CHAPTER 1

INTRODUCTION

Agriculture is the Backbone of the Indian economy it will keep on playing a noteworthy part in the future years as well. The historical backdrop of Agriculture in India dates to quite a while back, today India stands second worldwide in the farm yield, and however the majority of the horticultural practices in India are very primitive and includes a massive human labour for even a lesser area of land.

Though there are advancements in the field of technology that are used to develop the agriculture, they are not being used by the farmers because of their economic status. The methods of modern farming are nit effectively introduced and hence the outcome is also not as expected to the given amount of land. By the adoption of Scientific Farming the farmer will get high yields and also it avoids them from being bankrupt. The current technologies implemented in the farming does not suit the type of the farming practiced in India and also it does not efficiently be applied to the type of the crops that are grown here. Hence the need for the specialised vehicles to di the required tasks to be carried out.

There are Vehicles that are developed to perform individual tasks such as ploughing and sowing and other farming tasks. There has no such vehicle that does a combined task of the agriculture as a complete package to do all the required tasks that are otherwise had to be done by human labour which isn’t extremely precise. So our idea in this project is to impart a specialized vehicle for the purpose of agriculture which is capable of performing all the regularly required farming activities with a great precision. In our project we have designed a QUAD WHEEL vehicle which is a completely automated robot which performs the activities with the help of a remote control/mobile phone. The proposed Idea implements the vehicle to perform the farming activities such as, Water sprinkling and pest control etc. The other activities can also be added depending on the requirements of the crop that is to be grown.

In the proposed model we also have a camera that is mounted on the Bot to supervise the entire land. This Bot is also embedded with the technique of Image Processing to monitor carefully the progression of the crops. This feature also helps the farmer to know about the infiltrations that happen to the crops and can be vary of the remedies, The technique that is been implemented helps to distinguish between the healthy leaf and the infected leaf and also we provide the database to provide information to the farmer about the type of the disease it is infected with the crop and also the extent it is been affected to and it might potentially spread the disease to the neighbouring crops as well. This sure gives an insight to the farmer about the development of the crops and also he gets to know about the type of the pesticides to be used as well this feature will help the farmers enormously as it increases the yield and also the life of the crops and also effective usage of the area. The entire Bot is controlled by the Microcontroller Raspberry Pi. On the whole the idea of our project is to provide these kinds of Smart Vehicles to be implemented in the field of Agriculture for the better yields for the people.

1.1 Problem statement

In the recent days, the technology has changed tremendously. Along with improvement in technology, the human must also cope-up with updating environment. In order to diminish human work the vehicles are evolved. The main drawback which the farmers are experiencing now is lack of advance mechanization in farming. Due to manual pesticiding and watering the distance between the crops are not symmetrically maintained which in turn affects the growth of crops and wastage of area. Due to manual farming excess efforts for different process are necessary which requires more man power. Manual farming also requires excess time consumption for performing individual process.

Now, the idea is to solve this problem by developing intelligent robotic vehicle by integrating sensors and modernizing the agriculture for better result.

1.2 Possible solutions

The basic aim of the project is to build up a multipurpose machine which is utilized for water sprayer and pesticide the crops with least changes in accomplices with minimum cost. The whole system of the robot works with the battery or the solar power can be implemented in order to save the battery. Farmer can easily operate the robot through remote by sitting at one end thus reducing the man power and utilizing the technology.

1.3 Advantages

- The farmer can sit anywhere in this world and connect it through internet.
- Use of webcam reduces chances of error.
- Effective utilization of Internet of Things (IOT).
- High performance.
- Low power consumption and reduced man power.
- It uses IOT technology.

CHAPTER 2

BLOCK DIAGRAM

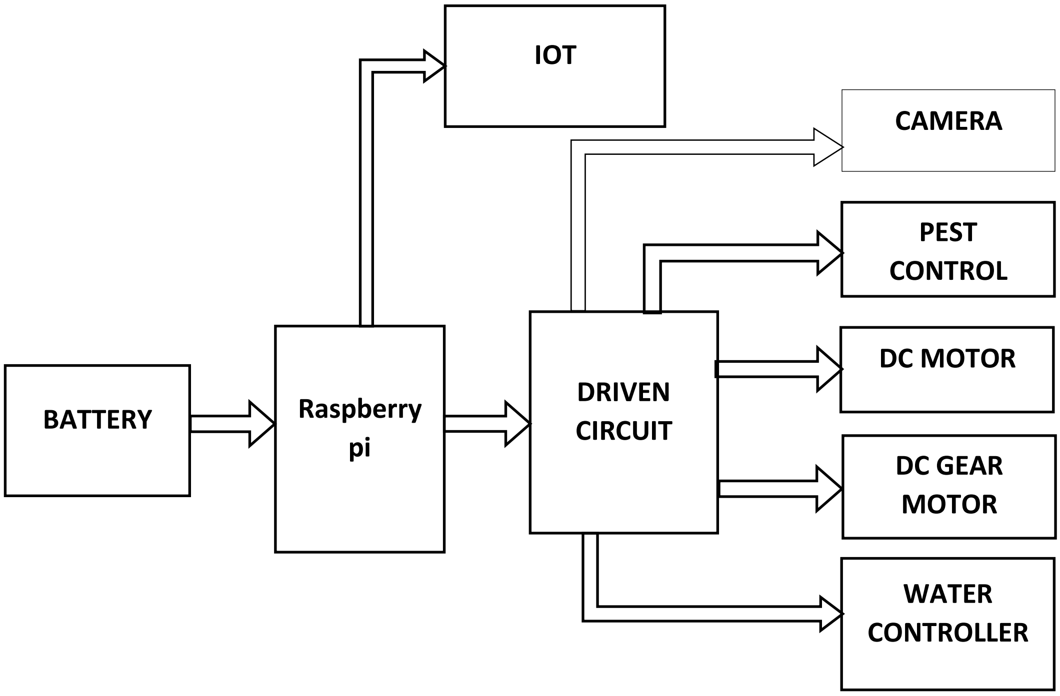


Fig 2.1: Block diagram

The block diagram of the Multi Utility Agricultural Bot is as shown in fig 2.1. The quad wheel vehicle is electrically powered by the 12V DC 7AH battery which is enough to drive the vehicle and perform the activities in the farm. The control and processing of the entire Bot is done through the Raspberry Pi which is a microcontroller. The Raspberry Pi is used as a micro-controller to control the circuitry of the Bot. The Raspberry Pi controls the pesticide and also the camera in the Bot. It will have the data and control of the components used.

- The Driver circuit used in our Bot is an 8bit relay which is used to drive the vehicle and controls the motion of the motor.
- The relay is given from the inputs of the Raspberry Pi which drives the relay and which in-turn provides the movement of the vehicle.
- The RF transceiver is used to wirelessly control the Bot as the Farmer can use the Bot effortlessly using a switch or a remote to control the entire movement of the Bot as he desires which is a prominent feature of the Bot.
- The camera used in the Bot is mainly to monitor the area where the crops are grown.
- The camera is mounted on a Pan Tilt mechanism which enables the Camera with the entire view of the Field.

- The Wiper motor that are connected to both the front wheels are used to provide the back and forth movement to the Bot.
- The IOT is used to control the bot.

CHAPTER 3

LITERATURE SURVEY

Sl.no	Title of paper with author(s)	Key feature of paper
1	**Advanced multi-tasking AGRIBOT a friend of farmer:** Prasun Shrivastava, Akash Singh, Kushagra Pratap Singh, Amritanshu Shrivastava	The branch of robotics is a bare root of advancement and in today technology we are able to out our thoughts in working condition. A combination of technologies can be tied up together for making more advanced system. The farmer bot can be easily customized as per requirement.
2	**Image processing in precision agriculture:** D. Pokrajac, A. Lazarevic, S. Vucetic, T. Fiez, Z. Obradovic	A brief review of our signal and image processing application in precision agriculture is presented. A method for determining sampling frequency for agriculture data is proposed and some initial results based on data simulation and image processing is reported.
3	**Solar E-bot for Agriculture:** P. Jothimurgan, J. Muthu Saravanan, R. Sushanth, V. Suresh, H. Siva Subramaniam, S. Vasanthraj, S. Yogeswaran	Solar powered e-bot for agriculture means simple eco-friendly agricultural robot. E-bot is a robot which runs on solar energy. The robot has been operated by Manual control and also be used as automated machine at low cost. The manual control of the robot

		is achieved by Wireless Remote (RF type) which can be used for long range up to 15metres and the path of the robot is transmitted lively using wireless camera.
4	**Agriculture robotic vehicle based pesticide sprayer with efficiency optimization:** Aishwarya B.V, Archana. G, C. Umayal	Robotics can be applied to various fields of agriculture. It is very important to improve the efficiency and productivity of agriculture by replacing labourers with intelligent machines like robots using latest technologies. A new strategy to replace humans in various agricultural operations like detection of presence of pests, spraying of pesticides, spraying of fertilizers, thereby providing safety to the farmers and precision agriculture
5	**Software and hardware architectures for agricultural disease detection:**	Disease detection tasks are conducted by human scouts. This qualitative approach is susceptible to error and relies on the visibility of symptoms which are visible only after the disease has progressed. Precision agriculture is a thriving new discipline that integrates new autonomous technology with agronomy.

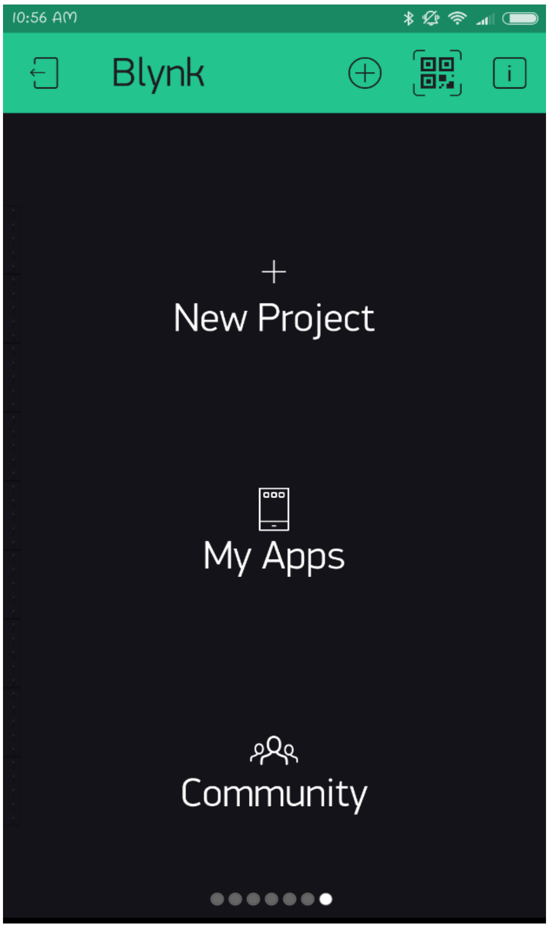
CHAPTER 4

SOFTWARE REQUIREMENT SPECIFICATIONS

4.1 Software

4.1.1 Blynk

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.



1. Blynk App

Blynk application can be found from the following links -

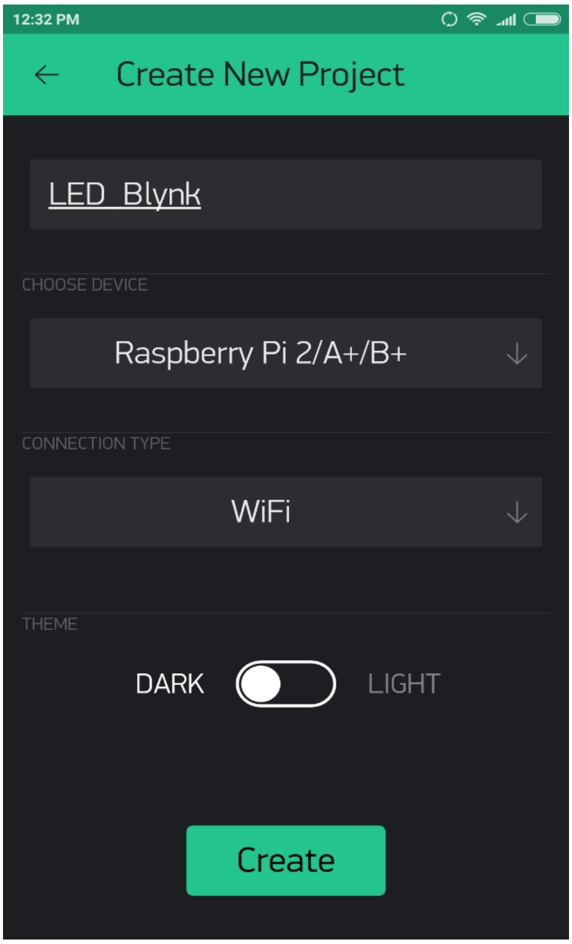
1. Android Blynk App

2. IOS Blynk App

After downloading the app, create an account and log in. (If possible than log in with your real mail id for better connectivity later.)

2. Create a Blynk Project

Click the “Create New Project” in the app to create a new Blynk app. Give it any name. Blynk works with hundreds of hardware models and connection types. Select the Hardware type. After this, select connection type. In this project we have select WiFi connectivity.



The ***Auth Token*** is very important – you’ll need to stick it into your Raspberry’s firmware. For now, copy it down or use the “E-mail” button to send it to yourself.

3. Add Widgets to the Project

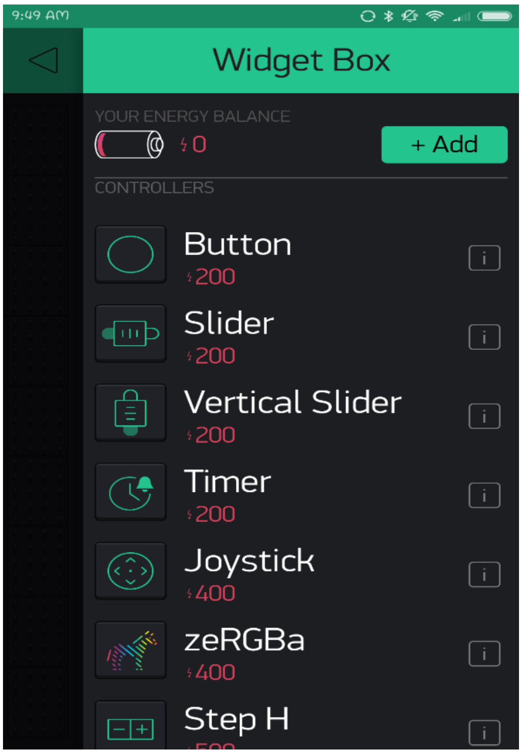
Then you’ll be presented with a blank new project. To open the widget box, click in the project window to open.

We are selecting a button to control Led connected with Raspberry Pi.

1. Click on Button.
2. Give name to Button say LED_Blynk.
3. Under OUTPUT tab- Click pin and select the pin to which led is connected to Raspberry Pi, here it is digital pin 25, hence select digital and under pin GP25. And Click continue.

Under MODE tab- Select whether you want this button as "push button" or "Switch".

You have successfully created a GUI for Raspberry Pi.


9:49 AM
Widget Box
YOUR ENERGY BALANCE
0
+ Add
CONTROLLERS
Button
200
Slider
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Vertical Slider
200
Timer
200
Joystick
400
zeRGBa
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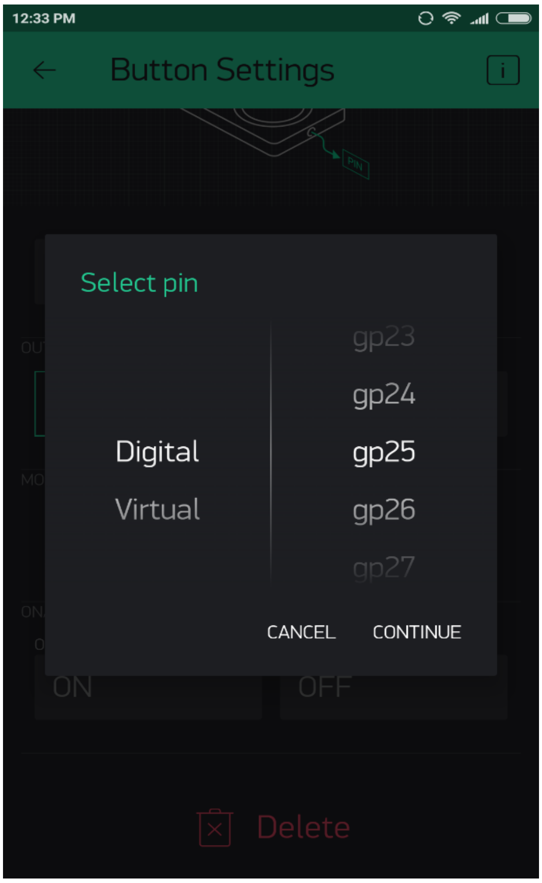
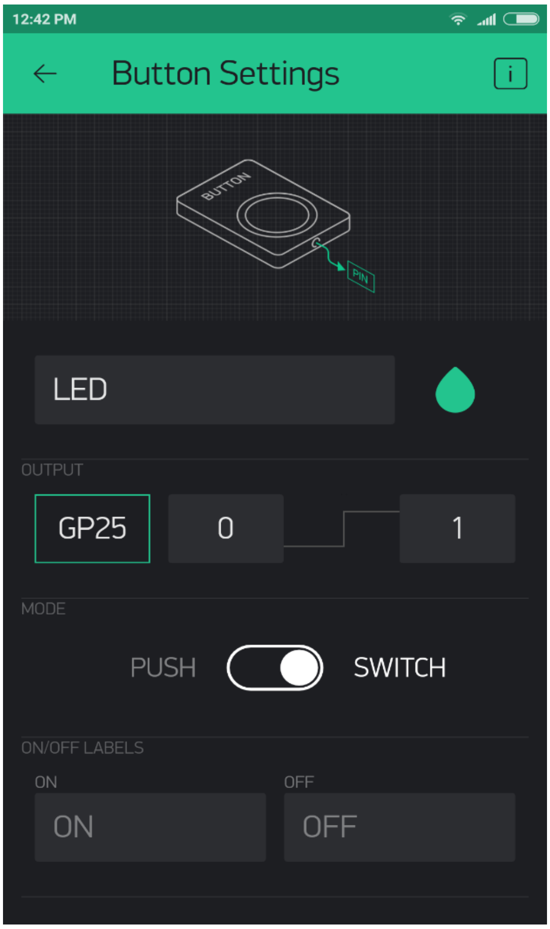
Step H


12:33 PM
Button Settings
Select pin
Digital
Virtual
gp23
gp24
gp25
gp26
gp27
CANCEL
CONTINUE
ON
OFF
Delete



4. Connecting with Raspberry Pi

1 .Open the command window and write:

$ sudo apt-get update

2. To make sure your Pi is up to date with the latest versions of Raspbian:

If you do not have GIT installed, you can install it with:

$ sudo apt-get install git-core

3 .To obtain WiringPi using GIT (WiringPi is maintained under GIT for ease of change tracking,):

$ git clone git://git.drogon.net/wiringPi

4. After that write:

cd wiringPi

./bulid

cd

Git clone https://github.com/blynkkk/blynk-library

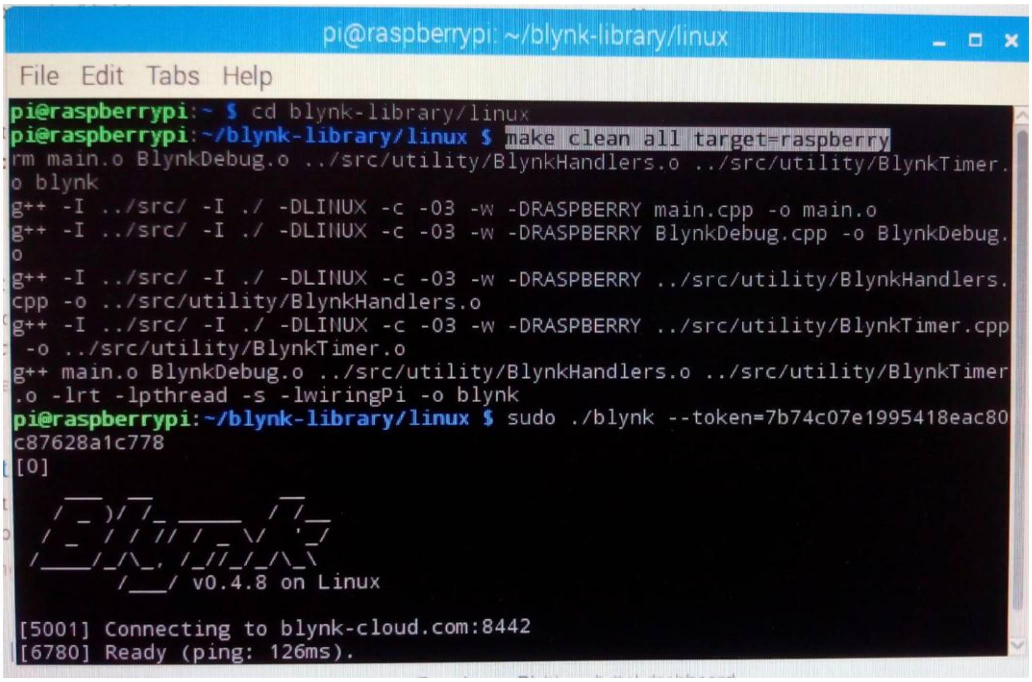
cd blynk-library/linux

Make clean all target=raspberry

Sudo ./blynk --token=token num

5. Execution

After doing this, Raspberry pi is connected with your Blynk project. Press the button on Blynk app and watch the LED.



Then click the “Run” button in the top right corner of the Blynk app. Press the button and watch the LED

Then add more widgets to the project. They should immediately work, without uploading any new firmware.

4.2 Hardware Components

4.2.1 Motor

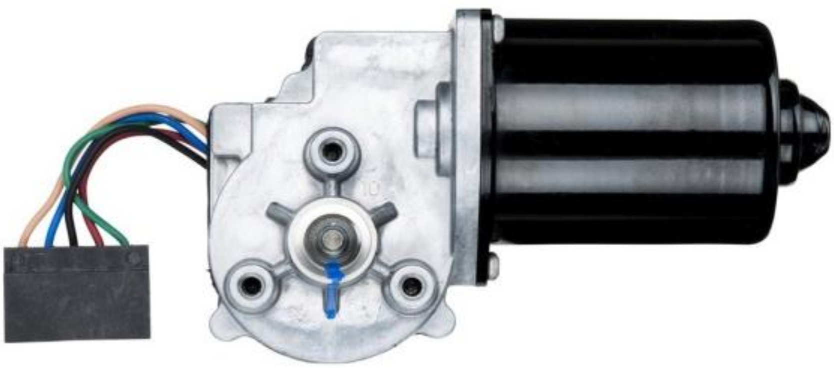


Fig 4.2.1: Wiper motor

Description:

It is a simple DC motor featuring metal gearbox for driving the shaft of the motor, so it is a mechanically commutated electric motor which is powered from DC supply. The Johnson Geared Motors are known for their compact size and massive torque-speed characteristic.
The Johnson Motor comes with side shaft also known as an off-centered shaft and six M3 mounting holes. The shaft of the motor equips metal bushes which makes these DC gear motors Shaft wear resistant. The shaft of the motor has a hole for better coupling.
The motor will run smoothly between the voltage range 6 to 18 V DC and give you 10 RPM at 12V supply. It provides the torque of 11.7 kg-cm at 10 RPM.
The Johnson Geared Motor gives very good torque at an affordable price hence they are widely applicable in Pan/Tilt camera, auto shutter, welding machines, water meter IC card, grill, oven, cleaning machine garbage disposers, household appliances, slot machines, money detector, automatic actuator, coffee machine, towel disposal, lighting coin refund devices, the peristaltic pump and so on.

4.2.2 DC gear motor

Fig 4.2.2: DC gear motor

Specification:

- RPM: 30 at 12V
- Voltage: 4V to 12V
- Load current: 9A
- Shaft diameter: 6mm

- Shaft length: 22mm
- Gear assembly: Spur
- Brush type: Carbon
- Motor weight: 143gm

Description:

A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower or low speed motor output. A gear motor can run on either an alternating current (AC) or direct current (DC) electric motor. Gear motors are primarily used to reduce speed in a series of gears, which in turn creates more torque. This is accomplished by an integrated series of gears or a gear box being attached to the main motor rotor and shaft via a second reduction shaft. The second shaft is then connected to the series of gears or gearbox to create what is known as a series of reduction gears.

There are two basic speed specifications for a gearbox, namely the normal speed and the stall speed. These torque specifications essentially assist in the creation of torque. This is done through a series of integrated gears attached to the main shaft and rotor mechanism. The attachment is done through a reduction shaft between the gearbox and the drive shaft.

4.2.3 Raspberry pi

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.

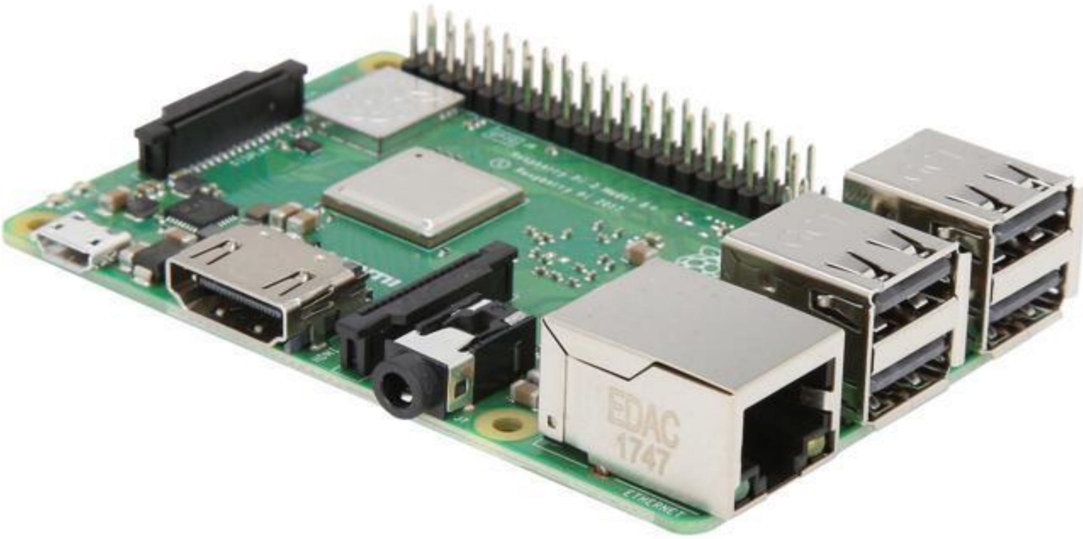


Fig 4.2.3: Raspberry Pi

4.2.4 Relay

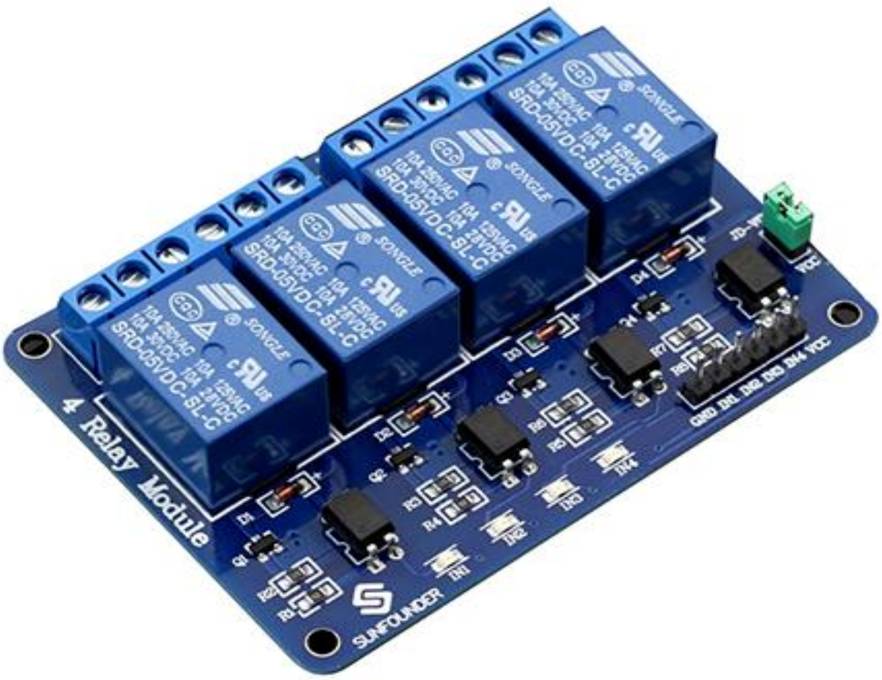


Fig 4.2.4: 4-Channel Relay

Specification:

- Drive current: 20mA
- Control signal: 5V/12V/24V TTL level
- Relay Maximum output: DC 30V/10A, AC 250V/10A.
- State: Active low

Description:

A relay is an electrically operated switch. Relays use an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core (a solenoid), an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts. The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. The armature is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open.

A LOW Level 5V 4-channel relay interface board requires a 15-20mA driver current for each channel. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller. This module is optically isolated from high voltage side for safety requirement and also prevent ground loop when interface to microcontroller. A schematic of a 4 channel relay is shown

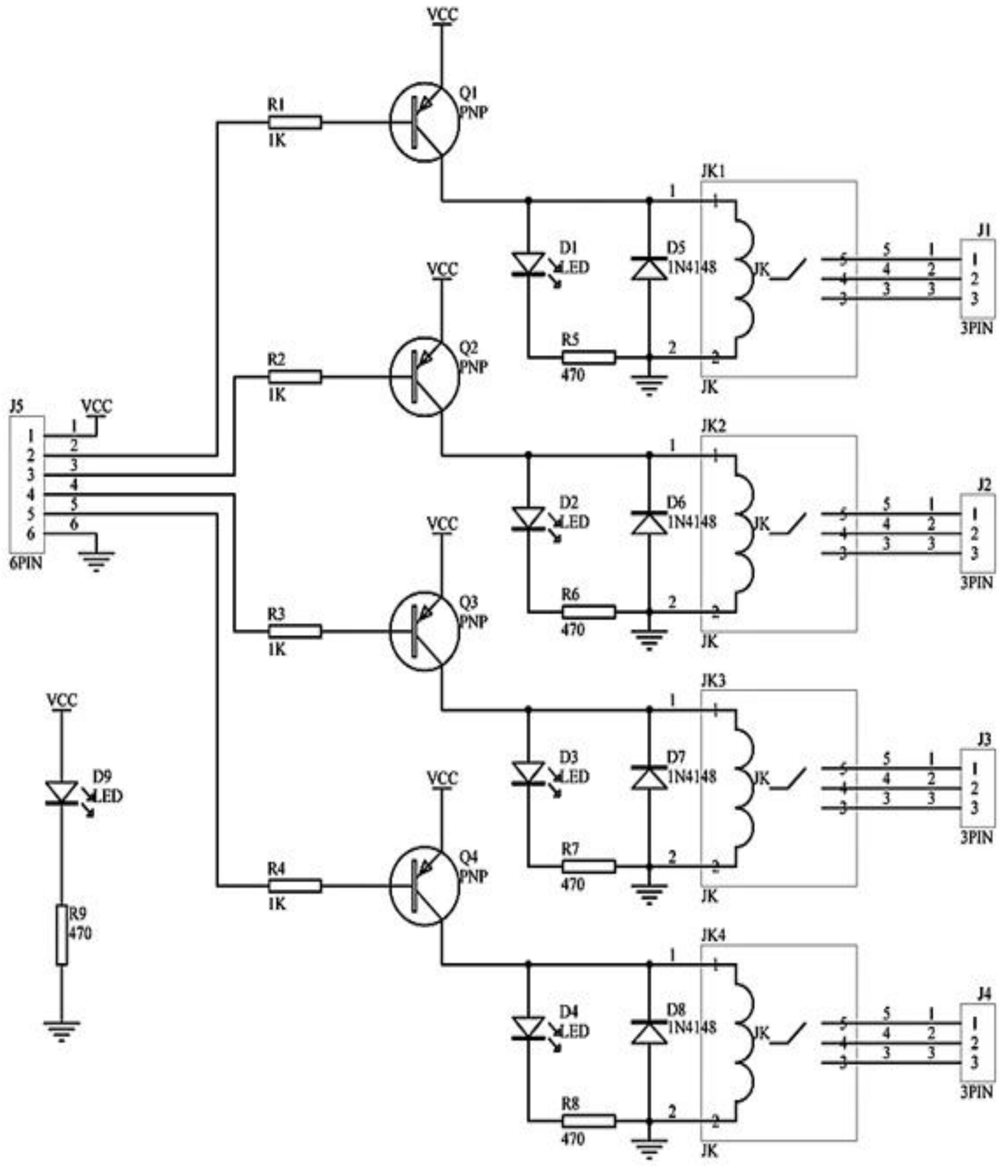


Fig 4.2.5: 4 channel relay module schematic

The module layout of a 4 channel relay is as shown

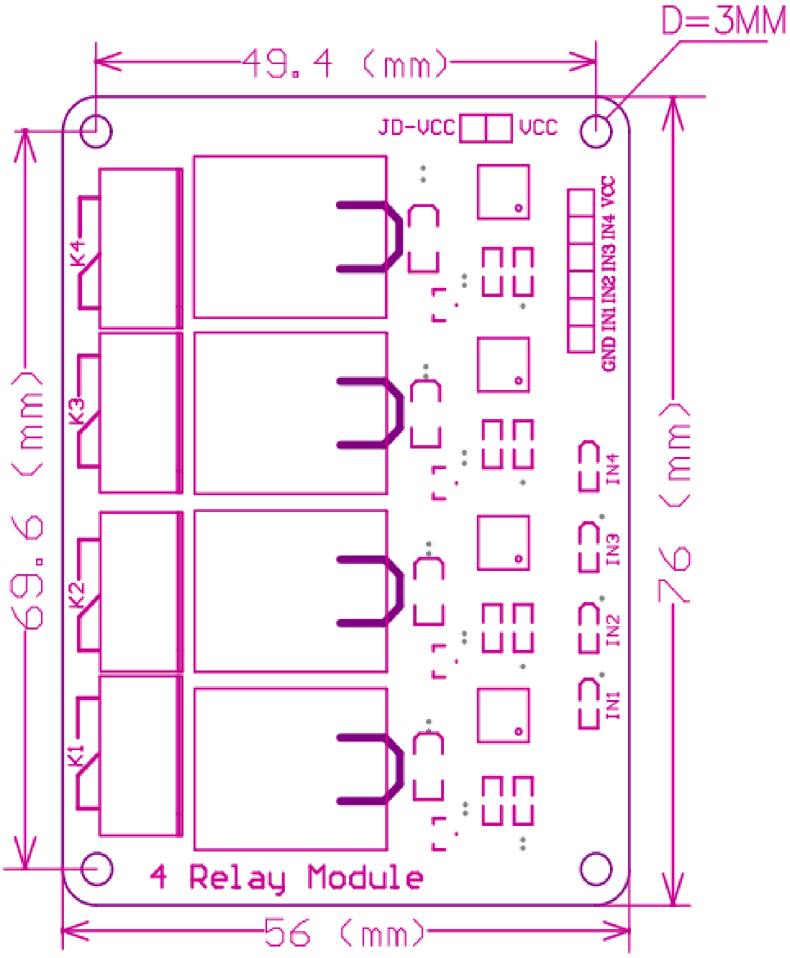


Fig 4.2.6: 4 channel relay module layout

4.2.5 Ultrasonic sensor

Fig 4.2.7: Ultrasonic sensor

Specification:

- Operating voltage: +5V
- Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

Description:

Ultrasonic sensor is a device which is used to measure the distance of the object. HC-SR04 Ultrasonic sensor is a 4 pin module, whose pin names are V_{CC}, Trigger, Echo and Ground respectively. This sensor is used in many applications where measuring distance or sensing objects are required. The module has two eyes like projection in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor, this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor

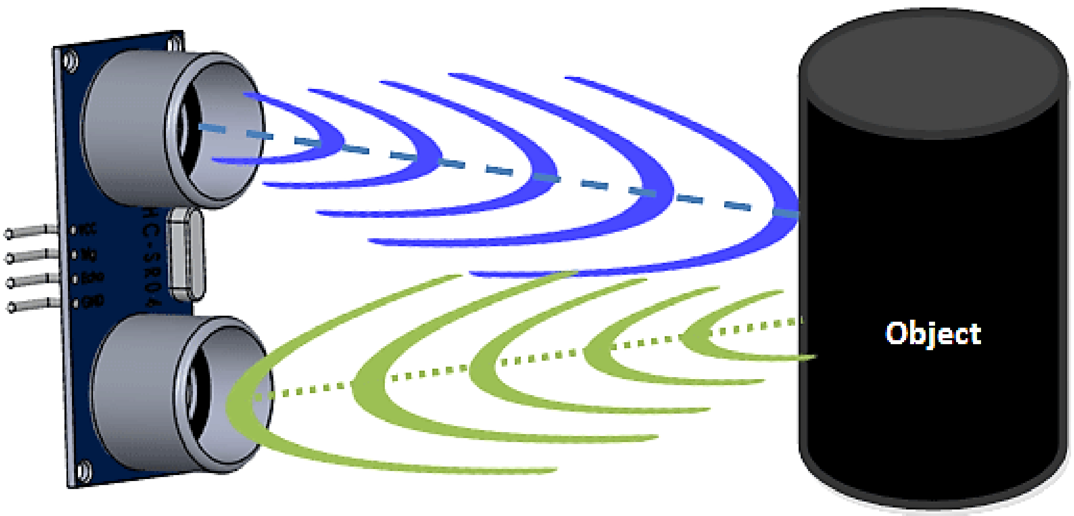


Fig 4.2.8: Operation of an Ultrasonic sensor

platforms like Arduino, ARM, PIC, Raspberry Pie etc. The Sensor is powered using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins. The

Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor. The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured.

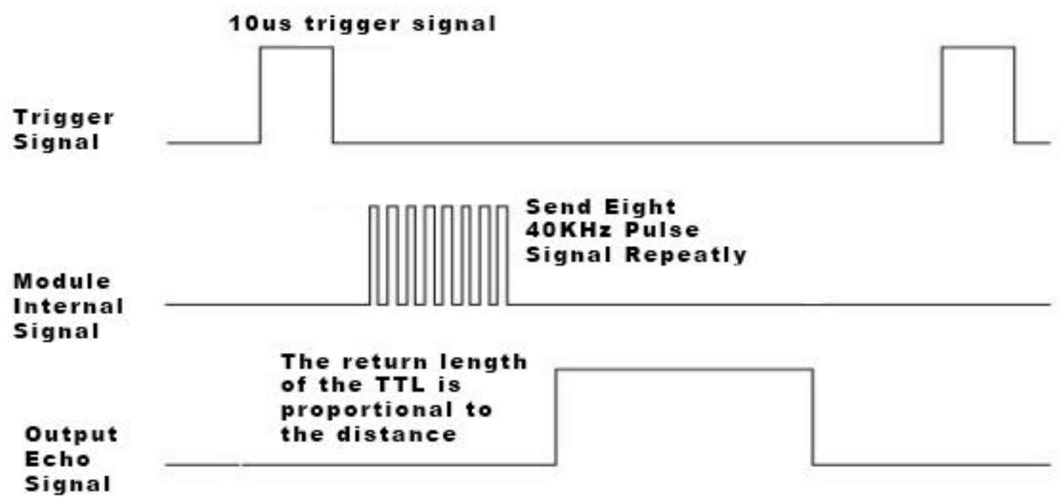


Fig 4.2.9: Timing diagram of ultrasonic sensor

A trigger signal of 10µs has to be provided. The module internally has a 40 KHz pulse signal. Once the echo signal is detected its distance is measured. The pulse width of the echo signal is proportional to the measured distance. The output measured in the receiver can be viewed in the Arduino IDE software and appears as shown below

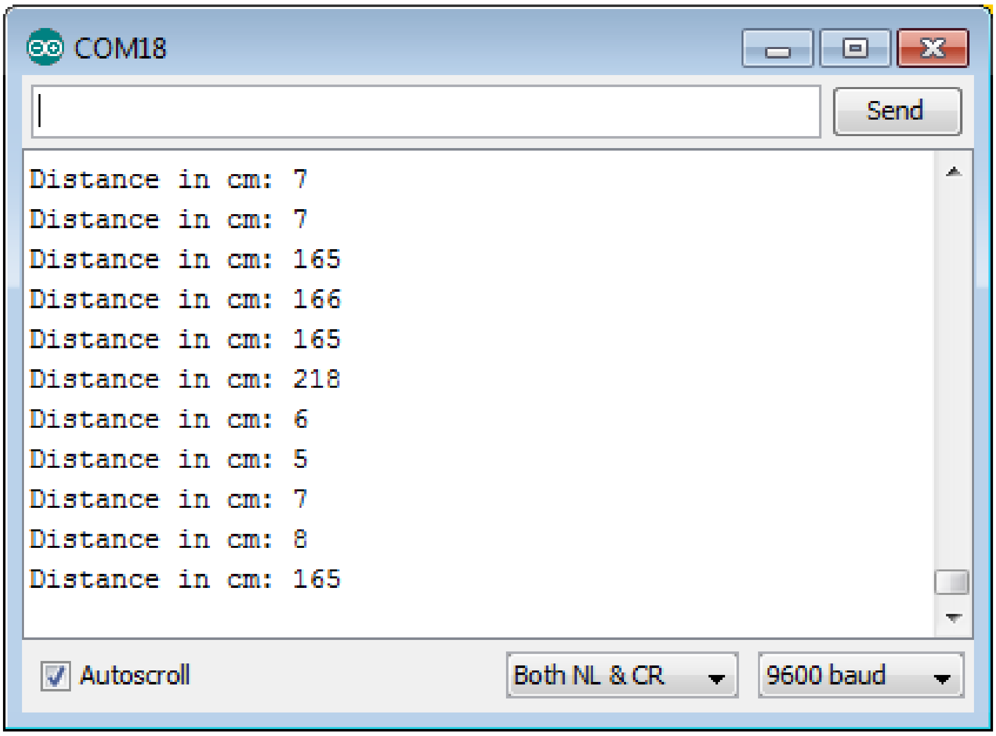


Fig 4.2.10: Output result of ultrasonic sensor

The pin configuration for an ultrasonic sensor is as shown

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system

Table 1: Pin configuration of ultrasonic sensor

The ultrasonic sensor is connected to a ranging detector module as shown in the fig 4.2.11.

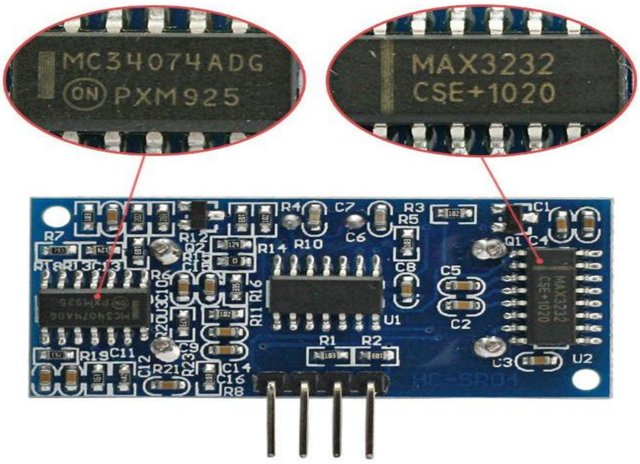


Fig 4.2.11: Ultrasonic ranging module

The module is connected in the rear end of ultrasonic sensor. The circuit consist of LED's which blinks when the obstacle is detected from the sensor. It consists of two internal IC's MC34074ADG and MAX3232 which performs the major operation.

The MC34074ADG is a monolithic quad Operational Amplifier offers 4.5MHz of gain bandwidth product, 13V/µs slew rate and fast settling time without the use of JFET device technology. With a Darlington input stage, this series exhibits high input resistance, low input offset voltage and high gain. The all NPN output stage, characterized by no dead-band crossover distortion and large output voltage swing, provides high capacitance drive capability, excellent phase and gain margins, low open loop high frequency output impedance and symmetrical source/sink AC frequency response.

The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±15-kV ESD protection terminal to terminal (serial-port connection terminals, including GND). The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The devices operate at data signalling rates up to 250kb/s and a maximum of 30-V/µs driver output slew rate.

The ultrasonic sensor is also connected with a 12V Piezo buzzer which creates sound when an obstacle is detected. The buzzer has a pitch of 7.6mm and is as shown in Fig 4.2.12

Fig 4.2.12: 12V piezo buzzer

4.2.6 Dry battery

Fig 4.2.13: 12V rechargeable battery

<u>Specification:</u>

- Voltage: 12V
- Power: 7 Ah
- Number of cells: 6
- Maximum charging current: 1.75 AMPS

<u>Description:</u>

Dry cell batteries are batteries that use an extremely low-moisture electrolyte. They are contrasted by wet cell batteries such as lead-acid batteries, which use a liquid electrolyte. The electrolyte that is used in most dry cell batteries is a sort of paste which, though containing moisture, is still relatively dry.

Dry cell batteries create electrical energy by converting chemical energy into electricity. The exact means of doing so depends on the type of dry cell battery in question, but the materials that are used are generally zinc and carbon or zinc and manganese dioxide. These materials are placed within the electrolyte paste within the battery. They react with each other through a chemical process in which the electrolyte (carbon or manganese dioxide) reacts with the zinc, creating electricity. This is transmitted out of the battery using positive and negative electrodes. The inner view of a battery is as shown:

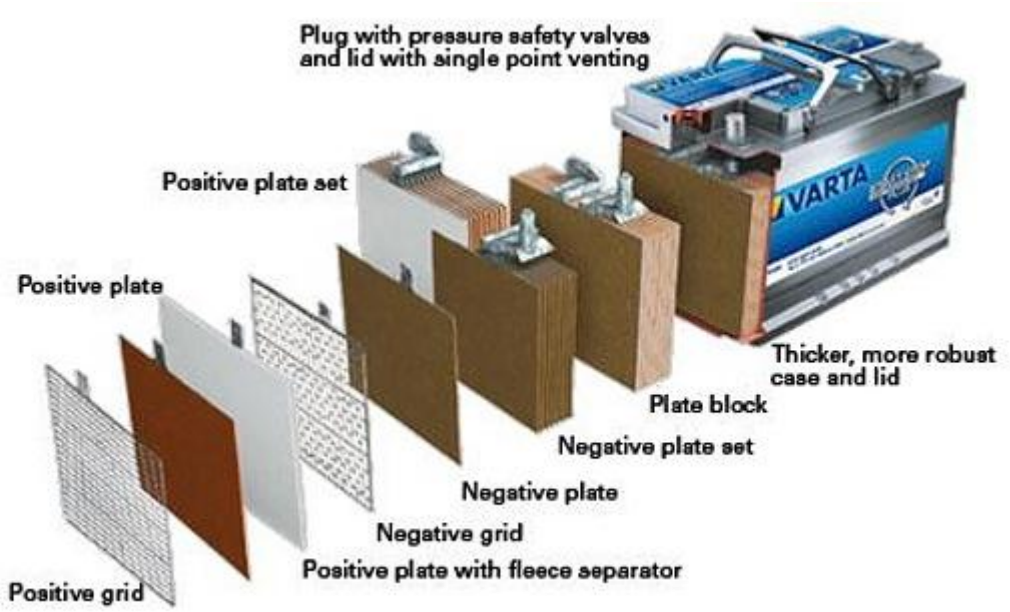


Fig 4.2.14: Inner view of a battery

The various parts of the lead acid battery are shown below. The container and the plates are the main part of the lead acid battery. The container stores chemical energy which is converted into electrical energy by the help of the plates.

1. Container – The container of the lead acid battery is made of glass, lead lined wood, ebonite, the hard rubber of bituminous compound, ceramic materials or moulded plastics and are seated at the top to avoid the discharge of electrolyte. At the bottom of the container, there are four ribs, on two of them rest the positive plate and the others support the negative plates. The prism serves as the support for the plates and at the same time protect them from a short circuit. The material of which the battery containers are made should be resistant to sulphuric acid, should not deform or porous, or contain impurities which damage the electrolyte.

2. Plate – The plate of the lead-acid cell is of diverse design and they all consist of some form of a grid which is made up of lead and the active material. The grid is essential for conducting the electric current and for distributing the current equally on the active material. If the current is not uniformly distributed, then the active material will loosen and fall out.

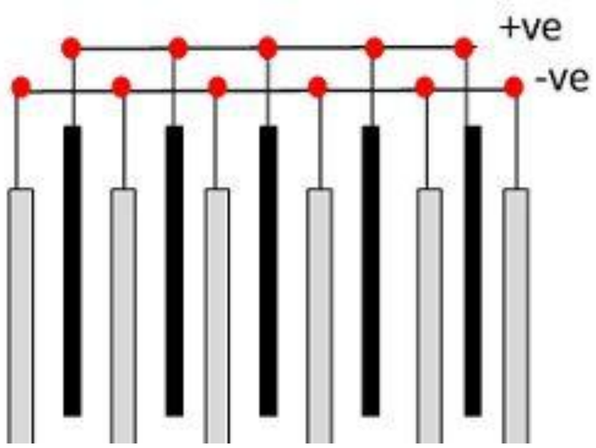


Fig 4.2.15: Arrangements of plates in Lead-acid battery

The grids are made up of an alloy of lead and antimony. These are usually made with the transverse rib that crosses the places at a right angle or diagonally. The grid for the positive and negative plates are of the same design, but the grids for the negative plates are made lighter because they are not as essential for the uniform conduction of the current. The plates of the battery are of two types. They are the formed plates and pasted plates.

Plante's plates: They are used largely for stationary batteries as these are heavier in weight and more costly than the pasted plates. But the plates are more durable and less liable to lose active material by rapid charging and discharging. The plante's plate has low capacity weight-ratio.

Faure process: It is much suitable for manufacturing of negative plates rather than positive plates. The negative active material is quite tough, and it undergoes a comparatively low change from charging and discharging.

3. Active Material – The material in a cell which takes active participation in a chemical reaction (absorption or evolution of electrical energy) during charging or discharging is called the active material of the cell. The active elements of the lead acid are

a. **Lead peroxide (PbO_2)** – It forms the positive active material. The $PbO_2$are dark chocolate broom in colour.

b. **Sponge lead** – Its form the negative active material. It is grey in colour.

c. **Dilute Sulphuric Acid (H_2SO_4)** – It is used as an electrolyte. It contains 31% of sulphuric acid.

The lead peroxide and sponge lead, which form the negative and positive active materials have the little mechanical strength and therefore can be used alone.

4. Separators – The separators are thin sheets of non-conducting material which are made up of chemically treated lead wood, porous rubbers, or mats of glass fibre and are placed between the positive and negative to insulate them from each other. Separators are grooved vertically on one side and are smooth on the other side.

5. Battery Terminals – A battery has two terminals the positive and the negative. The positive terminal with a diameter of 17.5 mm at the top is slightly larger than the negative terminal which is 16 mm in diameter.

4.2.6.1 Working principle:

When the sulphuric acid dissolves, its molecules break up into positive hydrogen ions ($2H^+$) and sulphate negative ions (SO_4^{--}) and move freely.

If the two electrodes are immersed in solutions and connected to DC supply then the hydrogen ions being positively charged and moved towards the electrodes and connected to the negative terminal of the supply. The SO_4^{--} ions being negatively charged moved towards the electrodes connected to the positive terminal of the supply main (i.e., anode).

Each hydrogen ion takes one electron from the cathode, and each sulphates ions takes the two negative ions from the anodes and react with water and form sulphuric and hydrogen acid

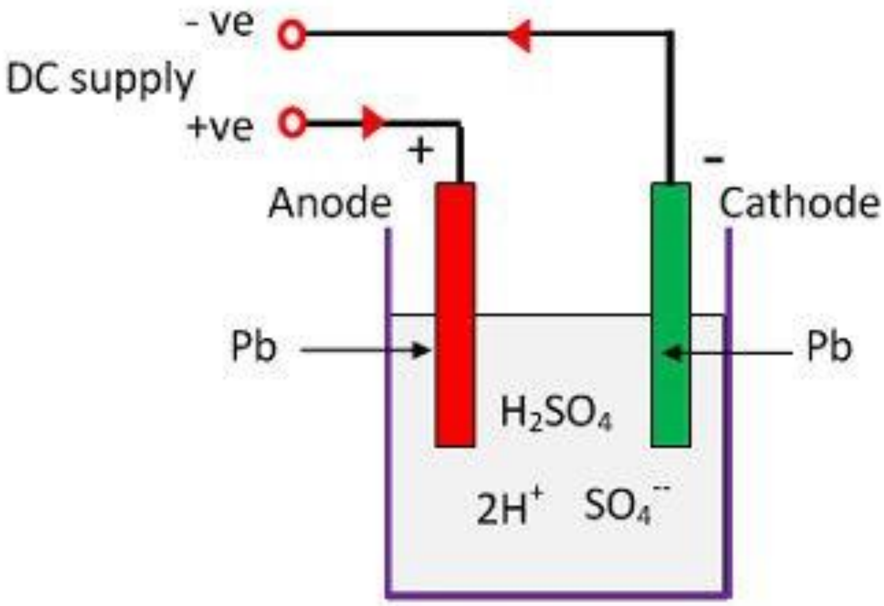


Fig 4.2.16: Chemical reactions of a battery

The oxygen, which produced from the above equation react with lead oxide and form lead peroxide (PbO_2.) Thus, during charging the lead cathode remain as lead, but lead anode gets converted into lead peroxide, chocolate in colour. If the DC source of supply is disconnected and if the voltmeter connects between the electrodes, it will show the potential difference between them. If wire connects the electrodes, then current will flow from the positive plate to the negative plate through external circuit i.e. the cell is capable of supplying electrical energy.

4.2.6.2 Working principle during discharging:

When the cell is full discharge, then the anode is of lead peroxide (PbO_2) and a cathode is of metallic sponge lead (Pb). When the electrodes are connected through a resistance the cell discharges and electrons flows in a direction opposite to that during charging. The hydrogen ions move to the anode and reaching the anodes receive one electron from the anode and become hydrogen atom. The hydrogen atom comes in contacts with a PbO_2, so it attacks and forms lead sulphate ($PbSO_4$), whitish in colour and water according to the chemical equation.

$$PbSO_4 + 2H_2O + 2H = PbSO_4 + 2H_2SO_4$$

$$PbSO_4 + 2H = H_2SO_4 + Pb$$

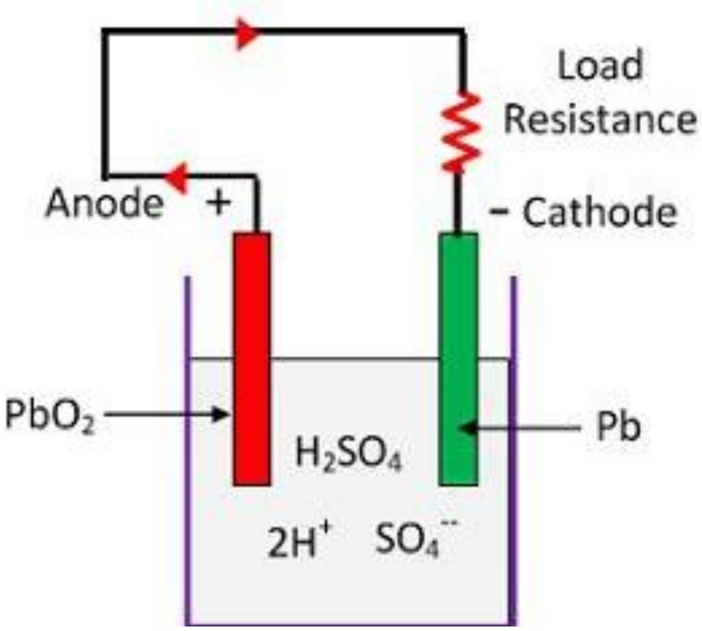


Fig 4.2.17: Discharging of a battery

The each sulphate ion (SO_4^{--}) moves towards the cathode and reaching there gives up two electrons becomes radical SO_4, attack the metallic lead cathode and form lead sulphate whitish in colour according to the chemical equation.

4.2.6.3 Working principle during recharging:

For recharging, the anode and cathode are connected to the positive and the negative terminal of the DC supply mains. The molecules of the sulphuric acid break up into ions of $2H^+$ and SO_4^{--}. The hydrogen ions being positively charged moved towards the cathodes and receive two electrons from there and form a hydrogen atom. The hydrogen atom reacts with lead sulphate cathode forming lead and sulphuric acid according to the chemical equation

$$PbSO_4 + 2H = PbO + H_2O$$
$$PbO + H_2SO_4 = PbSO_4 + 2H_2O$$
$$\overline{PbO_2 + H_2SO_4 + 2H = PbSO_4 + 2H_2O}$$

SO_4^{--} ion moves to the anode, gives up its two additional electrons becomes radical SO_4, react with the lead sulphate anode and form leads peroxide and lead sulphuric acid according to the chemical equation

The following figure shows the recharging of a Lead-oxide cell

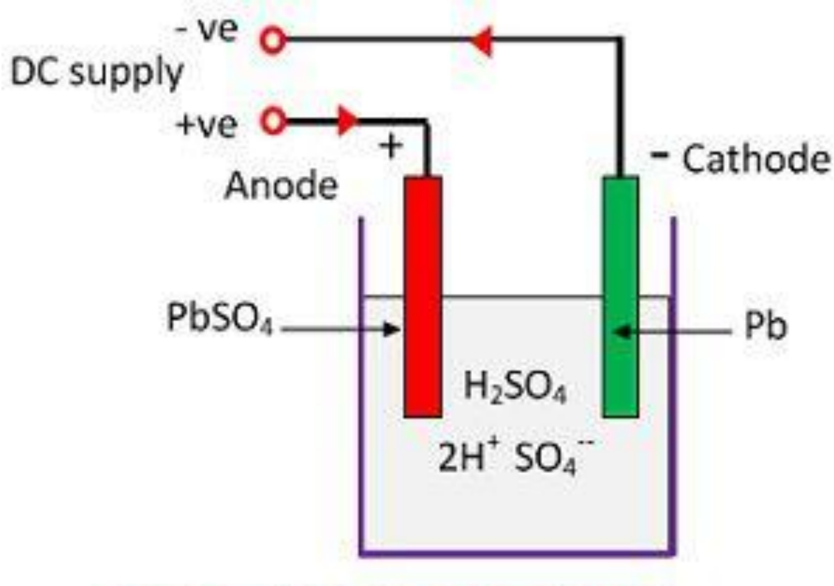


Fig 4.2.18: Recharging of a battery

The charging and discharging are represented by a single reversible equation given below

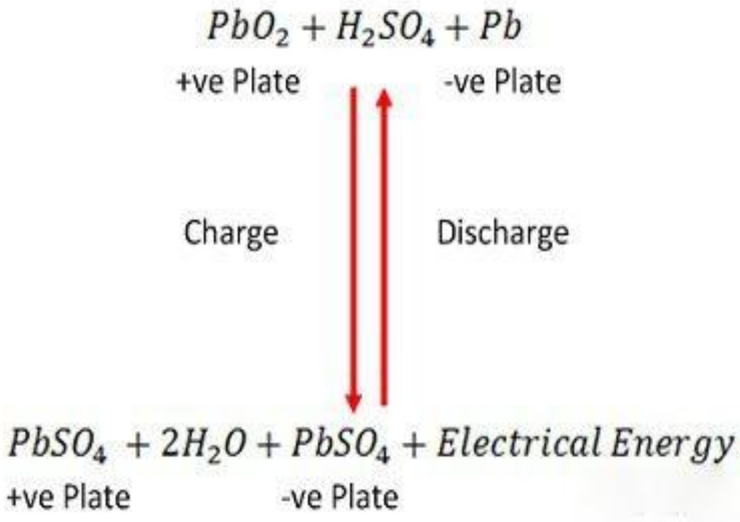


Fig 4.2.19: Chemical reactions

4.2.7 Diaphragm motor

Fig 4.2.20: Diaphragm motor

Specification:

- Working voltage: DC 6-12V
- Power: 7W
- Current: 0.5-0.7A
- Maximum flow: 700ML/30S
- Maximum suction: 2m

Description:

Diaphragm pumps are the positive displacement pump which moves gases, liquids via a reciprocating diaphragm. They are highly reliable because they do not include inner parts that rub against each other. They also contain no sealing or lubricating oils within the pumping head which means that there is no chance of oil vapour leakage or contamination of the handled media.

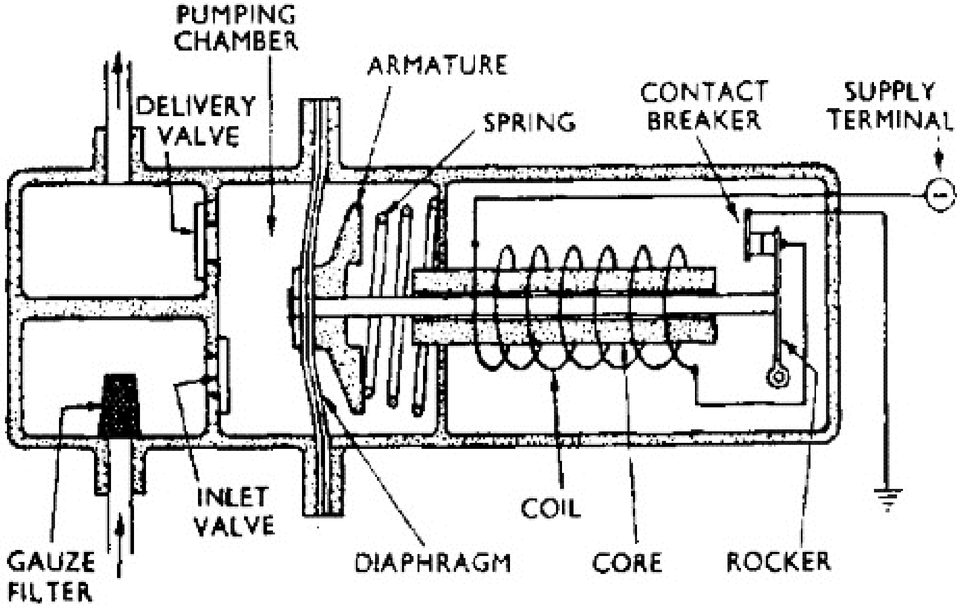


Fig 4.2.21: Inner view of diaphragm motor

Simple diaphragm pumps consist of a diaphragm, displacement chamber, two valves, and a driving mechanism. The diaphragm is made of a flexible material companionable with the pumped media. It is sealed in place between the side of the displacement chamber and an attached flange. The chamber volume is slightly greater than what the diaphragm can displace. The valves are typically spring-loaded ball valves or flapper valves made of the same material as the diaphragm, and they function to admit the fluid in and out of the chamber. The driving mechanism is what flexes the diaphragm.

4.2.8 Camera

Fig 4.2.22: Camera

Specification:

- Pixels: 720p
- Capturing angle: 170°
- Screen length: 2”
- Connection type: Wireless

Description:

The camera body is made of plastic. The protective lens rim outer diameter is 20.6 mm. The lens protrudes forward making protection against scratches and dents. The camera uses the most popular LCD driver. It works with 2-inch LCD display with mediocre viewing angles. Brightness is enough for shooting under different lighting conditions. The screen is not touch sensitive and is covered with glossy transparent protective film. The front panel has the power button. The shutter button is located on the top. The left side has two buttons on it. There are two LED indicators located on the back side of the camera. The red one lights up when the battery is charging, the blue one is permanently on when the camera is powered up. Another red LED is on the top, it starts blinking after switching on the Wi-Fi connection. Removable battery compartment is located on the bottom of the case. Battery dimensions are 33 x 30 x 11 mm and weighs 16 g. The battery capacity is marked as '900mAh.

Internet of Things (IOT)

The internet of things, or IOT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an IP address and is able to transfer data over a network.

Increasingly, organizations in a variety of industries are using IOT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.

How IOT works

An IOT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to collect, send and act on data they acquire from their environments. IOT devices share the sensor data they collect by connecting to an IOT gateway or other edge device where data is either sent to the cloud to be analysed or analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IOT applications deployed.

Benefits of IOT

The internet of things offers a number of benefits to organizations, enabling them to:

- Monitor their overall business processes.
- Improve the customer experience.
- Save time and money.
- Enhance employee productivity.
- Integrate and adapt business models.
- Make better business decisions.
- Generate more revenue.

CHAPTER 5

SOFTWARE DESCRIPTION

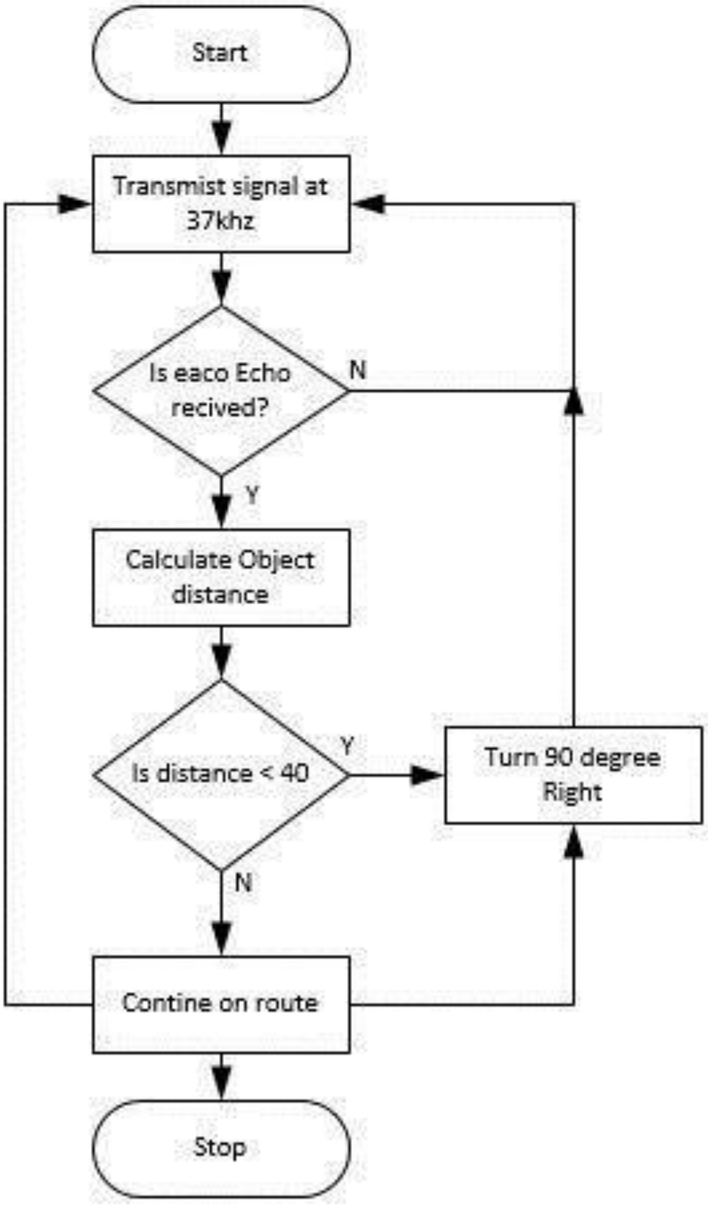


Fig 5.1: Obstacle Detection diagram

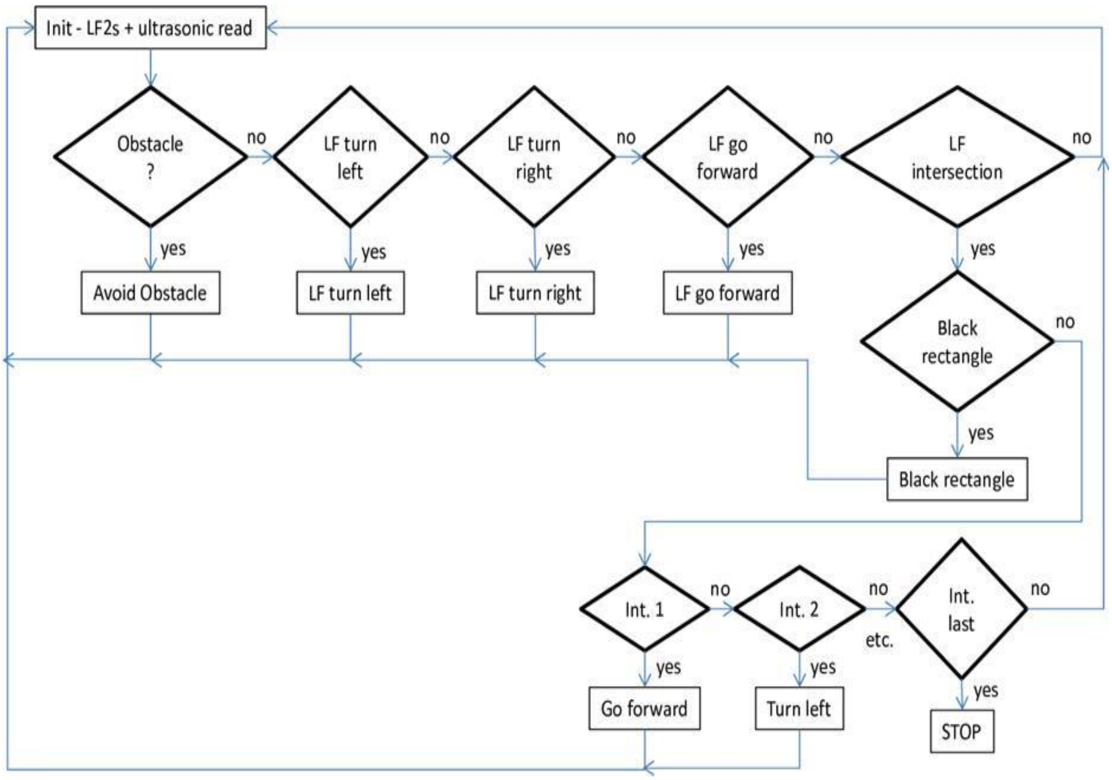


fig 5.2: Flowchart of Ultrasonic detection

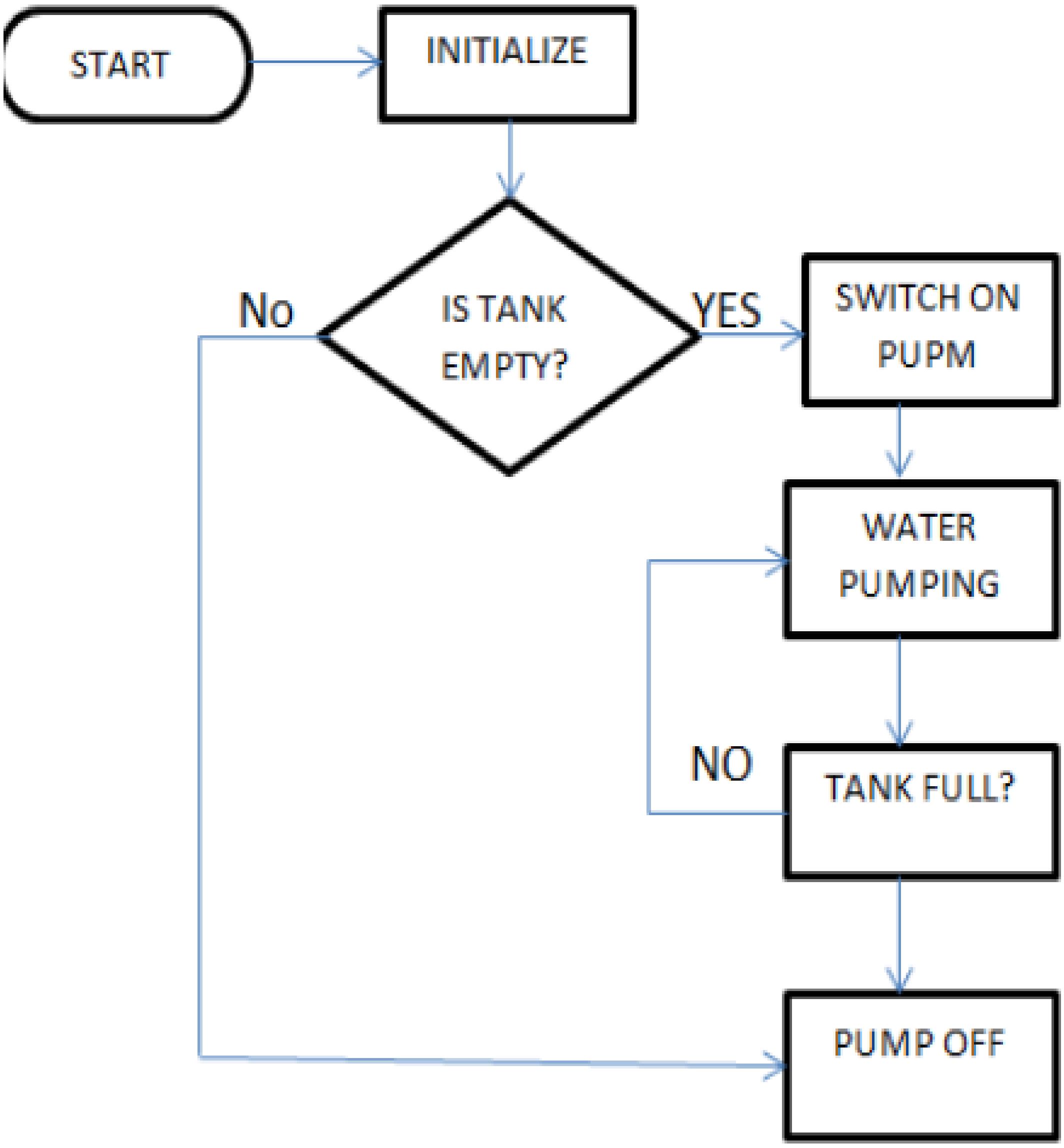


Fig 5.3: Flow of water pump

CHAPTER 6

IMPLEMENTATION

```
import RPi.GPIO as GPIO

from time import sleep

GPIO.setmode(GPIO.BCM)

GPIO.setup(2,GPIO.IN)

GPIO.setup(3,GPIO.IN)

GPIO.setup(5,GPIO.IN)

GPIO.setup(6,GPIO.IN)

GPIO.setup(7,GPIO.IN)

GPIO.setup(8,GPIO.IN)

GPIO.setup(14,GPIO.IN)

GPIO.setup(27,GPIO.IN)

GPIO.setup(12,GPIO.IN)

GPIO.setup(13,GPIO.IN)

GPIO.setup(16,GPIO.OUT)

GPIO.setup(20,GPIO.OUT)

GPIO.setup(19,GPIO.OUT)

GPIO.setup(26,GPIO.OUT)

GPIO.setup(17,GPIO.OUT)
```

```
GPIO.setup(15,GPIO.OUT)

GPIO.setup(18,GPIO.OUT)

GPIO.setup(21,GPIO.OUT)

GPIO.setup(25,GPIO.OUT)

try:

    while True:

        # forward object detection

         if GPIO.input(13):

             GPIO.output(16,1)

             GPIO.output(20,1)

             GPIO.output(19,1)

             GPIO.output(26,1)

             GPIO.output(25,0)# When Obejects detects Red Light  turns On

             print("Front Object detected")

             sleep(1)

        # Backward Object detection

         elif GPIO.input(12):

             GPIO.output(16,1)

             GPIO.output(20,1)

             GPIO.output(19,1)

             GPIO.output(26,1)
```

```
        GPIO.output(25,0)# When Obejects detects Red Light  turns On
        print("Back Object detected")
        sleep(1)
    elif GPIO.input(2): # To move forward
        GPIO.output(16,0)
        GPIO.output(20,1)
        GPIO.output(19,1)
        GPIO.output(26,0)
        print("Forward")
    elif GPIO.input(3): # To move backward
        GPIO.output(16,1)
        GPIO.output(20,0)
        GPIO.output(19,0)
        GPIO.output(26,1)
        print("Backward")
    elif GPIO.input(14): # To turn left
        GPIO.output(16,1)
        GPIO.output(20,0)
        GPIO.output(19,1)
        GPIO.output(26,0)
        print("Left")
```

```
elif GPIO.input(27): # To turn right
    GPIO.output(16,0)
    GPIO.output(20,1)
    GPIO.output(19,0)
    GPIO.output(26,1)
    print("Right")
else:
    GPIO.output(16,1)
    GPIO.output(20,1)
    GPIO.output(19,1)
    GPIO.output(26,1)
    GPIO.output(25,1) # When there is no Object Red Light  turns Off
    print("Stop")
if GPIO.input(5): #Bottom Sprinkler moves forward
    GPIO.output(17,1)
    GPIO.output(15,0)
    print("Sprinkler1 Forward")
elif GPIO.input(6): #Bottom Sprinkler moves backward
    GPIO.output(17,0)
    GPIO.output(15,1)
    print("Sprinkler1 Backward")
```

```
        else:

            GPIO.output(17,1)

            GPIO.output(15,1)

        if GPIO.input(7): # Top Sprinkler turns left

            GPIO.output(18,1)

            GPIO.output(21,0)

            print("Top Sprinkler Left")

        elif GPIO.input(8): # Top Sprinkler turns right

            GPIO.output(18,0)

            GPIO.output(21,1)

            print("Top Sprinkler Right")

        else:

            GPIO.output(18,1)

            GPIO.output(21,1)

finally:

            GPIO.cleanup()
```

CHAPTER 7

RESULT

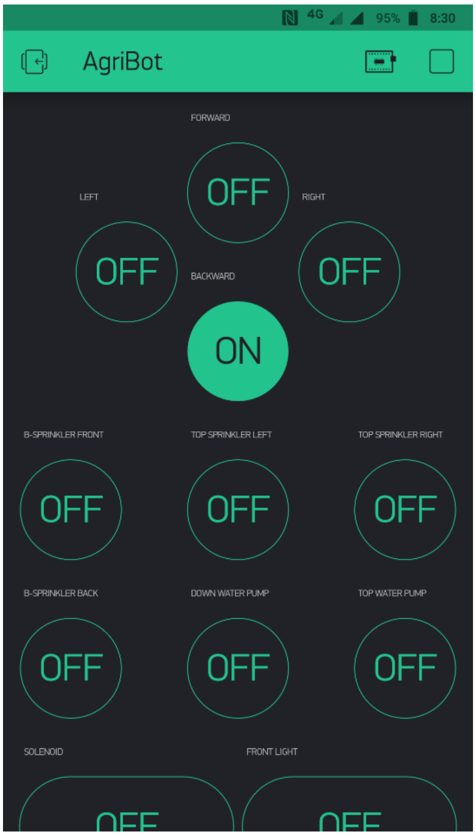
7.1 Forward Movement

Input:

Output:

7.2 Backward Movement

Input:



Output:

7.3 Left Turn Movement

Input:

Output:

7.4 Right Turn Movement

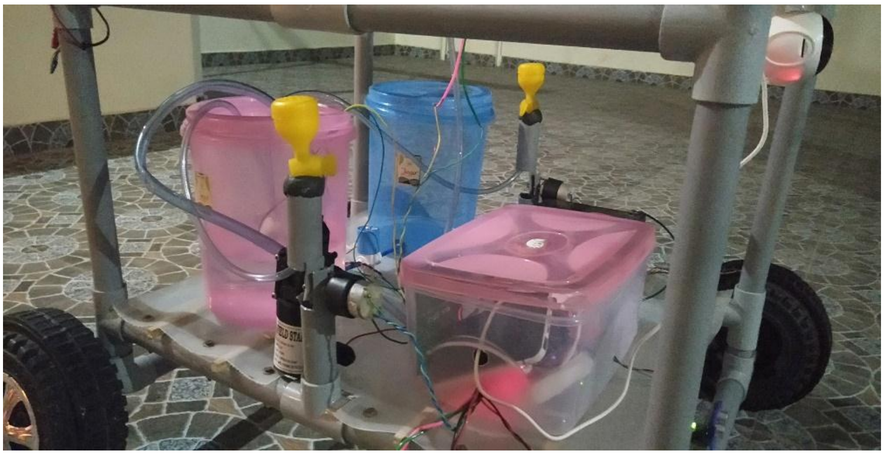
Input:

Output:

7.5 Bottom Sprinkler Forward Movement

Input:

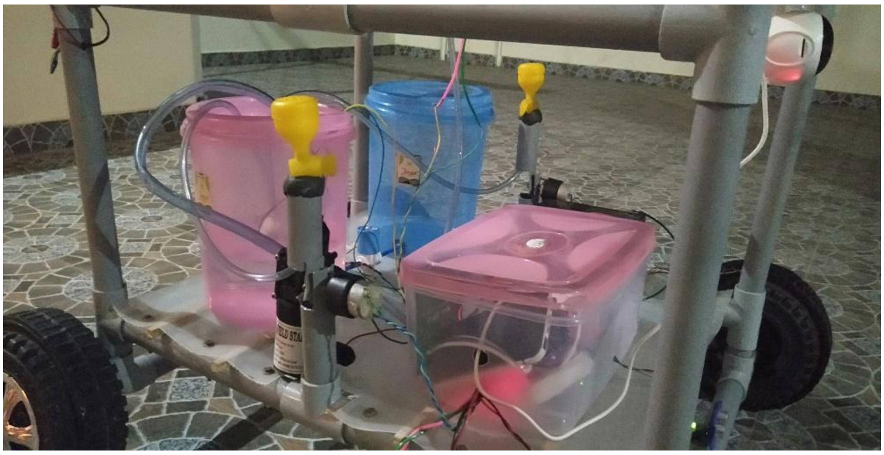
Output:



7.6 Bottom Sprinkler Backward Movement

Input:

Output:



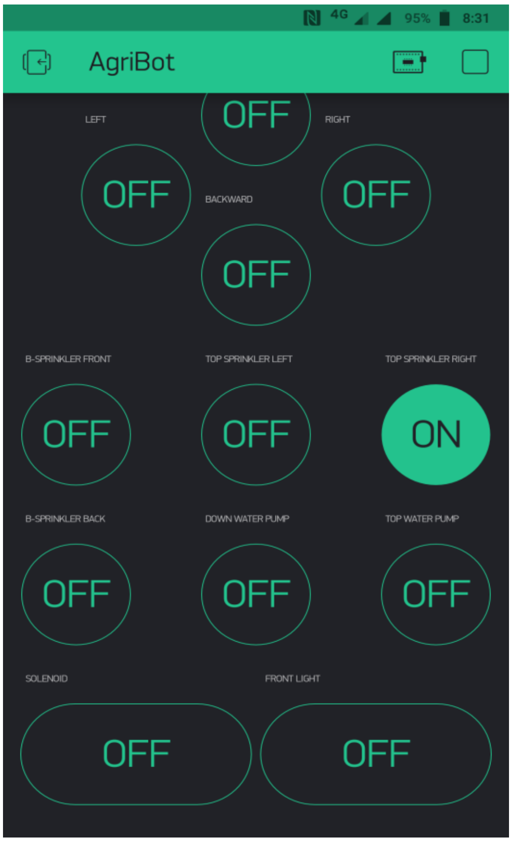
7.7 Top Sprinkler Left Turn

Input:

Output:

7.8 Top Sprinkler Right Turn

Input:



Output:

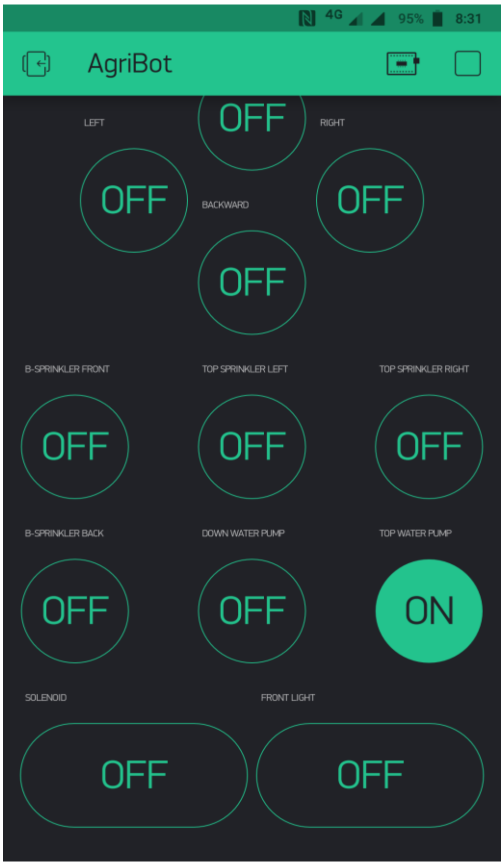
7.9 Bottom Water Pump Flow

Input:

Output:

7.10 Top Water Pump Flow

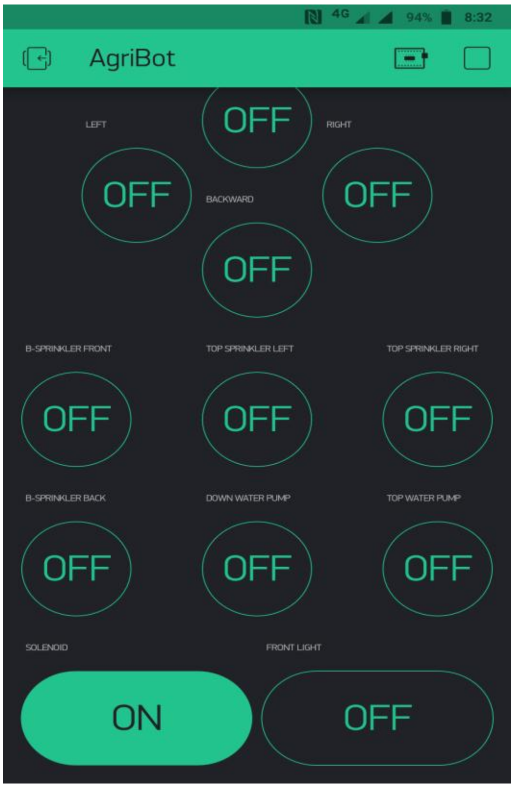
Input:



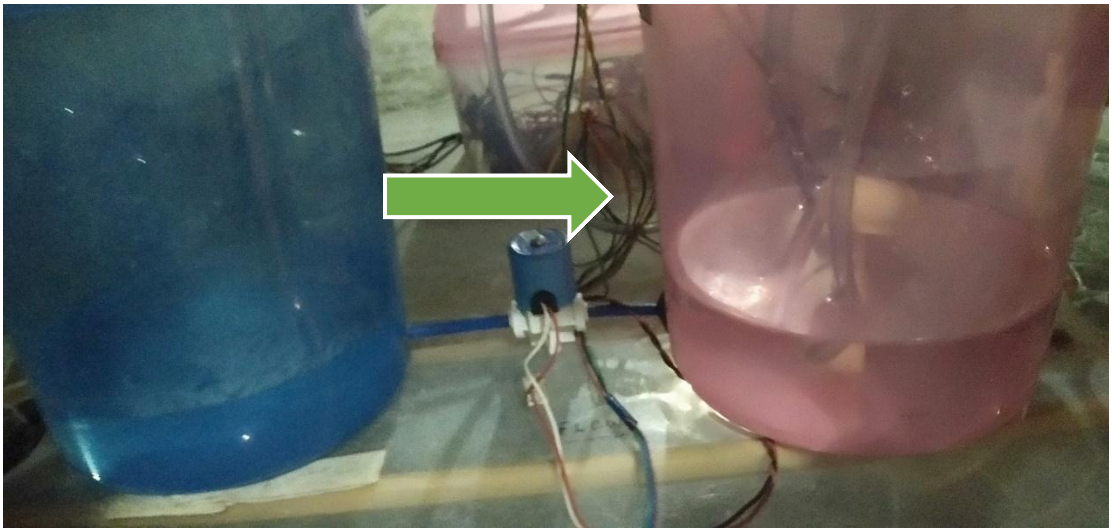
Output:

7.11 Solenoid Valve

Input:



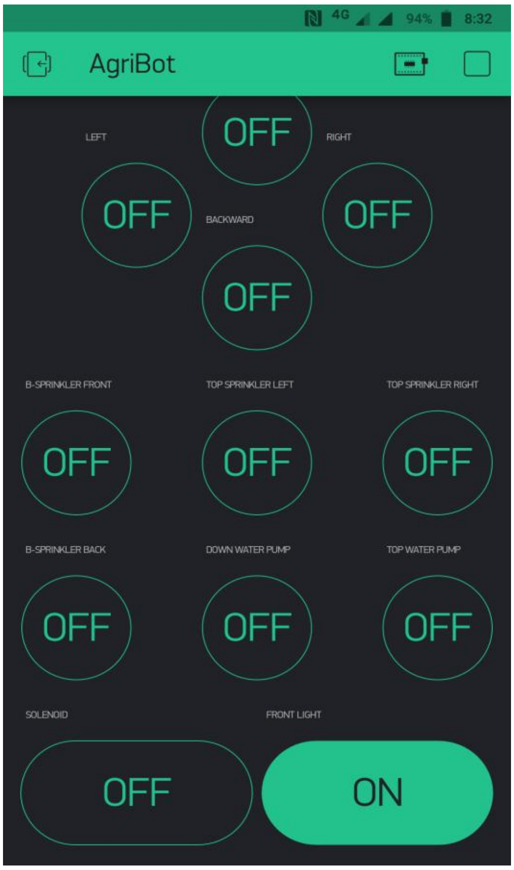
Output:



The pesticide water flows from left to right when the solenoid valve is switched on.

7.12 Front Light

Input:



Output:

7.13 Front Obstacle Detection

Bot automatically stops all the movement when any front obstacle is detected. It is indicated with the red light at rear that the obstacle is detected.

7.14 Rear Obstacle Detection

Bot automatically stops all the movement when any rear obstacle is detected. It is indicated with the red light at rear that the obstacle is detected.

CHAPTER 8

CONCLUSION

- The use of automation in vehicle handling through computer saves tremendous human efforts and animal power.
- The Use of the camera keeps the farmer well informed about the ongoing things in the field with respect to the crop.
- Effective utilization of automation which eases the load off the farmers both physically and economically.
- The performance and the precision is been increased to a greater extent as the human errors are reduced and substantial increase in the yield is witnessed.
- Low power consumption and reduced man power.
- Overall our project helps to overcome the disadvantages faced by the farmer in the Agriculture.
- This Project certainly sets a trend in future of the agriculture in our country as there is an improved yield.

CHAPTER 9

FUTURE APPLICATION

With fully-automated farms in the future, robots can perform all the tasks like mowing, fertilizing, monitoring of pests and diseases, harvesting, tilling, etc. This also enables the farmers to just supervise the robots without the need to operate them. The key aspects of automated farms are the following:

- It facilitates 24/7 operation in the farm
- It improves safety
- It allows selective harvesting
- It sustains domestic agriculture
- It reduces chemical usage and labour needs
- It enables plant-level management
- It assists in precision pest management
- It helps small family farmers by enabling small farms to compete globally.
- Crop scouting – Accurate and timely data can be collected in an inexpensive manner with the presence of automated systems in the crop having sensors to evaluate health and status of the crop.
- Weed mapping - It is a method used for recording the density and position of various weed species using the automated machines.
- Robotic weeding -Several methods can be employed to kill the weeds. For example, the interface between the soil and the root is broken by tillage and wilting of weed plants.
- Micro spraying – In this, care should be taken not to damage the crop or disturb the soil while killing the weeds. This can be achieved using micro spray that releases very small amount of herbicide directly on the weed leaf. Automated machines can locate the position of an individual weed plant and spray the herbicide through a set of nozzles.
- Robotic irrigation – Water can be applied at variable rates over the predefined areas using a robotic irrigator developed in the form of a mechatronic sprinkler.

CHAPTER 10

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