which is extremely fast. Therefore, to conFigure and enable the camera, the following commands were executed at the CLI of the Raspberry Pi 3 Model B+ (Sudo apt-get install fswebcam).

– Passive Infrared Sensor: The device used here was HC501SR passive infrared sensor. The detection range is 7 meters by 140(degrees) coning angles. It has a delay time of 16 sec but adjustable. The ambient temperature is 253K − 323K. It was powered directly from the Pi through the 5V dc supply pin. Its output was connected as the input to the programmable GPIO pin. – Servo Motor : This component used to control Fuel injector. It was designed to be controlled through the action of system when unauthorized person detected.



4.1 LCD

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

3.1.1 LCD OPERATIONS

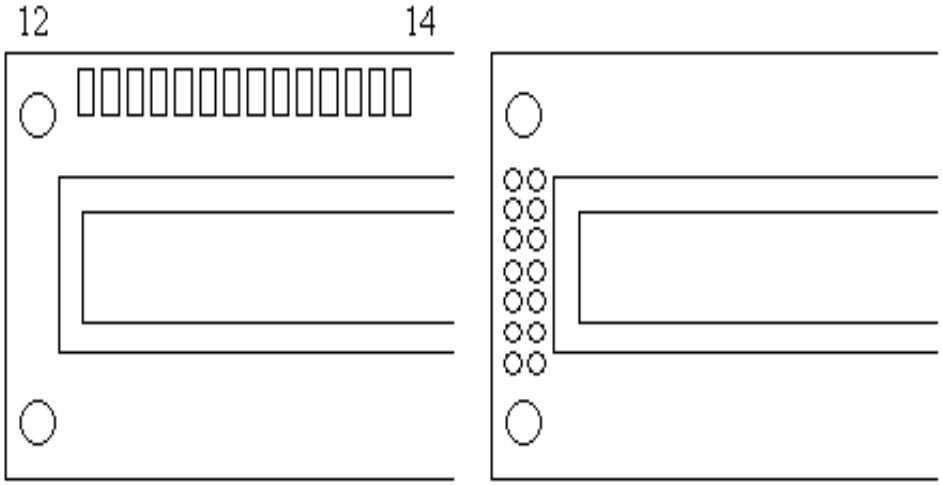


Figure 9.1 Sample LCD Display

In recent years the LCD is finding widespread use replacing LEDs (seven segment LEDs or other multisegment LEDs). This is due to the following reasons:

1. The declining prices of LDCs.
2. The ability to display numbers, characters, and graphics. This is in contrast to LEDs, Which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LDC, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU (or in some other way) to keep displaying the data.
4. Ease of programming for characters and graphics.

4.3 LCD pin descriptions

Figure 6.2: Pin Description for LCD

The LCD discussed in this section has 14 pins. The function of each pin is given in Table 11.1. Figure 11.1 shows the pin positions for various sample LCDs.

VCC, VSS, and VEE:

While V_{CC} and V_{SS} provide +5V and ground, respectively, V_{EE} is used for controlling LCD contrast. RS, register select. There are two very important registers

Inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home, etc. IF RS=1 the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W (read/write):

R/W input allows the user to write information to the LCD or read information from it. R/W=1 when reading; R/W=0 when writing.

E(enable):

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high-to-low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450 ns wide.

D0 - D7:

The 8-bit data pins, D0 - D7, are used to send information to the LCD or read the contents of the LCD's internal registers.

To display letters and numbers, we send ASCII codes for the letters A - Z, a - z, and numbers 0 - 9 to these pins while making RS=1.

There are also instruction command codes that can be sent to the LCD to clear the display or force the cursor to the home position or blink the cursor. Table 11.2 lists the instruction command codes.

We also use RS = 0 to check the busy flag bit to see if the LCD is ready to receive information. The busy flag is D7 and can be read when R/W=1 and RS = 0, as follows: if R/W = 1, RS = 0. When D7 = 1 (busy flag = 1), the LCD is busy taking care of internal operations and will not accept any new information. When D7 = 0, the LCD is ready to receive new information. Note: It is recommended to check the busy flag before writing any data to the LCD.

Pin Descriptions for LCD:

Pin	Symbol	I/O	Description
1	VSS	--	Ground
2	VCC	--	+5V power supply
3	VEE	--	Power supply to control contrast
4	RS I	--	RS=0 to select command register,
			RS=1 to select data register
5	R/W	I	R/w-0 for write, R/W=1 for read
6	E	I/O	Enable
7	DB0	I/O	The 8-bit data bus
8	DB1	I/O	The 8-bit data bus
9	DB2	I/O	The 8-bit data bus
10	DB3	I/O	The 8-bit data bus
11	DB4	I/O	The 8-bit data bus
12	DB5	I/O	The 8-bit data bus
13	DB6	I/O	The 8-bit data bus
14	DB7	I/O	The 8-bit data bus

Table 6.2.2: LCD Command Codes:

Code Command to LCD Instruction

(Hex) Register

1 Clear display screen

2 Return home

4 Decrement cursor (shift cursor to left)

6 Increment cursor (shift cursor to right)

5 Shift display right

7 Shift display left

8 Display off, cursor off

A Display off, cursor on

C Display on, cursor off

E Display on, cursor blinking

F Display on, cursor blinking

10	Shift cursor position to left
14	Shift cursor position to righ
18	Shift the entire display to the left
1C	Shift the entire display to the right
80	Force cursor to beginning of 1st line
C0	Force cursor to beginning of 1st line
38	2 lines and 5x7 matrix

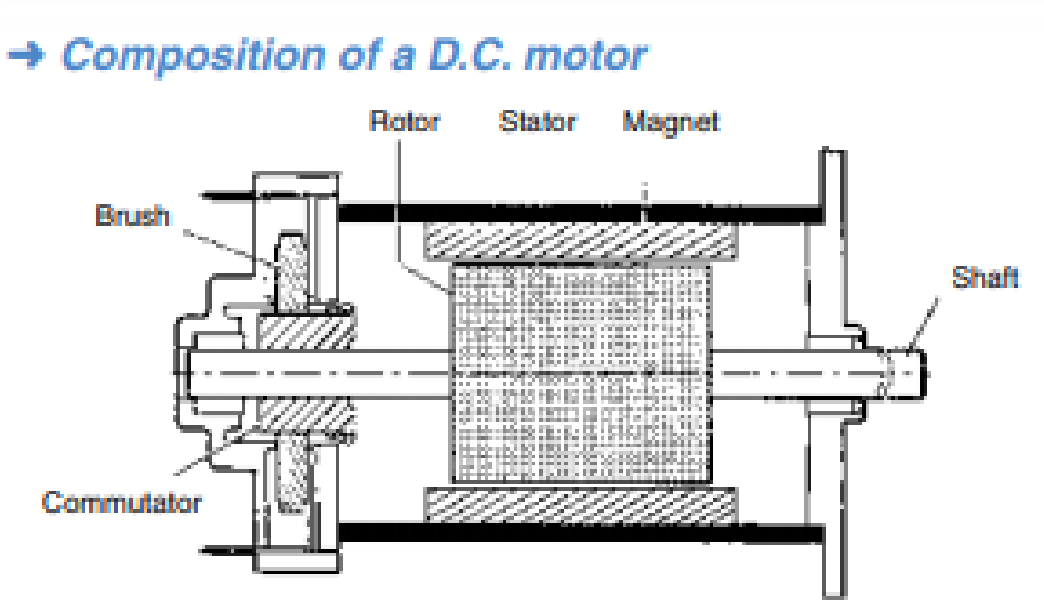
4.2.1 DC MOTOR

A DC motor consists of an stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the two magnetic fields inside the motor cause it to turn. DC motors are the simplest type of motor and are used in household appliances, such as electric razors, and in electric windows in cars.

Why DC motor used

Many applications call for a high start-up torque. The D.C. motor, by its very nature, has a high torque vs. falling speed characteristic and this enables it to deal with high starting torques and to absorb sudden rises in load easily. The speed of the motor adjusts to the load.

Furthermore, the D.C. motor is an ideal way of achieving the miniaturization designers are constantly seeking because the efficiency it gives is high compared with other designs.



The stator is formed by a metal carcass and one or more magnets that create a permanent magnetic field inside the stator. At the rear of the stator are the brush mountings and the brush gear which provide electrical contact with the rotor. The rotor is itself formed by a metal carcass carrying coils which are interconnected at the commutator at the rear of the rotor. The commutator and brush assembly then select the coil through which the electric current passes in the opposite direction.

Principle of operation

Whatever the complexity of the rotor coil windings, once they are energized, they may be represented in the form of a ferromagnetic cylinder with a solenoid wrapped around it. The wire of the solenoid is in practice the wire bundle located in each groove of the rotor. The rotor, when energized, then acts as an electromagnet, the magnetic field following the axis separating the wires of the solenoid in the direction of the current which flows through them.

The motor, therefore, consists of fixed permanent magnets (the stator) a moving magnet (the rotor) and a metal carcass to concentrate the flux (the motor body) The motor,

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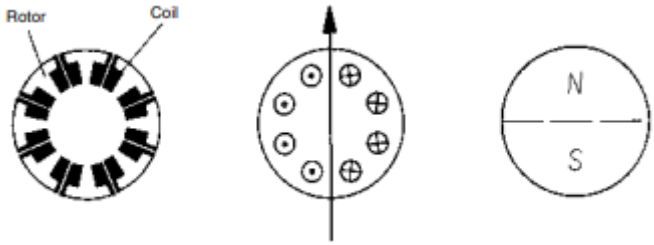
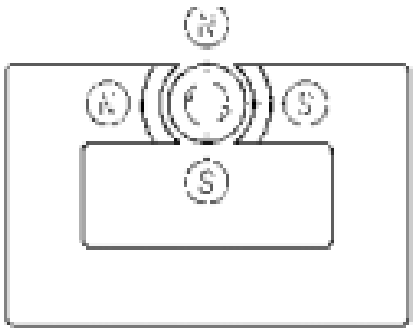


By the attraction of opposite poles and repulsion of like poles, a torque then acts on the rotor and makes it turn. This torque is at a maximum when the axis between the poles of the rotor is perpendicular to the axis of the poles of the stator.

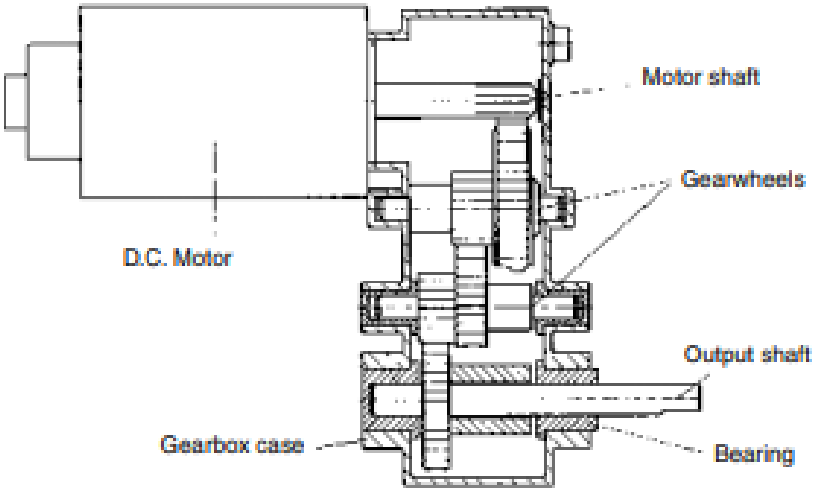


As soon the rotor begins to turn, the fixed brushes make and break contact with the rotating commutator segments in turn. The rotor coils are then energised and de-energised in such a way that as the rotor turns, the axis of a new pole of the rotor is always perpendicular to that of the stator. Because of the way the commutator is arranged, the rotor is in constant motion, no matter what its position. Fluctuation of the resultant torque is reduced by increasing the number of commutator segments, thereby giving smoother rotation. By reversing the power supply to the motor, the current in the rotor coils, and therefore the north and south poles, is reversed. The torque which acts on the rotor is thus reversed and the motor changes its direction of rotation. By its very nature, the D.C. motor is a motor with a reversible direction of rotation.

How to select from the Crouzet range

The motor unit is selected according to the required output power. Depending on the required speed, a direct motor or a geared motor is selected. Speeds 1,000 to 5,000 rpm Direct motor Speeds below 500 rpm Geared motor The gearbox is selected depending on the maximum required torque and the duty cycle.

Gearbox construction



 Selection of a geared motor A geared motor is selected according to the required usable power output. A geared motor must have usable power equal to or greater than the power required to rotate the load. It is selected by checking that the point corresponding to the required operating conditions (torque and speed output) is higher than the nominal torque versus speed curve of the geared motor. The required torque output of a geared motor must be within its maximum recommended torque for continuous duty. Selecting the reduction gear ratio Two selection criteria may be applied. The first criterion concerns the required speed output of the reduction gear only. It is adequate for most applications and is easy to apply. Given that : N1 = required speed of geared motor Nb = basic nominal speed of motor The second criterion concerns the required usable power output of the motor. The rotational speed of the motor is given by : N = speed of motor (rpm) No = no-load speed of motor (rpm) P = required output power (W) Cd = start-up torque of motor (Nm) This gives the equation : In order to avoid using numbers less than 1 where the reduction ratio is concerned, the value 1/R is employed. Due to the fact that it is always a reduction gear and not a «multiplier» gear, there should be no ambiguity concerning the number used. Motor shaft Gearwheels Output shaft Gearbox case Bearing D.C. Motor P (useable) .M .n 2 π = 60 W Nm rpm N1 Nb R = N1 N R = 1/R = or 1/R = Nb N1 N N1

Gearbox characteristics

Our gearboxes have been designed for optimum performance and for maximum life under normal operating conditions. Their main characteristic is the capacity to withstand maximum design torque with continuous duty. The range of gearboxes shown in this catalogue can operate with maximum torque of 0.5 to 6 N.m for long time periods. All values previously stated are for standard products in normal operating conditions, as specified. In certain cases, these values may be increased if a shorter life is required. Please consult our Sales Office for further information. Every gearbox has a torque limit, which is the breaking torque If this torque is applied to the gearbox, it will cause severe damage.

4.2.2 L293D Motor Driver

For robots that need to be lean, mean, and effective, the Solarbotics 'Secret' L293D motor driver replaces the guts of standard servos with the power of the robot-friendly L293D motor driver chip. It fits most standard servo bodies, to give your robot more power from a tighter space.

The L293D is a 16-pin chip with a little notch cut out of the front of it (that last bit is for you non-experts). Orient the chip so its notch matches the notch in the shape of the chip on the PCB. Carefully drop the chip into the gold-plated (pretty uptown, eh?) pads, and

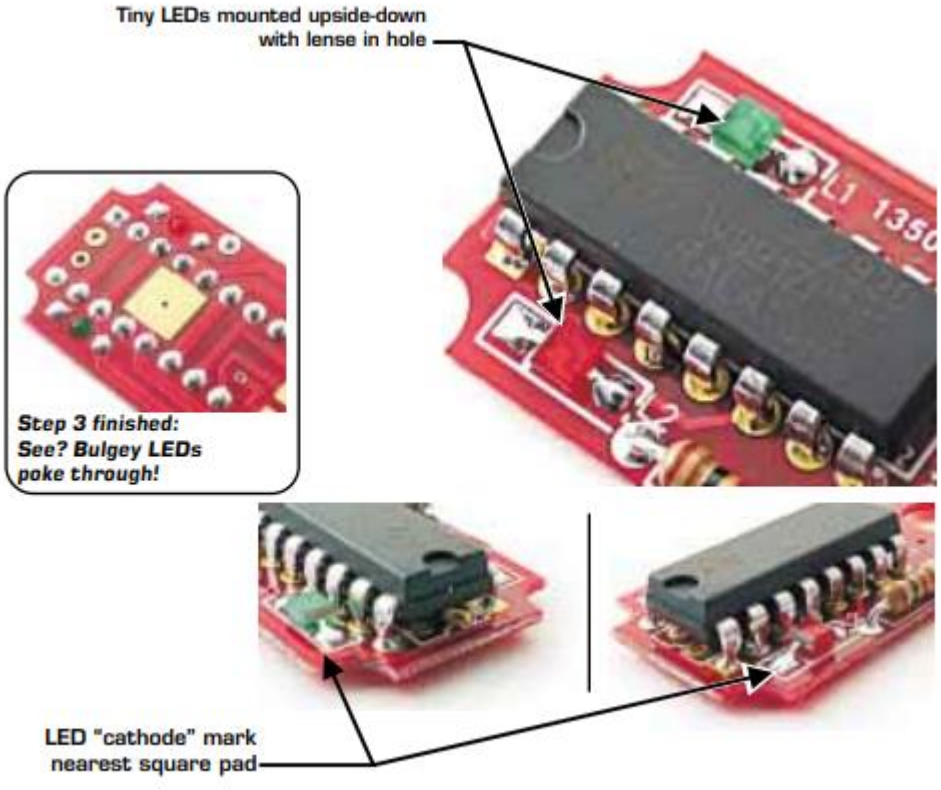
solder it into place from the other side. To a v o i d a n y n a s t y punctures, clip off any excess pins that poke through the pads on the solder side.

The 1k resistor (brown / black / red / gold) is inserted in about the only position it can fit into - position ‘R1’. Snug it up close to the circuit board, bend the leads over, and solder it into place from the other side. When done, clip off the excess leads.

This is one of the really cool things about the ‘secret’ driver board - the LED indicators. You have the option to mount them upside-UP or upside-DOWN. We recommend upside-DOWN, so you can easily see them from either side. The tiny LEDs in your kit have a lense that can be poked into the hole of the PCB which can easily been seen if you use the driver board on a breadboard, or in a transparent servo case (like the Solarbotics GM4 motor). Don’t worry - you’ll still see the LED light up from the other side too! Upside-down.

Upside-down or upside-up, just as long as the lead near the painted bar on the LED (the cathode) goes into the pad hole, and matches the bar printed on the PCB! If they aren’t installed properly, they aren’t going to light up.

Your kit comes with a set of five (5, for those who can’t read “five”) conductor ribbon cable. You’ll have to split the ends apart, and strip off about 1.5mm (1/16”) from each end. Try to arrange your ribbon cable like the one below, as splaying them apart will make it easier to solder each end to the driver board. For easier soldering, pre-tin the ends of each wire. Starting with the on the side nearest the pad marked ‘ ’, start soldering them into place, one per pad. We’ll be using the wire colours for different functions.



No rocket science here - simply put the servo bottom plate back in place, insert the corner screws, and tighten them down. Be careful to fold over a few of the edge ribbon wires, as it'll be too wide to fit the slot that originally fit three. Or hey - be a rebel and use a knife (or other favourite tool of destruction) and widen the slot so all five wires lay flat.

Usage

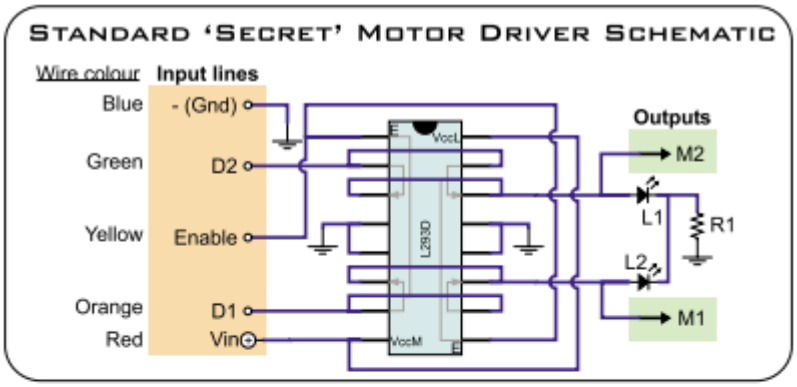
So you want to know how to use it? It ain't too difficult. Here's the long and short of it: Red - Vcc ('+') Blue - Gnd ('-') (on the opposite side of the cable) Orange & Green - D1 & D2 (direction power flow of motor outputs) Yellow - Enable (turns the chip off - connect to gnd to turn it off). Connect the red ('+') and blue ('-') to power. Leave the yellow line alone, unless if you want to turn the chip off, or pulse it to slow the motor down (a technique called "Pulse Width Modulation). Connect D1 to 5V, D2 to gnd, and the motor will turn one way. Connect D1 to gnd, and D2 to 5V, and the motor turns the way. Connect D1 D2 to either 5V or gnd, and the motor is in "brake" mode (try turning it - hard to do, eh?). Connect the yellow line to gnd, and it doesn't matter what D1 and D2 are connected to, as the motor is in "coast" mode, as if it weren't connected to the motor driver board at all.

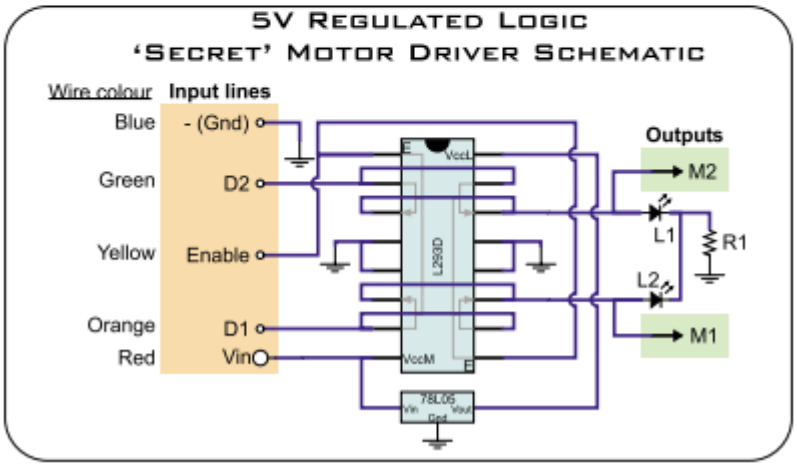
Performance Characteristics

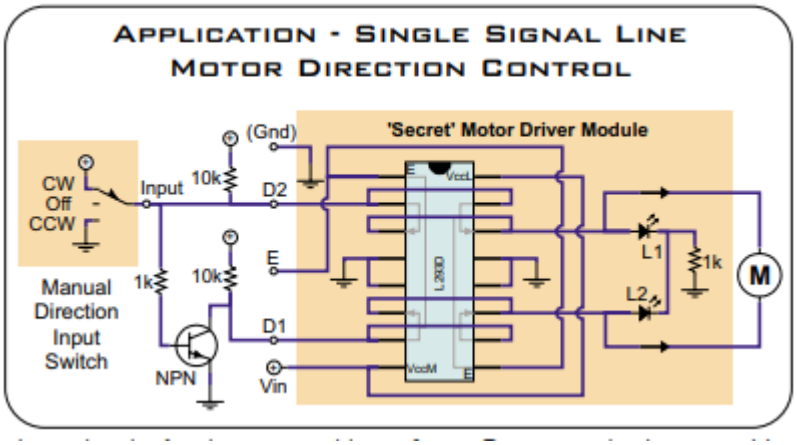
Here's the nitty gritty on the SGS Thompson L293D chip as tested it. You can find full manufacturer's datasheets online at "http:/downloads.solarbotics.com/pdf/l293d.pdf"

SOLARBOTICS MEASURED CHARACTERISTICS

Test	IC Voltage		
	5V	9V	12V
Quiescent current draw, IC enabled (mA)	51.4	53.5	54.1
Quiescent current draw, IC disabled (mA)	16.4	16.6	16.6
IC input impedance (ohms)	65.3k	82.5k	140k
Output peak current (A) 0 Ohm Load	2.27	3.38	Near-instant thermal shutdown
Voltage drop across 8 ohm load (V)	3.98	7.43	9.88
Current delivered to 8 ohm load (mA)	498	929	1240
Equivalent internal resistance (ohms)	2.05	1.69	1.71

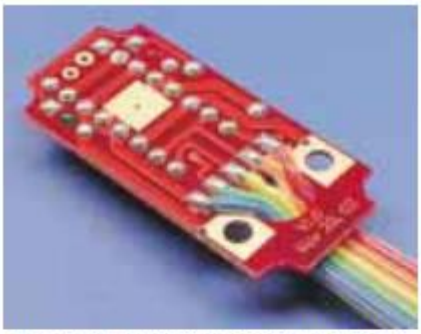






Schematics & Other Installations

The 'secret' motor driver also fits well on the outside of the Solarbotics GM2 and GM3 gear motor. Run the ribbon cable the other way off the driver PCB through the motor hole (for stress relief), and glue the top of the L293D IC to the gear motor case. Use short lengths of wire to connect the output pads of the motor driver to the motor contacts, and you're in business! In the case of the dog-leg inline GM2 motor, you might want to trim off one of the motor retainer clamps so you have a convenient flat mounting location.



Run the wires through the hole

The GM3 installation

The GM2 installation - note the clipped motor retainer under the PCB

4.2.3 POWER SUPPLY UNIT

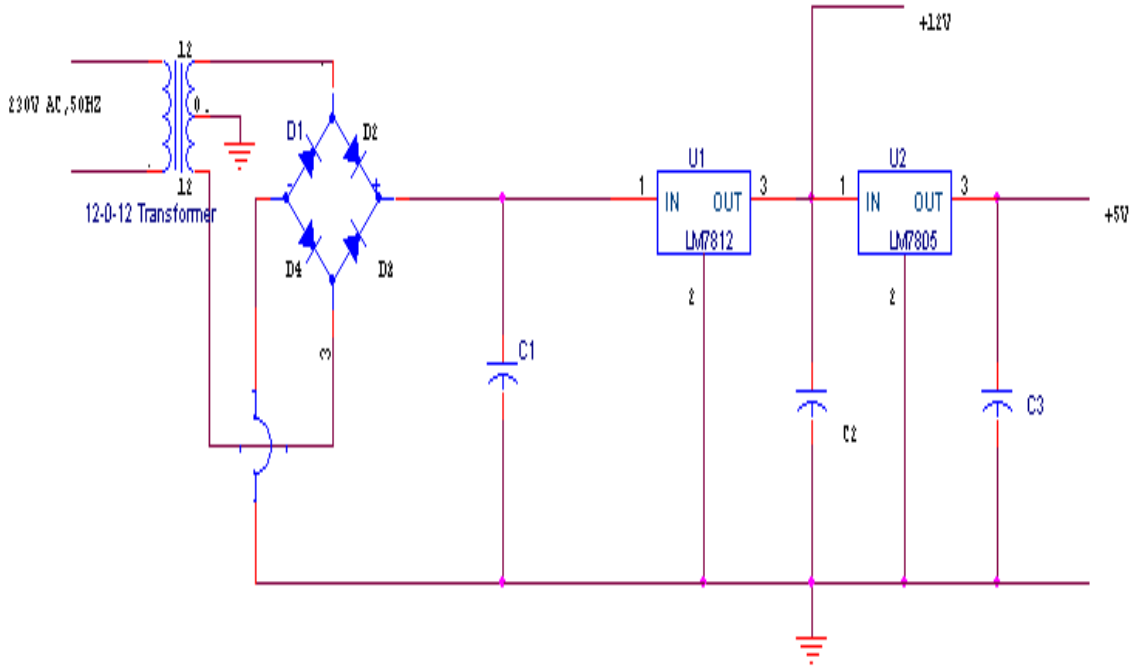


Figure 3.1: Dual Power supply unit for 5V and 12V

In every project we need different voltages for different circuits. So we need to construct different power supply of different voltages employing different voltage transformers, rectifier circuits, filter circuits and regulator circuits.

This type of construction requires many components (transformers, capacitors, regulators.....etc.). So the size of the power supply becomes bulky and costly. To overcome above disadvantages by using regulator IC'S the different voltages (12V, 9V.....etc.) can be obtained with only one transformer.

The circuit diagram of Dual power supply is shown in the figure 3.1. The function of each component of the circuit is explained below. The circuit consists of following stages.

1. Transformer
2. Rectifier
3. Filter
4. Regulator

4.1.1. TRANSFORMER:

It is an electrical device which transfers the power from one winding to the other winding with isolation. All the electronic gadgets work for less voltage (normally 3V to 12V).So a step down transformer is used, whose function is to step down the AC voltage from 230V to required voltage depending on the need. In this project 12V-0-12V is used. The output of transformer is 12V AC which is connected to the diodes for rectification.

3.1.2. RECTIFIER CIRCUIT:

It employs diodes, which converts AC voltage into DC voltage. The output of rectifier circuit is not a pure DC. It also consists of some AC components, which is called ripples. In order to remove these AC components, filter circuits are employed. So the output of rectifier circuit is fed to the filter circuit (capacitor).

3.1.3. FILTER CIRCUIT:

Filter circuit employs electrolytic capacitors in order to remove the AC components. As we know the capacitor does not allow DC components to pass through it because it offers high reactance to the DC component. And offers less reactance to the AC component, so all AC components will be bypasses through the capacitors to ground.

3.1.4. REGULATOR:

Regulator is an electronic circuit whose function is to keep output always constant though the input is varied. In this project the three terminal IC regulators of 7812 & 7805 is used for providing output DC voltages. E.g. 7809, the number 78 represents the positive regulator IC and 09 represents the output voltage i.e. output is 12V.

3.2 Component List:

SL.NO.	Component Name	Specification	Value	Quantity
1.	Transformer	Step-down	12-0-12	1
2.	Diode	D1 D2 D3 D4	IN4001 IN4001 IN4001 IN4001	1 1 1 1
3.	Capacitors	C1 C2 C3	1000uF,25V 0.01uF 0.01uF	1 1 1
4.	Regulator	U1 U2	LM7812 LM7805	1 1

Table 3.2 Component list for power supply unit

4.3 RELAY

Relays are the switches which aim at closing and opening the circuits electronically as well as electromechanically. It controls the opening and closing of the circuit contacts of an electronic circuit. When the relay contact is open (NO), the relay isn't energizing with the open contact. However, if it is closed (NC), the relay isn't energize given the closed contact. However, when energy (electricity or charge) is supplied, the states are prone to change.

Relay | What is a relay, its function, types and relay wiring

Page Contents [hide]

What Is a Relay

If you are from the electronics field, this word must be prevalent and if you are not, let us tell you all about it!

Relays are the switches which aim at closing and opening the circuits electronically as well as electromechanically. It controls the opening and closing of the circuit contacts of an electronic circuit. When the relay contact is open (NO), the relay isn't energize with the open contact. However, if it is closed (NC), the relay isn't energize given the closed contact. However, when energy (electricity or charge) is supplied, the states are prone to change.

Omron Relay

Relays are normally used in the control panels, manufacturing and building automation to control the power along with switching the smaller current values in a control circuit. However, the supply of amplifying effect can help control the large amperes and voltages because if low voltage is applied to the relay coil, a large voltage can be switched by the contacts.

If preventive relays are being used, it can detect overcurrent, overload, undercurrent, and reverse current to ensure the protection of electronic equipment. Last but not the least; it is used to heat the elements, switch on audible alarms, switch the starting coils, and pilots the lights.

Relay Types

In addition to the electromechanical and electromagnetic relay, there is a wide variety of relays with different working principles; principles of operation and polarity.

Electrothermal Relay – When two different material gets in contact, bimetallic strip is formed, and when it is energized, it bends. This bending allows the users to make contact connections

Electromechanical Relay – When different mechanical parts are connected on the basis of the electromagnet, contact connection is established

Solid State Relay –This relay uses semiconductor devices to make a connection to ensure the effectiveness, efficiency, and easiness of the switching speed. This is commonly used for two reasons; faster-switching process and durability

Hybrid Relay – It is the name given to the solid-state and electromechanical relays

Relay Types As Per The Polarity

Polarized Relay – These relays are identical to electromechanical relays except for the presence of electromagnet and a permanent magnet. With this relay, the armature movement is based on the input polarity applied to the coal and is commonly applicable in telegraphical purposes

Non-polarized Relay – There are no polarities in this relay, and it executes no change with the alteration of the input signal

We all are aware of the TV remotes on which we can press one button to make a function, relays work similarly to that. Relays are used to eliminate the direct link of users with electronic equipment to protect them for expected high voltages. If the vast industries are focused, they are using the bigger capacity relays to optimize the motors and pumps operation.

The common purpose of relays can be understood by analyzing the headlight turn on. The headlight switching button can be found on the car dashboard, and if moved, they supply the small value of current to the coil which results in contactor switching on. Then, relay comes into action by controlling the high power load (headlights). There are many other common examples of relays from our daily life.

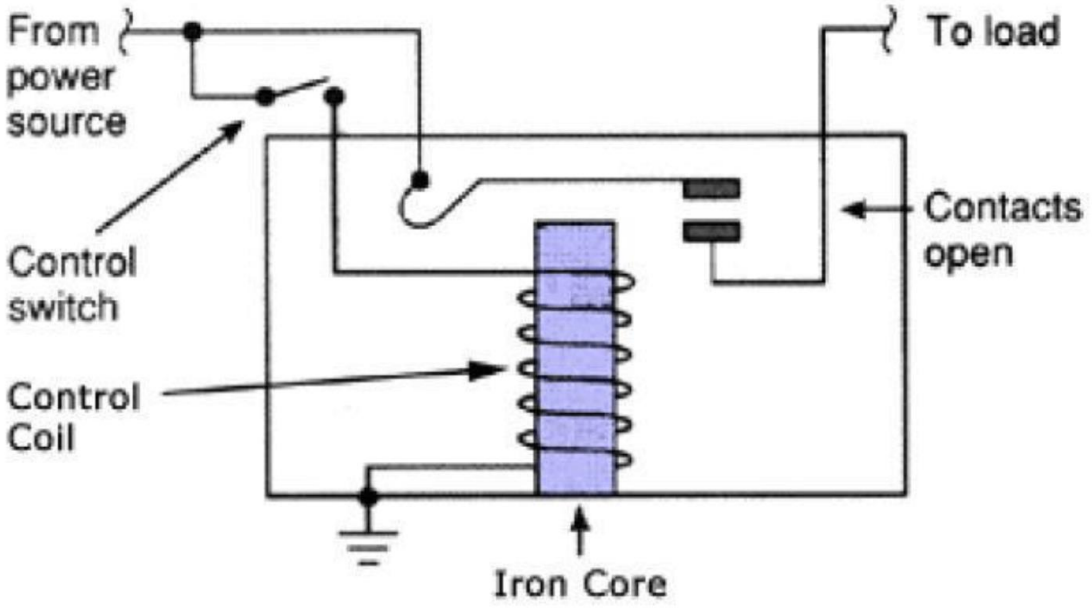
Everyone has a fridge at their home and relays control the equipment responsible for working and production of cold temperature. Traffic lights are another application of relays where they are used as the switching component. The movement and direction of automatic garage doors are also utilizing the relays for optimal switching contacts.

It is safe to state that relays are responsible for energizing the electronic equipment and work on their functioning to ensure the optimal operation. These have eased our lives by bringing in automation factors along with the safe and smooth running of electronic

equipment. This means that there are no threats involved regarding the high voltage as there will be

Relay Function

We have added the relay diagram in the section below to ensure the clear understanding of relay wiring and relay circuits along with their working.



The diagram sheds focus on the internal section of the relay in the circuit. There is an iron core delimited with the control coin. The power source connects with electromagnet through load contacts and a control switch. When energy is supply to the circuit through the control coil, magnetic fields intensifies given the commencement of energizing. This way, upper contact arms gets attracted by the lower fixed arm which closes the contacts leading to the short circuit. However, if the relay was de-energized, an open circuit is created with the opposite movement of the contact.

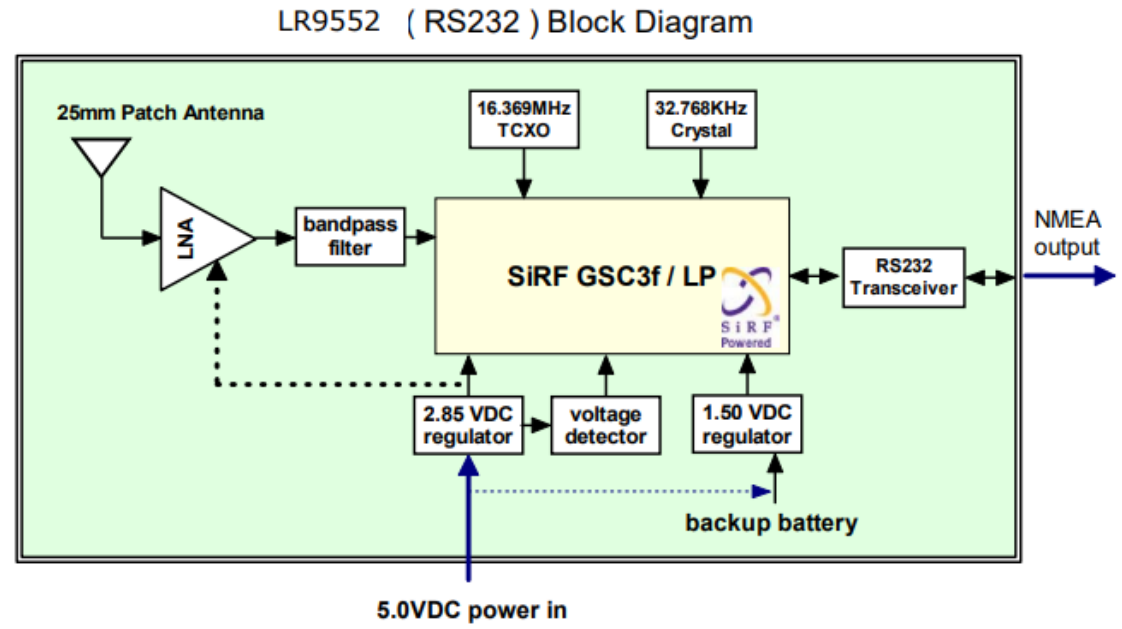
Once the coil current goes off, a movable armature is force back to the initial position, and the force is equal to half of the magnetic force and electric strength. The main reasons behind this force include gravity and spring.

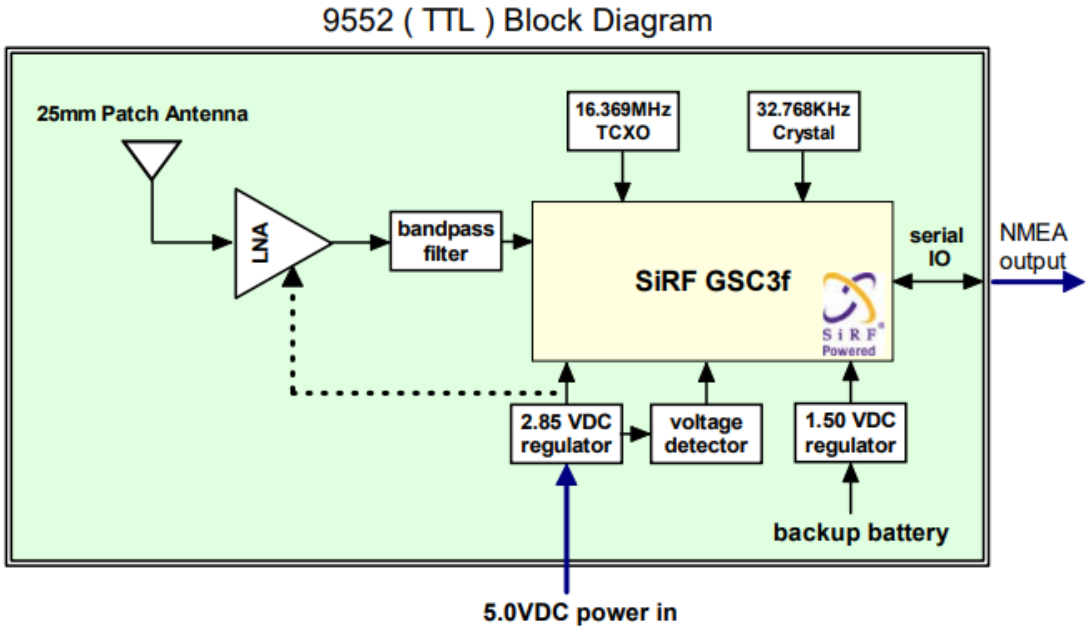
The relays perform two basic functions, such as high voltage application and low voltage application. In the case of high voltage, arcing is reduce while in the low voltage applications, overall circuit noise is reduce to a minimum.

4.4 GPS

A Satellite navigation device, colloquially called a GPS receiver, or simply a GPS, is a device that is capable of receiving information from GNSS satellites and then to calculate the device's geographical position.

Module architecture





1.1. Dimensions

The Physical dimensions of the Leadtek 9552 GPS Module are as follow:

Items	Description
Length	25.0 ± 0.3 mm
Width	25.0 ± 0.3 mm
Height	8.90 ± 0.3 mm 6.90 ± 0.3 mm

Weight	13.0g (w/ 4mm patch antenna) 8.0g (w/ 2mm patch antenna)

Software Features

The Leadtek 9552 module includes GSW3.2., high sensitivity software solution. For SiRFStarIII/LP receivers, the default configuration is as follows:

Item	**Description**
Core of firmware	SiRF GSW3.2
Baud rate	4800, 9600, 19200, 38400 or 57600 bps (default 4800)
Code type	NMEA-0183 ASCII
Datum	WGS-84
Protocol message	GGA(1sec), GSA(5sec), GSV(5sec), RMC(1sec),VTG(1sec)
Output frequency	1 Hz

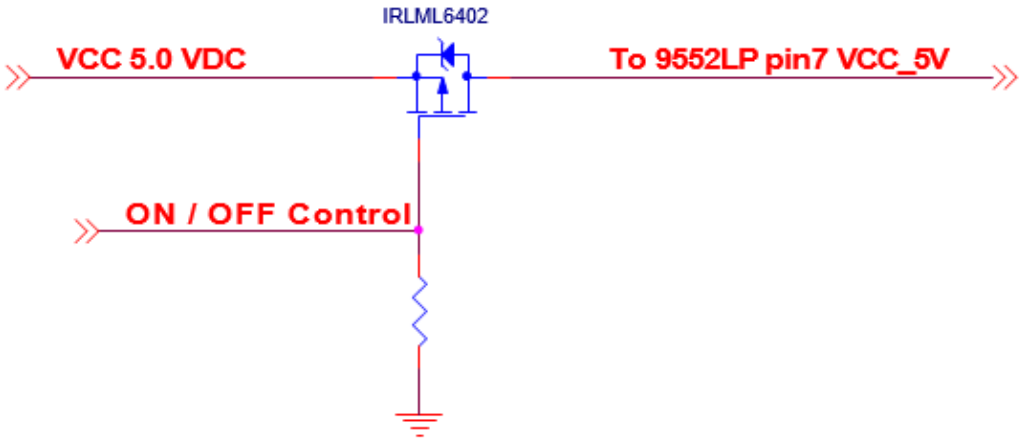
Environmental Specification

Item	**Description**
Operating temperature rang **(note)**	-30 deg. C to +60 deg. C
Storage temperature range	-30 deg. C to +65 deg. C
Humidity	up to 95% non-condensing or a wet bulb temperature of +35 deg. C
Altitude	18,000 meters (60,000 feet) max.
Velocity	515 meters/second (1000 knots) max.
Jerk	20 meters/second3, max.
Acceleration	4g, max.

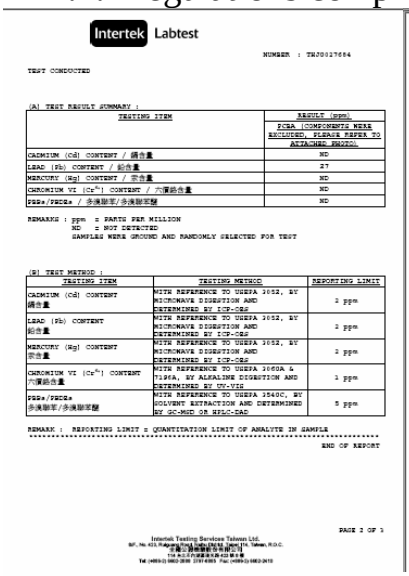
Note: The module can be operated between -30℃~+85℃, but higher temperature may cause internal Li backup battery deterioration that will influence the performance of GPS hot start.

1.1. Reference design

The user can use a PMOS to control 9552 power on or off as below:



1.1. Regulations compliance



Intertek Labtest

NUMBER : TH30027684

TEST CONDUCTED

(A) TEST RESULT SUMMARY :

TESTING ITEM	RESULT (ppm) PCBA (COMPONENTS WERE EXCLUDED, PLEASE REFER TO ATTACHED PHOTO).
CADMIUM (Cd) CONTENT / 鎘含量	ND
LEAD (Pb) CONTENT / 鉛含量	27
MERCURY (Hg) CONTENT / 汞含量	ND
CHROMIUM VI (Cr^{+6}) CONTENT / 六價鉻含量	ND
PBBs/PBDEs / 多溴聯苯/多溴聯苯醚	ND

REMARKS : ppm = PARTS PER MILLION
ND = NOT DETECTED
SAMPLES WERE GROUND AND RANDOMLY SELECTED FOR TEST

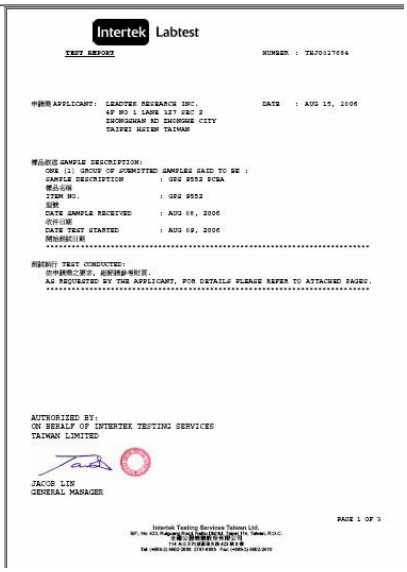
(B) TEST METHOD :

TESTING ITEM	TESTING METHOD	REPORTING LIMIT
CADMIUM (Cd) CONTENT 鎘含量	WITH REFERENCE TO USEPA 3052, BY MICROWAVE DIGESTION AND DETERMINED BY ICP-OES	2 ppm
LEAD (Pb) CONTENT 鉛含量	WITH REFERENCE TO USEPA 3052, BY MICROWAVE DIGESTION AND DETERMINED BY ICP-OES	2 ppm
MERCURY (Hg) CONTENT 汞含量	WITH REFERENCE TO USEPA 3052, BY MICROWAVE DIGESTION AND DETERMINED BY ICP-OES	2 ppm
CHROMIUM VI (Cr^{+6}) CONTENT 六價鉻含量	WITH REFERENCE TO USEPA 3060A & 7196A, BY ALKALINE DIGESTION AND DETERMINED BY UV-VIS	2 ppm
PBBs/PBDEs 多溴聯苯/多溴聯苯醚	WITH REFERENCE TO USEPA 3540C, BY SOLVENT EXTRACTION AND DETERMINED BY GC-MSD OR HPLC-DAD	5 ppm

REMARK : REPORTING LIMIT = QUANTITATION LIMIT OF ANALYTE IN SAMPLE

END OF REPORT

PAGE 2 OF 3



Intertek Labtest

TEST REPORT NUMBER : TH30027684

申請商 APPLICANT: LEADTEK RESEARCH INC. DATE : AUG 15, 2006
4F NO 1 LANE 127 SEC 2
ZHONGZHAN RD ZHONGHE CITY
TAIPEI HSIEN TAIWAN

樣品敘述 SAMPLE DESCRIPTION:
ONE (1) GROUP OF SUBMITTED SAMPLES SAID TO BE :
SAMPLE DESCRIPTION : GPS 9552 PCBA
樣品名稱
ITEM NO. : GPS 9552
型號
DATE SAMPLE RECEIVED : AUG 08, 2006
收件日期
DATE TEST STARTED : AUG 09, 2006
開始測試日期

測試執行 TEST CONDUCTED:
依申請商之要求, 起測請參考附頁.
AS REQUESTED BY THE APPLICANT, FOR DETAILS PLEASE REFER TO ATTACHED PAGES.

AUTHORIZED BY:
ON BEHALF OF INTERTEK TESTING SERVICES
TAIWAN LIMITED

JACOB LIN
GENERAL MANAGER

PAGE 1 OF 3

Intertek Labtest

NUMBER : TH30027684

TEST CONDUCTED

PHOTO

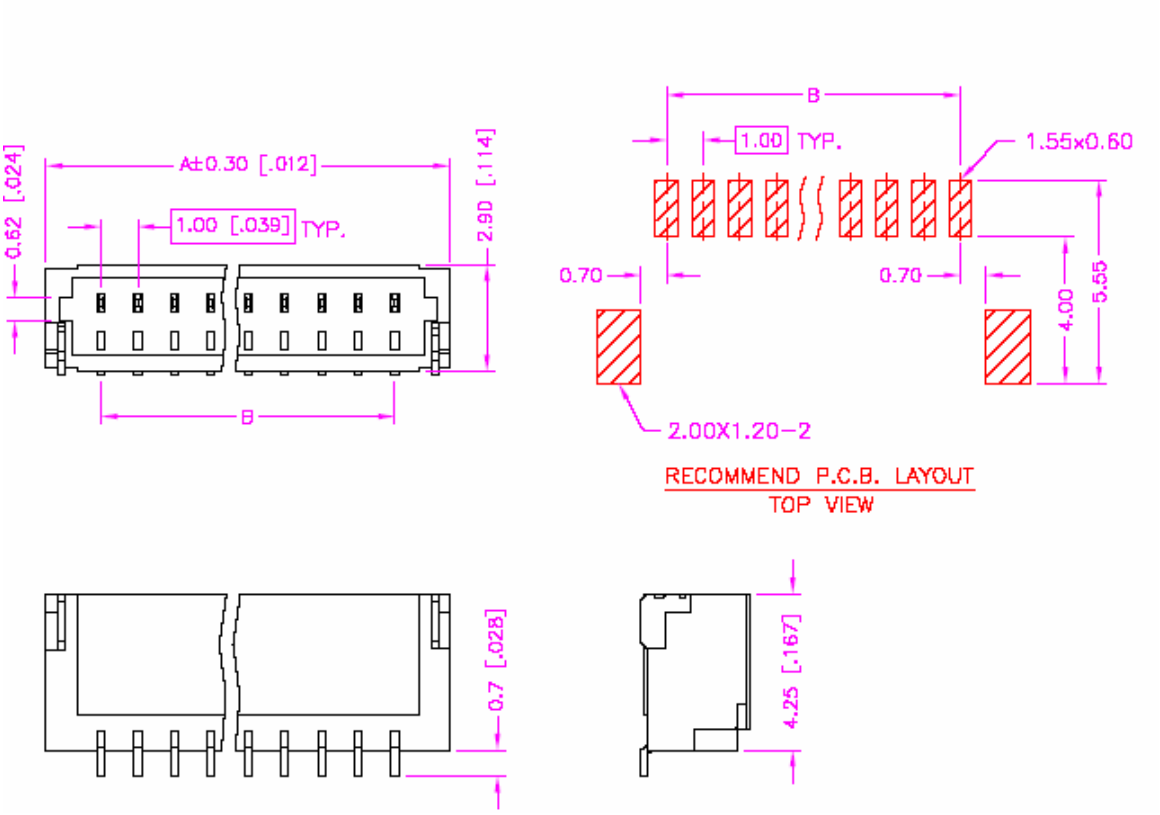
PAGE 3 OF 3

Hardware Interface Power supply

Parameter	Leadtek 9552 GPS Module
Input voltage	3.2 ~ 5.0V DC input.
Current (typ) at full power (3.3V)	55mA
Battery backup voltage	1.65 5.0V DC input.

Specifications

Pin positions



Pin Assignment

Pin No.	Define	Pin No.	Define
1	GND	5	RXDB
2	TXDA	6	TIMEMARK
3	RXDA	7	VCC_5V
4	TXDB		

Software interface

The host serial I/O port of the module's serial data interface supports full duplex communication between the module and the user. The default serials are shown in Table 5-1.

Port	Protocol	Description
Port A	NMEA 0183, 9600 bps	GGA, GSA, GSV, GLL, RMC, VTG
Port B	N/A	N/A

The Leadtek LR9552 module includes GSW3 high sensitivity software solution. Features include:

- λ High tracking sensitivity
- λ High configurability
- λ 1 Hz position update rate
- λ Real-time Operating System (RTOS) friendly
- λ Capable of outputting both NMEA and SiRF-proprietary binary protocols.

GSW3 default configuration is as follows:

Item	Description
Core of firmware	GSW3.2 serial
Baud rate	4800, 9600, 19200, 38400 or 57600 bps (default 4800)
Code type	NMEA-0183 ASCII
Datum	WGS-84
Protocol message	GGA(1sec), GSA(5sec), GSV(5sec), RMC(1sec),VTG(1sec)
Output frequency	1 Hz

Chapter 5

RASPBERRY PI

5.1 Introduction to RASPBERRY PI

Hey Friends! Electronic experts always strive to develop new electronic devices that meet the needs and requirements of the customers. Technology has been evolved remarkably well where devices are becoming compact and composed. Using old conventional ways to develop electronic devices are becoming obsolete that occupied more weight and space, turned out to be expensive and capable of doing fewer number of operations. Today, I am going to discuss the details on the **Introduction to Raspberry Pi 3**. It is just like a small computer that comes with CPU, GPU, USB ports and i/o pins and can be connected with external peripherals and helps in running number of operations like regular computer. First generation Raspberry Pi was developed in 2012, with the intention of making computer learning easy for school students. Learning advanced computer functions in the beginning of computer learning process is not easy for everyone. This tine computer was introduced, so everyone can get a hint of some initial functions advanced computer is capable of doing. Let's dive in and explore each and every feature of Raspberry Pi 3.

- Raspberry Pi 3 is tiny single board computer, introduced by Raspberry Pi Foundation, that comes with CPU, GPU, USB ports and i/o pins and capable of doing some simple functions like regular computer.
- This tiny computer was developed with the purpose of making computer learning process easy so an average student can get benefit and anticipate what an advanced computer can do.
- Raspberry Pi 1(first generation Model B) came into play in 2012, and soon got a renowned reputation in terms of ease of use and availability. Similarly, Raspberry Pi 2 was introduced in Feb,2015 will little improvement in design with added RAM than its previous version.
- Introduced in 2016, Raspberry Pi 3 Model B comes with a quad core processor that shows robust performance which is 10 times more than Raspberry Pi 1. And speed exhibits by Raspberry Pi 3 is 80% more than Raspberry Pi 2.
- The Raspberry hardware has gone through a number of variations in terms of peripheral device support and memory capacity. Every new addition comes with a

little improvement in terms of design where advance features are added in the device so it can do as many function as possible like a regular computer.

- Wi-Fi and Bluetooth that lack in older versions (Pi 1 and Pi 2), are added in the new addition of this device (Pi 3), allowing to maintain the connection with the peripherals without the involvement of any physical connection.
- Raspberry Pi Foundation recently launched Raspberry Pi 3 Model B+ on 14 March 2018, which is the most recent version of Raspberry Pi 3 that exhibits all the specifications introduced in Pi 3 Model B, with the additional improvement including Network boot, USB boot, and Power over Ethernet which make the device useful in hard to reach places.

4.2 History to Raspberry PI 3

The Raspberry Pi is a credit card-sized computer designed and manufactured in the UK with the initial intention of providing a cheap computing device for education. Since its release, however, it has grown far beyond the sphere of academia.

Its origins can be found in the University of Cambridge's Computer Laboratory in 2006. Computer scientist Eben Upton, along with Rob Mullins, Jack Lang and Alan Mycroft, were concerned that incoming computing undergraduate students had grown divorced from the technical aspects of computing. This was largely due to school syllabuses that placed an emphasis on using computers rather than understanding them.

Off the back of this initial concern, the Raspberry Pi foundation was formed. Over the next six years the team worked on developing a cheap and accessible device that would help schools to teach concepts such as programming, thus bringing students closer to understanding how computing works.

The Raspberry Pi's initial commercial release was in February 2012. Since then, the board has gone through a number of revisions and has been available in two models, those being Model A and Model B.

The Model A device is the cheaper and simpler of the two computers and the Model B the more powerful, including support for Ethernet connectivity.

In February 2015, the Raspberry Pi 2 Model B was released, and this is the device discussed in this book.

The new Raspberry Pi 2 is significantly more powerful than previous versions, opening us up too many new possibilities.

We will now look at the hardware of the device to get a basic understanding of what it is capable of doing. Future chapters will build upon the basics presented here.

5.3 Over view of Raspberry PI3

	Raspberry Pi 3 Model B	Raspberry Pi 2 Model B	Model B+	Model A+	Model A	CMDK
Processor Chipset	Broadcom BCM2837 64Bit ARMv7 Quad Core Processor powered Single Board Computer running at 1250MHz	Broadcom BCM2836 32bit ARMv7 Quad Core Processor powered Single Board Computer running at 900MHz	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor
GPU	Videocore IV	Videocore IV	Videocore IV	Videocore IV	Videocore IV	Videocore IV
Processor Speed	QUAD Core @1250 MHz	QUAD Core @900 MHz	Single Core @700 MHz	Single Core @700 MHz	Single Core @700 MHz	Single Core @700 MHz
RAM	1GB SDRAM @ 400 MHz	1GB SDRAM @ 400 MHz	512 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz	512 MB SDRAM @ 400 MHz
Storage	MicroSD	MicroSD	MicroSD	MicroSD	SDCard	4GB eMMC
USB 2.0	4x USB Ports	4x USB Ports	4x USB Ports	1x USB Port	1x USB Port	1x USB Port
Power Draw / voltage	2.5A @ 5V	1.8A @ 5V	1.8A @ 5V	1.8A @ 5V	1.2A @ 5V	1.8A @ 5V
GPIO	40 pin	40 pin	40 pin	40 pin	26 pin	120 pin
Ethernet Port	Yes	Yes	Yes	No	No	No
Wi-Fi	Built in	No	No	No	No	No
Bluetooth LE	Built in	No	No	No	No	No

3.4 Technical Specification

Processor

• Broadcom BCM2387 chipset.

• 1.2GHz Quad-Core ARM Cortex-A53 (64Bit) 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

• IEEE 802.11 b / g / n Wi-Fi. Protocol: WEP, WPA WPA2, algorithms AES-CCMP (maximum key length of 256 bits), the maximum range of 100 meters.

• IEEE 802.15 Bluetooth, symmetric encryption algorithm Advanced Encryption Standard (AES) with 128-bit key, the maximum range of 50 meters.

GPU

• Dual Core Video Core IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode.

• Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

Memory

• 1GB LPDDR2

Operating System

• Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IOT

Dimensions

• 85 x 56 x 17mm

Power

• Micro USB socket 5V1, 2.5A

Connectors: Ethernet

• 10/100 Base T Ethernet socket

Video Output

• HDMI (rev 1.3 & 1.4)

• Composite RCA (PAL and NTSC)

Audio Output

• Audio Output 3.5mm jack

• HDMI

• USB 4 x USB 2.0 Connector

GPIO Connector

• 40-pin 2.54 mm (100 mil) expansion header: 2x20 strip

• Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines Camera Connector
• 15-pin MIPI Camera Serial Interface (CSI-2)

Display Connector

• Display Serial Interface (DSI) 15-way flat flex cable connector with two data lanes and a clock lane

Memory Card Slot

• Push/pull Micro SDIO

3.5 Pin description of Raspberry PI3

The Raspberry Pi 3 boards (all models: 3A+, 3B, 3B+) have a GPIO header with 40 pins. Those pins bring a new set of feature to the Raspberry Pi 3.

They allow you to easily use hardware features and communication, directly from a computer – the Raspberry Pi microprocessor. It brings the Raspberry Pi 3 much closer to hardware applications, making it perfect for being embedded in a hardware application or product: a robot, a retro-gaming application, etc.

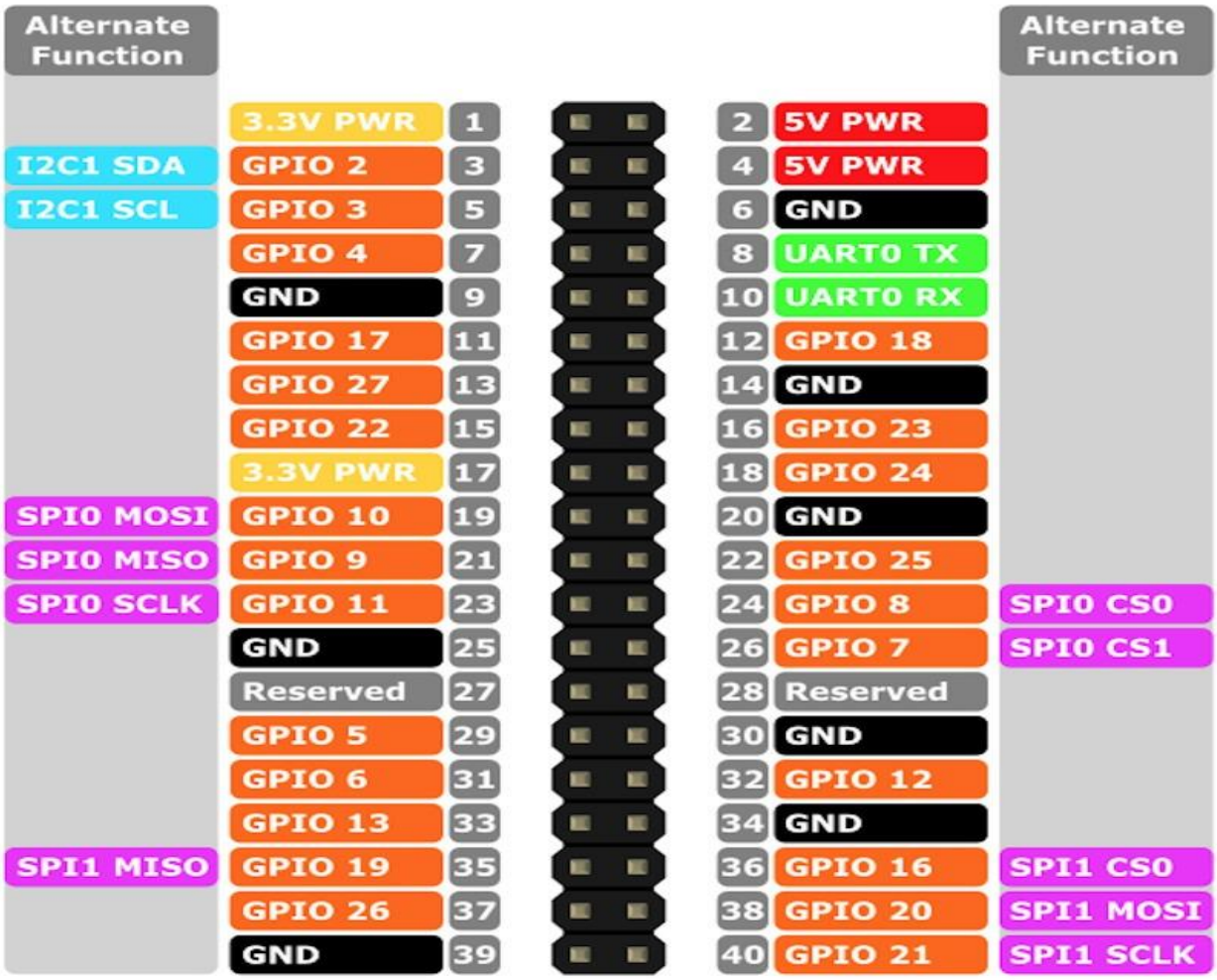
In this complete Raspberry Pi 3 pins guide I'll break down all the pins of the GPIO header, and you'll learn what you can/can't do with them.

Along the way I'll make some comparisons with the pins of the Arduino boards. You'll find out that the pins can be quite similar for some functionalities. At the end I'll give you more details about the differences between Arduino and Raspberry Pi pins. If you're interested about Arduino pins, check out this tutorial: Arduino Uno Pinout Guide.
Alright, let's get started!

Table of Contents

Raspberry Pi 3 pins overview

Here's a complete overview with all the GPIOs and their primary function.



Now, let's break down each pin or group of pins, and see what they can do.

A word of caution

Before you plug anything to a Raspberry Pi 3 pin, you have to know that you can easily damage the board if you do something wrong. There are no real hardware safety when it comes to the Raspberry Pi hardware pins.

If you connect a ground (GND) pin to a 3.3V pin directly, well… You might destroy your Raspberry Pi board the second those pins are connected together.

So, **be really careful when you plug something or when you create a test circuit**. If you have any doubt, double, triple check, and ask someone for help before you burn your board. But if you follow some basic rules and common sense, you'll have nothing to worry about!.

Ground pins

The ground is very useful for making a common reference between all components in your circuit. **Always remember to connect all components to the ground.**

If you connect 2 circuits together, add a wire between both grounds to make it common. If you add a new sensor/actuator to an existing circuit, connect the ground of the component to the ground of the circuit.

That's very important. Without that, you may burn some parts of the circuit, you may have components that do not function correctly, give wrong values, etc.

8 out of the 40 GPIOs are connected to the ground. You can find them with the 3 letters GND.

One additional warning: don't ever connect the ground directly to a power supply pin (3.3V or 5V)! This creates a short circuit and can definitively burn your Raspberry Pi 3 board.

Power pins

You can find 2 pins bringing 3.3V and 2 pins bringing 5V.

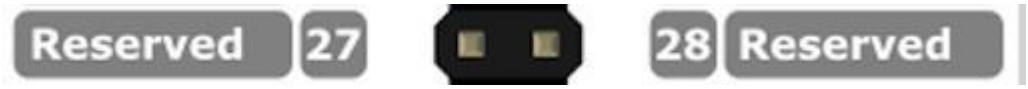
Those pins can be used to power components such as sensors or small actuators. Note that they are certainly not powerful enough to actuate motors such as servo or stepper motors. For that you'll need an external power source.

The power pins are used as a source to power external components, not to power the Raspberry Pi itself from an external source. (Well there is a way to power the Raspberry Pi from the GPIO header, but you have a high probability of burning it, so just use the micro-USB port)

And just another word of caution: as previously said in the Ground pins section, don't ever connect one of the power pin directly to one of the GND of the Raspberry Pi 3!

Reserved pins

The pins 27 and 28 are reserved pins. They are usually used for I2C communication with an EEPROM.



If you just begin with Raspberry Pi 3 pins, just don't connect something to those pins. There are many other available pins for you to use.

Well, that's 14 slots already taken for GND, power supply and reserved pins. Now let's see how the other 26 GPIOs are used for communication.

Raspberry Pi 3 GPIOs

GPIO means General Purpose Input/Output. Basically that's one pin you can use to write data to external components (output), or read data from external components (input).

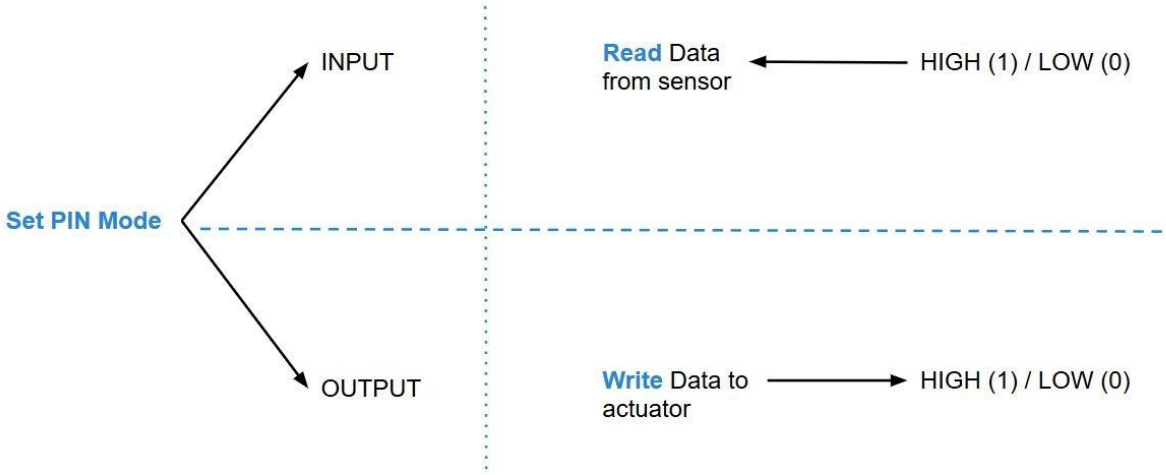
If you embed your Raspberry Pi board with some hardware components, the GPIO header will become quite useful.

GPIOs will allow you to read some basic sensors (ex: infrared), control some actuators (those which are working with a ON/OFF mode), and communicate with other hardware boards, such as Raspberry Pi, Arduino, Beaglebone, etc.

GPIOs are digital pins

The Raspberry Pi 3 GPIOs are quite similar to what we call "digital pins" on an Arduino board.

First you need to choose whether you want to use them as input or output. If you configure a GPIO as input, you'll be able to read a value from it: HIGH or LOW (1 or 0). And if you configure a GPIO as output, you'll be able to write a value to it, also HIGH or LOW.



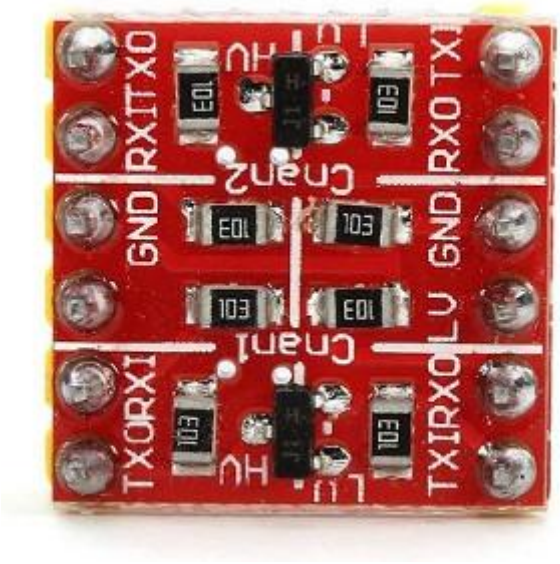
A digital pin has only two states. LOW usually means 0V, and HIGH means 3.3V (with some tolerances). That's very simple, it's like a switch that you turn on and off.

GPIOs voltage

All GPIOs work at 3.3V. It's important for you to know that, in case you need to plug in a component with a different voltage.

Sometimes, you'll find sensors that are powered with 5V, but all the communication pins are running with 3.3V. In this case, no problem: you can use the 5V power pin from the Raspberry Pi to power the component, and then use any 3.3V GPIO for the communication. If you don't mix the 5V signal with the 3.3V signals, everything should be alright.

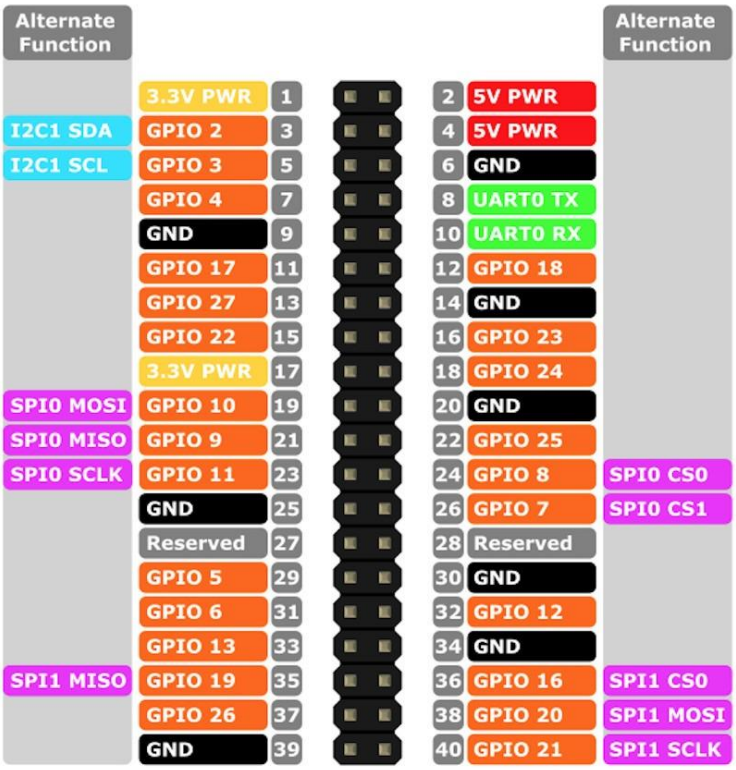
Now if you need to make your Raspberry Pi 3 GPIOs communicate with 5V pins directly (ex: Arduino Uno or Mega), you'll need to use a 3.3V to 5V level shifter. You can either buy one or build one yourself.



If you use 3.3V Arduino boards such as Due, Zero, or M0, you won't need to add a 3.3V to 5V level shifter, and you can plug the Arduino pins directly to the Raspberry Pi 3 GPIOs.

How to use GPIOs

Here's the GPIO header again:



To use a GPIO, first you need to know its number.

As you can see, **the pin numbers and GPIO numbers are different.** Pin numbers are in grey, and GPIO numbers in orange. Depending on the library you use to manipulate GPIOs, you'll either have to use the number of the pin or the GPIO number. For example, pin 29 corresponds to GPIO 5. Any time you have a doubt, just check the pinout again and you'll know!
So, to use any of those GPIO, first you need to configure it as input or output, and after that you can write to it, or read from it.

Now, you might wonder: how can you configure and use the GPIOs from your code? Do you need to dive into complex hardware stuff to do that?

Well, good news for you. There are at least 2 libraries that will allow you to easily use those pins. For Python, you can use RPi.GPIO, and for Cpp you can use WiringPi.

Those libraries were developed so **you can use the Raspberry Pi pins just like you would use Arduino pins**, which means that all the complex stuff is hidden and you can use them with just a few lines of code.
For example, to set GPIO 17 (pin 11) as output/high:

```
// With WiringPi (Cpp)
pinMode (17, OUTPUT);
digitalWrite(17, HIGH);
# with RPi.GPIO (Python)
GPIO.setmode(GPIO.BCM) # Choose BCM to use GPIO numbers instead of pin numbers
GPIO.setup(17, GPIO.OUT)
GPIO.output(17, GPIO.HIGH)
```

To make 2 boards communicating with each other, it's quite simple: you'll configure a GPIO as an input on one side, and as an output on the other side. You can then use more GPIOs to transfer more pieces of information.

Communication protocols through Raspberry Pi 3 pins

You can use some hardware communication protocols directly with the Raspberry Pi 3 GPIOs. Those communication protocols are in fact the same ones that you can natively use on many Arduino boards.

With those protocols you'll be able to **transfer far more information** than with just a bunch of GPIOs configured as digital pins.

On the Raspberry Pi 3 pinout schematics, you can see a column for alternate functions. Well, the communication protocols are all there!

In fact, saying that a GPIO is a digital pin is an overly exaggerated simplification. It's much more than that. For each GPIO you have at least one alternate function, and sometimes many more.

But let's keep things simple here. You don't need to know all the alternate functions to get started and develop cool applications. If you're interested though, check out page 102 of the bmc2835 datasheet (this is the datasheet for the whole GPIO header), where you'll see a complete table with all alternate functions for all GPIOs.

UART

UART is multi master communication protocol. This protocol is quite easy to use and very convenient for communicating between several boards: Raspberry Pi to Raspberry Pi, or Raspberry Pi to Arduino, etc.

For using UART you need 3 pins:

- GND that you'll connect to the global GND of your circuit.
- RX for Reception. You'll connect this pin to the TX pin of the other component.
- TX for Transmission. You'll connect this pin to the RX of the other component.

If the component you're communicating with is not already powered, you'll also have to use a power pin (3.3V or 5V) to power on that component.

By using a UART to USB converter, you can communicate between your laptop and Raspberry Pi with UART.

Now, to use UART in your code, you can use the Serial library in Python, and WiringPi in Cpp.

If you're interested in communicating between a Raspberry Pi board and an Arduino board via Serial, check out this Raspberry Pi Arduino Serial tutorial.

I2C

I2C is a master-slave bus protocol (well it can have multiple masters but you'll mostly use it with one master and multiple slaves). The most common use of I2C is to read data from sensors and actuate some components.

The master is the Raspberry Pi, and the slaves are all connected to the same bus. Each slave has a unique ID, so the Raspberry Pi knows which component it should talk to.

For using I2C you'll need 3 pins:

- GND: I guess you start to get used to that!
- SCL: clock of the I2C. Connect all the slaves SCL to the SCL bus.
- SDA: exchanged data. Connect all the slaves SDA to the SDA bus.

And as most of the time you'll need to power on the component, you'll also need a power pin (3.3V or 5V), linked to the Vcc pin of the component. Make sure you know which voltage is accepted by the component before you plug anything. But don't worry too much though: usually, hobby components will accept 3.3V and/or 5V.

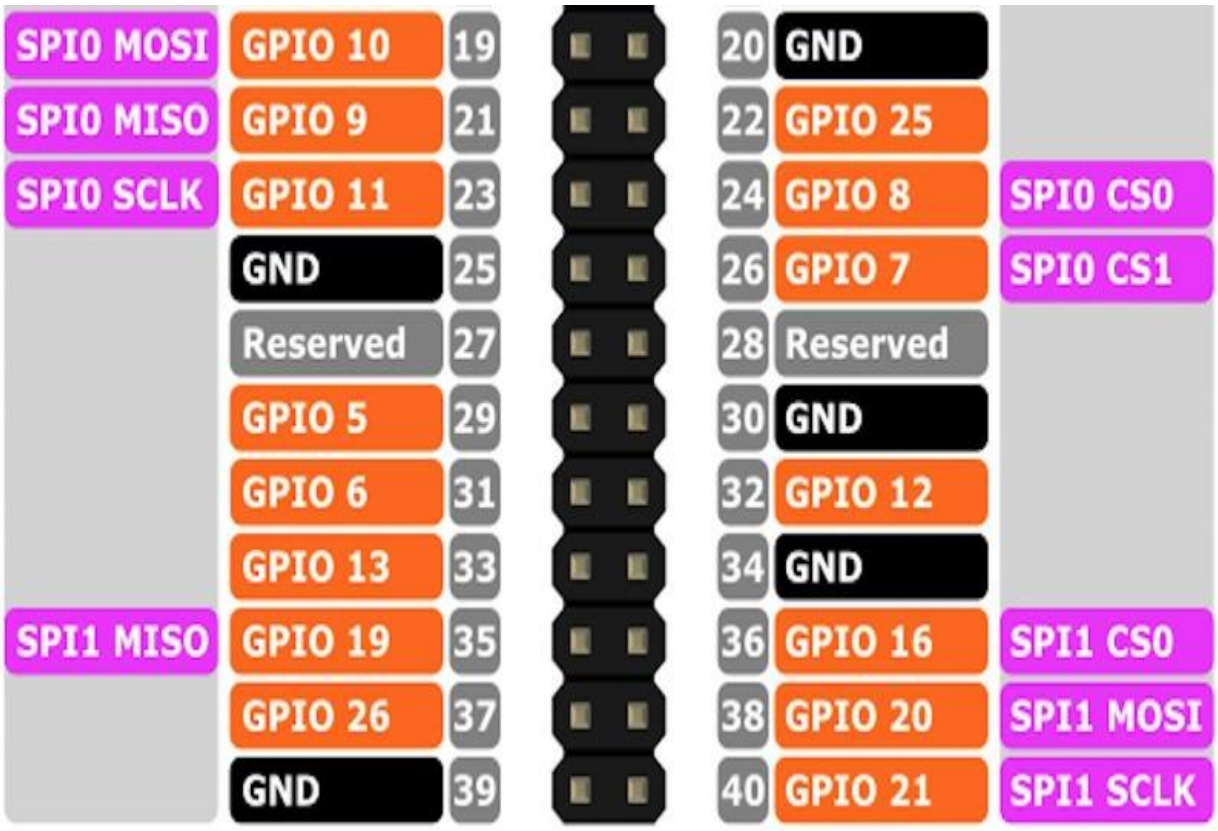
Note that the SDA and SCL pins on the Raspberry Pi are alternate functions for GPIO 2 and 3. When you use a library (Python, Cpp, etc) for I2C, those two GPIOs will be configured so they can use their alternate function.

Some of the best and easy-to-use libraries for I2C are SMBus for Python and WiringPi for Cpp.

SPI

SPI is yet another hardware communication protocol. It is a master-slave bus protocol. It requires more wires than I2C, but can be configured to run faster.

So, when to use I2C vs SPI on your Raspberry Pi 3? Well, the answer is quite simple. Sometimes you'll find a sensor that is only I2C or SPI compatible. And sometimes, you'll just want to have a balance between those protocols, so for example you'll choose to use I2C if you already have many components using the SPI. As you progress you'll start to know the differences better, and be able to make a better choice between those two protocols. But for now, let's keep things simple.



As you can see, you get 2 SPIs by default: SPI0 and SPI1. It means you can use the Raspberry Pi as a SPI master on two different SPI buses at the same time.

And, as for I2C, SPI uses the alternate functions of GPIOs.

For using SPI you'll need 5 pins:

- GND: what a surprise! Make sure you connect all GND from all your slave components and the Raspberry Pi together.
- SCLK: clock of the SPI. Connect all SCLK pins together.
- MOSI: means Master Out Slave In. This is the pin to send data from the master to a slave.
- MISO: means Master In Slave Out. This is the pin to receive data from a slave to the master.
- CS: means Chip Select. Pay attention here: you'll need one CS per slave on your circuit. By default you have two CS pins (CS0 – GPIO 8 and CS1 – GPIO 7). You can configure more CS pins from the other available GPIOs.

In your code, you can use the spidev library for Python, and WiringPi for Cpp.

The difference between Raspberry Pi 3 pins and Arduino pins

We often compare the Raspberry Pi 3 pins with the pins from the Arduino boards. To the point where many libraries use the same function name to actuate those pins! For example, WiringPi uses the

```
void digitalWrite(int pin, int value);
```

to set the state of a GPIO, which is the exact same function in Arduino to set the state of a digital pin.

But it's not quite the same.

First of all, Raspberry Pi has a microprocessor, often running a Linux system (for example Raspbian), while Arduino has a microcontroller. This makes a huge difference, especially when considering real time constraints.

Also, and that's something you can't see on the board directly, **many hardware functionalities from Arduino are not present in a Raspberry Pi board**.

You don't have analog pins on a Raspberry Pi board. If you want to use an analog sensor, you'll have to use an external ADC (Analog to Digital Converter), and maybe get the value using I2C or SPI protocol.

Also there are no native PWM on Raspberry Pi. PWM are quite useful to control components with a non-binary command. You can fake the PWM from software (ex with WiringPi), but it's clearly not recommended as it will take a lot of CPU and won't be really fast.

I won't make the complete list here, but you see the point. **Arduino is much closer to hardware than Raspberry Pi**, and thus there are many native-hardware functionalities that you can't get on a Raspberry Pi board.
So, before you choose between those 2 kinds of boards for your project, make sure you know what you need: **more computation power, the need to use high level languages (Raspberry Pi), or something more close to hardware, with limited resources (Arduino)?**

Get started with Raspberry Pi 3 pins

Well, there are many things you can do with Raspberry Pi 3 pins.

I'll repeat it here: you can never be too cautious when manipulating the pins! A mistake can destroy your board in less than a second. But if you pay attention and double check everything, there is no reason you'll burn anything.

Now, if you feel lost with so much information and don't know where to start, here's a list of steps you can take from there:

- Get some simple examples and do them, like powering on a LED, read the value from a button, etc. For that you'll need to create a small circuit on a breadboard, and you'll use the pins with their primary function (GPIO).
- Once you're familiar with how basic circuits work (GND, Vcc, and communication pins), try to get a more complex sensor, for example an I2C accelerometer, so you can measure whether your board is on a flat surface or not.
- After you know how to communicate with one sensor, try to communicate between your Raspberry Pi board and another Raspberry Pi/Arduino/Computer, using all 3 protocols: UART, I2C, SPI. You'll learn a lot by doing that.

Chapter 6

SOFTWARE

cPanel is an online Linux-based graphical interface (GUI) used as a control panel to simplify website and server management. cPanel allows you to publish websites, manage domains, organize web files, create email accounts, and more. ... Many web hosting companies supply cPanel to customers as part of their hosting package.

6.1 cPanel Hosting

cPanel hosting is essentially Linux web hosting which includes the installation of cPanel. cPanel has its pros and cons, but it works pretty well in the majority of cases and makes for a sensible choice when you're looking for a control panel solution. Here's what to expect:

Pros:

- Easy to learn
- Easy to use
- Saves time and money
- Tried and tested
- Includes software auto-installers
- Plenty of tutorials/support available online

Cons:

- Number of features can be overwhelming
- Relatively easy to accidentally change important settings
- Some hosts run outdated software
- Can cost more and is rarely offered with free hosting

6.2 Alternative to cPanel

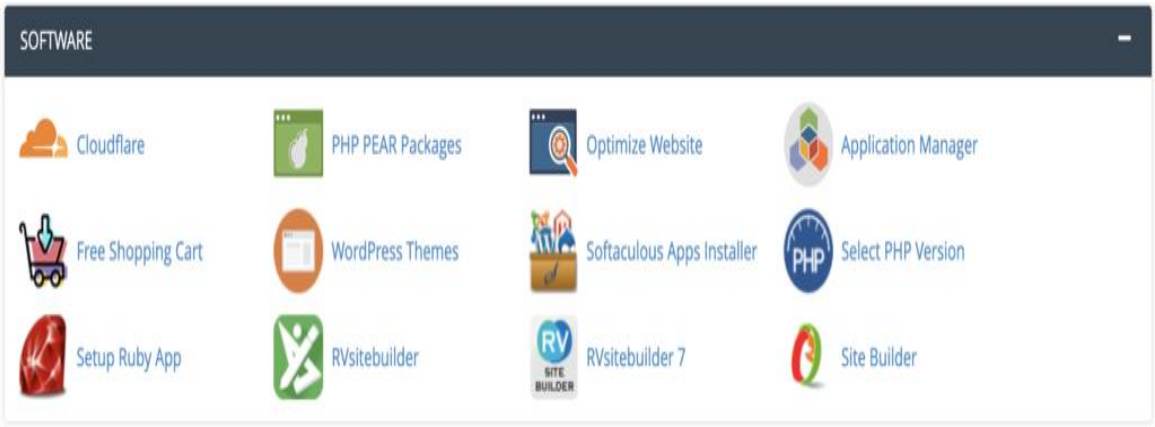
Write a few lines about this subsection There are thousands of alternatives to cPanel out there, and because every hosting provider is different, you'll need to check with each potential host to get an idea of what control panel solutions they're using.

Here at Hostinger, we have developed our own **custom control panel**, which is available with all **web hosting plans**. It shares a few similarities with cPanel and allows us to be more flexible while adjusting to the needs of our users.

Premium and Business plans include a free domain name, along with plenty of other features, providing you with all the ingredients to publish a website on the Internet with a single purchase.

Ultimately, it doesn't really matter whether you use cPanel or an alternative, as long as you're able to accomplish what you want. If you need your control panel to do something specific, then double-check with the provider.

6.3 cPanel software



These modules are largely about PHP and Perl and aren't necessarily needed unless you're a more advanced user. Common modules include:

- Softaculpis Apps Installer
- Optimize Website
- Free Shopping Cart
- Setup Ruby App
- RVsitebuilder
- WordPress Themes
- PHP PEAR Packages

- Cloud flare
- PHP Version Selector
- Application Manager

6.3 Programing

```
#include <TinyGPS.h>
#include "LiquidCrystal.h" //lcd
libary #include <SoftwareSerial.h>
SoftwareSerial SIM900(7, 8);
LiquidCrystal lcd(2, 3, 4, 5, 6, 7); //LCD object Parameters: (rs, enable, d4, d5, d6, d7)
//const int trigPin = 12; //trig pin connection
//const int echoPin = 13; //echopin
connection int Motor1 = 10;
//int Motor2 =
9; int led =
13;
 int val
  =50; int
  sw1=12
  ; int
  sw2=11
  ; int
  sw3=9;
//long duration;
//int distanceCm;
//float liquid;
int value = 0;    // Variable for reading pushbutton
status TinyGPS gps;
```

```
void setup()
{
  Serial.begin(9
  600);
  lcd.begin(16,2
  );
//pinMode(trigPin, OUTPUT);
//pinMode(echoPin,
INPUT);
pinMode(Motor1,
OUTPUT);
//pinMode(Motor2,
OUTPUT); pinMode(led,
OUTPUT); pinMode(sw1,
INPUT);
pinMode(sw2,
INPUT);
pinMode(sw3,
INPUT);
lcd.setCursor(0,0);
lcd.print(" Anti
theft");
lcd.setCursor(0,1);
lcd.print(" vehicle
"); delay(20);
lcd.clear();
digitalWrite(sw1,
HIGH);
digitalWrite(sw2,
HIGH);
```

```
digitalWrite(sw3,
HIGH);
}
void loop()
{
if(!digitalRead(sw1))                // checking if reset button is pressed or not
   {
   //Serial.println("HIGH flux"); lcd.clear(); lcd.setCursor(0,0); lcd.print("vehicle in ");
   lcd.setCursor(0,1); lcd.print("driver mode"); delay(200);

  while(1)
  {
  if(!digitalRead(sw3))              // checking if reset button is pressed or not
   {
    MotorAntiClockwise();
    lcd.clear();
   lcd.setCursor(0,
   0);
   lcd.print("vehicl
   e ");
   lcd.setCursor(0,
   1);
   lcd.print("starte
   d"); delay(200);
   MotorStop();
   break;
   }
   }
   }
  if(!digitalRead(sw2))              // checking if reset button is pressed or not
   {
    digitalWrite(led,HIGH)
```

```
; lcd.clear();
lcd.setCursor(0,0);
lcd.print("vehicle in ");
lcd.setCursor(0,1);
lcd.print("nondriver
mode");
digitalWrite(led,LOW);
delay(200);
 while(1)
{
if(!digitalRead(sw3))              // checking if reset button is pressed or not
 {
  lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("vehicle ");
 lcd.setCursor(0,1);
 lcd.print("theft");
 delay(200);
  MotorStop();
      Serial.begin(9
      600);
                  SIM900.begin(9600);
                   bool newData =
                   false; unsigned
                   long chars;
                   unsigned short sentences, failed;

                   // For one second we parse GPS data and report some key
                   values for (unsigned long start = millis(); millis() - start <
                   1000;)
```

```
{
    while (Serial.available())
    {
        char c = Serial.read();
        //Serial.print(
        c); if
        (gps.encode(
        c)) newData
        = true;
    }
}

if (newData)   //If newData is true
{
        float flat, flon;
        unsigned long
        age;
        gps.f_get_position(&flat, &flon,
        &age);
        SIM900.print("AT+CMGF=1\r")
        ;
        delay(40);
       SIM900.println("AT + CMGS = \"+919845529179\"");//
recipient's mobile number with country code
        delay(30);
        SIM900.print("Latitud
        e = ");
        SIM900.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ?
        0.0 : flat, 6);
        SIM900.print(" Longitude = ");
        SIM900.print(flon == TinyGPS::GPS_INVALID_F_ANGLE
```

```
                    ? 0.0 : flon, 6); delay(20);
                    SIM900.println((char)26); // End AT command with a ^Z,
                    ASCII code 26 delay(20);
                    SIM900.println();


                  }

                  Serial.println(failed);
                 // if (chars == 0)
                  // Serial.println("** No characters received from GPS: check
                   wiring **"); MotorStop();
  break;
 }
 }
 }
  if(!digitalRead(sw3))              // checking if reset button is pressed or not
 {
 MotorAntiClockwise
  (); lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("vehicle
  theft ");
  lcd.setCursor(0,1);
  lcd.print("stop");
  delay(2000);
digitalWrite(led,LO
W);
analogWrite(Motor1,
val); MotorStop();
```

```
  Serial.begin(9600);
    }
}



void MotorAntiClockwise()
{
   digitalWrite(Motor1, HIGH);
// digitalWrite(Motor2, LOW);
}

void MotorClockwise()
{
   digitalWrite(Motor1, LOW);
  // digitalWrite(Motor2, HIGH);
}

void MotorStop()
{
   digitalWrite(Motor1, LOW);
  // digitalWrite(Motor2, HIGH);
}
```

Chapter 7

RESULTS AND DISCUSSION

In this system before using the Haar − Cascade classifier was applied as face detection and PCA for face recognition. Therefore, the parameters used in our system are as follows:

– Scale increase rate: this parameter aims to balance between the number of the pass between the Haar detector and the accuracy. If the sitting is high, then the detector run fast with missing faces. Thus, the parameter value should be 1.2 out of these values 1.1, 1.2, 1.3, and 1.4, which lead to run a moderate number of passes to present better accuracy.

– Minimum neighbors threshold: the target of this parameter is to find the minimum-neighbors threshold which leads to decide for discarding or keeping the group of the rectangle as a face or not. Since the parameter range values from 0 to 10. In this work, we choose the minimum neighbors, which have the highest probability to be identified as a "face".

– Minimum detection scale: the next parameter is to find the smallest size of the face by changing the Haar cascade classifier values in XML file. To get the best results we set this value to 25 × 25 in our experiments. But we need to assure that the ratio of width to height should be the same as the default.

– Threshold: the maximum value between the testing images values and training images values evaluated by Euclidean distance function is called Threshold. At different values of threshold all experiments were done by 5 authorized drivers; 100 times without glasses and 100 times with glasses. Also, the system evaluated by 5 unauthorized person 100 time. From our experiments, recognition rate increased by using trial and error of the threshold value which is taken using Θnew = 0.8*Θold of the maximum value of minimum Euclidian distances of each image from other images see subsection

7.1 Implementation results and security analysis

Figure 10: Some samples of ORL database

The proposed VSS − IoT is evaluated on two face datasets which are ORL dataset [22] as shown in Figure 10 and our dataset which were collected from 10 vehicles, each vehicle has 5 authorized drivers. Whereas, for each authorized driver, our system will gather 10 images to be trained as eigenfaces. Then every authorized driver was tested; 100 times without glasses and 100 times with glass. Also, for every vehicle, we test on 5 unauthorized person where everyone was tested 100 times. All experiments have been performed using Intel Core i7, 4 GHz processor with 4 GB of RAM. The experiments have been implemented using python language environment with firebase database and Raspberry Pi 3 Model B+ micro-controller and java language using some sensors.

7.1.1 Performance measurements

The recognition effectiveness of the proposed $VSS-IoT$ is measured in terms of accuracy, sensitivity, specificity and precision are calculated based on the values of (TP), (TN), (FP), and (FN) as shown in equations 8, 9, 10 and 11 respectively. While equation 12 show that how equations 9 and 10 are effected on the accuracy in the way that they are multiplied in equations 13 and 14.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (8)$$

$$Sensitivity = \frac{TP}{TP + FN} \quad (9)$$

$$Specificity = \frac{TN}{TN + FP} \quad (10)$$

$$Precision = \frac{TP}{TP + FP} \quad (11)$$

$$Accuracy = Prevalence \times Sensitivity + (1 - Prevalence) + Specificity \quad (12)$$

Where,

$$Prevalence = \frac{Positive}{Positive + Negative} \quad (13)$$

$$1 - Prevalence = \frac{Negative}{Positive + Negative} \quad (14)$$

Where,

- True negatives (TN): shows the number of normal events is successfully labeled as normal.
- False positives (FP): refer to the number of normal events being predicted as abnormal.

- False negatives (FN): Represent the number of abnormal events is incorrectly predicted as normal.
- True positives (TP): refer to the number of abnormal events is correctly predicted as abnormal. Prevalence: is the number of positive samples to all samples. 1-Prevalence: pretend to the number of negative samples to all samples.

5.2 Prototype Results

The prototype is successfully designed and tested. The objectives of the project are satisfactorily realized. Following are the major results obtained. An advanced system is designed the protection of vehicles from theft and other hostile conditions becomes important due to insecure environment.

1. One level of ensuring authentication of driving is through finger print recognition system that authenticates a user being an authorized person to have access to the ignition system.

2. Real time vehicle security system based on computer vision provides a solution to this problem. The proposed vehicle security system performs image processing based real time user authentication using face detection and recognition techniques and microprocessor based control system fixed on board with the vehicle.

3. Automatic locking of vehicles on the alcohol detection

7.2 Result and discussion

The program for face detection is coded using python language. This program is run in the Raspberry Pi . The image of the person is captured immediately by the USB CAM. This is then croped to obtain the face. This face detection procedure is depicted in the figure (fig. 4)shown below in which the face is croped by the square generated by the Haar Cascade Classifier. This detected image is then compared with the predefined images of the owner stored in the database. The minimum euclidean distance exceeds the threshold ‘th’ an MMS and SMS is sent to the owner’s mobile and the ignition valve is ceased according to the SMS received from the owner in response to the MMS.

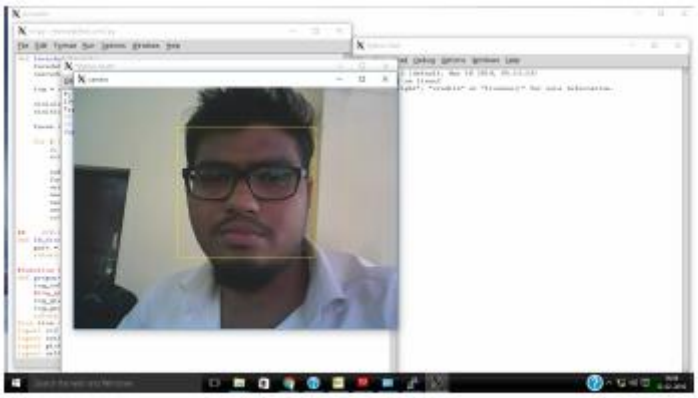


Fig. 4. Face Detection

If the Euclidean distance is less than the threshold, then it's an authorized access and the access is granted. The resultant value is displayed in the result window (fig. 5).

Fig. 5. Result Window

CHAPTER 8

ADVANTAGES AND APPLICATION

If an unauthorized user tries to use the car, the system scans the person's face, and checks whether face matches with the authorized face, if it does not match the system denies and the buzzer starts. In this way system helps to secure such intelligent vehicles.

8.1 Application

The “smart face recognition security based on raspberry pi” is basically based on embedded security system; the applications of this project are not limited as each application gives rise to the new applications. so it can be implement in the following area of securities; for example,

- In car security.
- In home security.
- In budgeted industries.
- In surveillance from remote place (depending on the communication network).
- In the office cabins.
- In the shopping malls, etc.

Chapter 9

CONCLUSIONS AND SCOPE FOR FUTURE WORK

Face recognition is a both challenging and important recognition technique. Among all the biometric techniques, face recognition approach possesses one great advantage, which is its user-friendliness. This paper proposes the image recognition techniques that can provide the important functions by advanced intelligent automobile security, to avoid vehicle theft and protect the use of unauthenticated users. Secured and safety environment system for automobile users and also key points for the investigators can easily find out the hijacked image. From this we can predict the theft by using this in our daily life. This system mainly helps to reduce the complexity and improve security, also much cheaper and smarter than traditional one's.

w intelligent vehicle security system called VSS − IoT using a secure, efficient, low-cost, and Low Power Processing chip with the Internet as its important part. Moreover, this paper employed a hybrid mechanism (Haar Cascade + PCA) for face detection and recognition of the captured image by a USB camera. Whereas, the Haar cascade Classifier can be used to reject the regions that unlikely to have consisted in the digital image. Also, it is used to detect the faces in the digital image by extracting the best features. While PCA is a mathematical method that expressed as a transformation of high-dimensional facial images into few-dimensional principal components called Eigen face which used to recognize faces in the digital image. According to the primary and earlier experimental results compared with other existing systems, the proposed VSS − IoT achieved the best accuracy rate 98.2% on ORL dataset, whereas 99.6% when applied on our dataset to identify the authorized and unauthorized people. Also, the VSS−IoT enhances the sensitivity to 97.7% which is important when the system work under different illumination conditions hen the value of the threshold is 3*103 and 3.50*103 . As well as, the proposed VSS−IoT enhanced the time compared with other systems which achieved 0.152 sec. Besides, the results presented that cameras pixel size 640×480 gave better memory space and CPU utilization more than others 76% and 53.5 MB respectively which is important for the real-time vehicle security systems. Therefore, due to its low-cost and high performance, it is very suitable for improving the security of the automobile sector.

7.1 Future work

This project is used to minimize the theft rate. The GPS technology is used to track the location and Wi-Fi module is used send the notification of the car door security breach and the face detection through the application. The email information is also about the security breach contains image of the burglar. This system plays a major role in theft tracking as it provides the major lead on the burglar apart from notifying the owner initially and helps to pull of the kill switch and steer lock. The monitoring system using the Raspberry Pi as well as the webcam had been completed and tested. Not only the Raspberry Pi applied as a server but also the webcam applied as a motion detection sensor.

The capturing and sending notification would be done if there was a motion. The result of the testing illustrates that the monitoring system works well. As the future scope this system can be extended further by adding additional infrared emitting system to detect the people face if they wore the mask on his/her face. By adding this additional system we can easily identify the person even though the person covered his/her face. Apart from this we can interface sensors like Gas sensors, Smoke sensors, and Fire sensors to give alerts respectively.

Additional use of security system is a keen control device, which is thermostat, whichever could be disciplined through a cyberspace. The thermostat or control device could be control the warming arrangement within the house also regulate that one towards the wanted climate. We are going to make available a wireless relay connection also wireless sensor, which can be movable as well as, can be operated and which can be used in company and appoints for Security to the whole building with one single system.

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