1. Introduction

1.1 Preamble

For agriculture based country like India control of pest in filed is an important factor Spraying of pesticides is an important task in agriculture for protecting the crops from insects. Farmers mainly use hand operated or fuel operated spray pump for this task.Also carbon dioxide emitted as pollutant during the operation of such pumps has a detrimental effect in the environment. Also there is a chance of direct contact of pesticides with human body which would be harmful. Hence, these conventional sprayers are not much appreciated. Efforts have been made to "Automate pesticides spraying" by using DC pump and battery.

1.2 Literature Survey

Before going into the details of our Intelligent IoT based Automated Irrigation system, one will review some of the existing system in vogue pertaining to Agriculture.Traditional Agricultural Monitoring[1] .In some of the traditional irrigation system, irrigation is scheduled by monitoring the soil and water status by employing tension meter and drip irrigation by automating the controller system in sandy soil. In some irrigation system, fuzzy logic controller been implemented for an efficient irrigation system for field having different crops. Fuzzy logic increases the accuracy of measured value and accordingly assists in decision making.Green house based modern agriculture need to be precisely controlled in terms of humidity and temperature. The atmospheric conditions of plants inside the green house vary from place to place which makes it difficult towards maintaining uniformity at all places in farmhouse manually. So towards this, GSM been used towards reporting the status about irrigation for farmer's mobile handset. After data analysis, message sent to farmers notifying the field conditions and providing suggestions.. Knowledge base can be created based on the data collected using Expert systems for further analysis[2]. This system is not scalable and cannot be reused on other applications as it is not based on the concept of Machine to Machine Communications (M2M) which cover a large geographical area with many sensors deployed in the field. Research been carried out by employing Bluetooth Wireless Transmitter that sense soil moisture, temperature etcand accordingly send the data to the Base station (BS) which makes the decision towards irrigation decision based on field and time.

The irrigation control unit which is responsible towards irrigating the field pertaining to operating the sprinkler would receive the control signal from the BS. This is based on water Requirement of the fields. Some researchers are also working towards Variable rate Sensor based Irrigation System.Researchers Wall and King developed an automated field specific irrigation system with soil moisture sensor and sprinkler valve controller. These systems do not take into consideration monitoring the water pollution in lakes or rivers and also do not consider M2M Communication concept[3]. Research been carried out in developing an intensive sensor based irrigation monitoring system which is scalable and self organizing .

In terms of machine learning, lot of research been carried out towards crop yield and crop disease prediction only. There has been no research reported which employs machine learning algorithm towards analysing the soil condition based on trained data set for irrigating the field automatically without any human intervention. Also there exists no M2M system which interacts between the system towards making analysis and predicting intelligently.

1.3 Problem statement and Scope of the project

In an agriculture, the farmers have to do tedious work in the farm fields .A different farm field requires extensive spraying every 5-6 days in the rainy season. Earlier spraying of pesticides done manually and also the operator is exposed to harmful chemicals Long term exposure may affect the operator's health.

The automated spraying system has following scopes

- Automatic and control of spraying can be made possible with some advancement in proposed device
- The proposed device can be used for spraying pesticides with optimum performance with minimum efforts

1.4 Technical Features of project

This project is built on Raspbian Os and Blynk App is used to switch on and off the motor. This App gives the versatility to use the system with its user-friendly interface and Python programming language makes it even more easy and shorter to code.

1.5 Methodology Adapted

The research is split into two major parts- a theoretical and a practical. The theoretical one is based on a pilot survey where we went through the major security concerns regarding IoT devices as well as finding appropriate project scope supporting the goal of the project. The practical part was to familiarize ourselves with the development tools and environments required fulfilling a functional system that consider time, cost and efficiency concerns mentioned in the theoretical study.

2. Project Description

Indian Farmers usually do not wear any protective gear while spraying chemicals in fields. This exposes them to harmful toxics chemicals contained in pesticides, causing severe health impacts and even death in extreme cases. Hence automated pesticides spray came in to existence to overcome this problem. The Internet of Things (IOT) is an emerging topic of technical, social, and economic significance. IOT is the network of physical objects, devices, and buildings, vehicles and other items embedded sensors and network connectivity that enables using with electronics, software these objects to collect and exchange data.

Here the project is about building an automated pesticides sprayer using Raspberry pi mounted on a Robotic Car. This could be a useful, inexpensive and time efficient for farmers. In this IOT project, mainly using Raspberry pi, Blynk App, diaphragm water pump, relay channel and DC motor with Robot chassis to build the Robotic car.

Spray module composed of nozzles, diaphragm pump, relays. The valves are controlled by on-board microprocessor electronically. The pump is turned on and off to enable selective spraying of plants. The pump is capable of producing pressures sufficient for producing a mist from the dispersing elements. The pesticide reservoir holds pre-measured and premixed pesticide that can be used for direct treatment of an area. A misting schedule is entered into the controller, or timer. At the predetermined misting times, the controller completes the circuit between the battery and pump, thereby energizing the pump and causing the pesticide mixture to be pumped into the dispersing elements

A robotics-based guidance method is presented to guide a robot platform which is designed independently to drive through the crops in a field according to the designed concept of open architecture. The proposed system is basically developed to implement an agricultural production. This type of system is very useful in agriculture field where we need to spray the pesticides to the crop. Also minimize the wastage of pesticide and time. It can be operated in small farming land with the standard spacing decreasing the labor cost and human effort.

3. Software Requirement Specification

3.1 Introduction

India is a country where nearly 70% of people lives in rural area and main source of their income is farming, directly or indirectly.70% of people in India are connected with farming directly or indirectly, instead of that we are not producing the crop of which we having capacity to produce. Reason behind this is the farmers of our country are not using technology very well. So now have to make machines that can help then to save their time and money and to increase the production rate and their profit[4]. one have to make economic machineries so farmers can purchase it as per capita income of our country's farmers are low and our country per capita income is low that of compared to other country as our country is developing country.

Present scenario in agricultural field in India related to sprayer is that farmers are using hand operated sprayer or motorized sprayer. According to idea in the project are making a small 4 wheel kart or vehicle which is electronically operated by a wireless remote which runs on power source as a DC battery. Nozzle is fitted to these arms so that it can spray pesticides both the sides. As more no of nozzle are there hence spraying is done rapidly and time and money is saved.

Definition: Automated sprayer is a device used to spray a liquid using remote access which requires less manpower, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients.

Overview: The project is developed to provide mechanism for spraying and controlling various parameters like spraying speed control, monitoring task status, fixing the sprayer at specific altitude and location etc and to spray chemicals aerially and reduce the human work. The spraying mechanism mainly consists of Raspberry pi which is programmed to perform various functions. It also contains a tank of 250ml capacity to which a water pump is connected. To this water pump, a splitter is connected which spits the pesticide to the two nozzles which are connected at the two opposite ends and spraying is achieved.

3.2 Hardware and Software Requirements

Hardware Requirements

- Raspberry pi3 Model B
- Nozzles
- Diaphragm water pump 12V
- Battery

Software Requirements

- Raspbian OS
- Python3

3.3 Functional Requirements

- Diaphragm pump module

  A diaphragm pump (also known as a Membrane pump) is a positive displacement pump that uses a combination of the reciprocating action of rubber, thermoplastic or teflon diaphragm and suitable valves on either side of the diaphragm (check valve, butterfly valves, flap valves, or any other form of shut-off valves) to pump a fluid.

- Spray module

  Spray module composed of nozzles, diaphragm pump, relays The valves are controlled by the on-board microprocessor electronically. The pump is turned on and off to enable selective spraying of plants

3.4 Non -Functional Requirements

- Performance: System must works at real time
- Operational: This system works automatically and it is connected to mobile application to control the system
- Cost: The cost of the system must not be too expensive

3.5 External Interface Requirements

- User Interface: - The System provides user with mobile App as an input device which can control the switching of the pump
- Hardware Interface: - The Proposed System runs on raspberry pi along with jumper wires that helps the system to work smoothly and interactive with the software interface

3.6 Performance Requirements

- Increase the utilization rate of pesticides : Spray technology will be based on the issues to take full spray, semi-spray, no spray measures to deal with , initial speed of the spray to achieve effective penetration, improve the pesticide adhesion rate, Thereby reducing the cost pressure caused by spray operations
- Cost saving : Because the variable spray can effectively use the advantages of pesticides, it greatly reduces the amount of pesticides used while reducing the number of spray, thus saving manpower and material resources, reflecting its obvious economic benefits.

4. System Design Specification

4. 1 Architectural Design

- **Problem specification**

Here the project is about building an automated pesticides sprayer using Raspberry pi mounted on a Robotic Car. This could be a useful, inexpensive and time efficient for farmers. In this IOT project, mainly using Raspberry pi, Blynk App, diaphragm water pump, relay channel and DC motor with Robot chassis to build the Robotic car.

- **Block diagram**

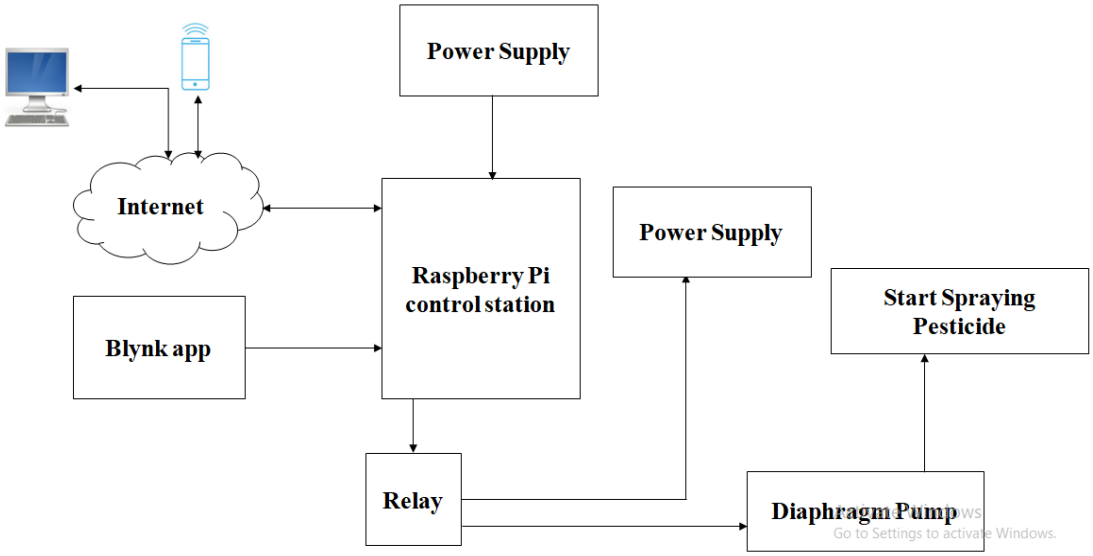

Fig 4.1: Block diagram of Automated Pesticides Spray

The block diagram that is being depicted in Fig 4.1 shows the basic working of automated sprayer based on raspberry pi in which the block describes the working. The circuit connection consists of raspberry pi, 12V battery, channel relay, Diaphragm pump, Nozzles. The User unit

consists of PC within which the Wi-Fi range. The Blynk app is having options of controlling the diaphragm motor and server motors. The signal is sent from Blynk app to the raspberry pi. The raspberry pi sends the signals to relay channel which switches the motor. When the motor receives the signal from relay channel, the spray module works.

- **Module specification**

  Module 1- Spray module

  Input : Signal from relay (on and off), electricity.

  Process: Spray module composed of nozzles, diaphragm pump, relays. The valves are controlled by on-board microprocessor electronically. The pump is turned on and off to enable selective spraying of plants .

  Output : Spray the pesticide(if on) and stop the spraying(if off).

  Module 2- Car module

  Input : User gives input Left, Right, Forward, Backward.

  Process : A user interface in a laptop which is built in python and Tkinter which has Left, Right, Forward, Backward links ,clicking on which can move the robot in any direction.

  Output : Moves to direction as directed by user.

4.2 System Design

4.2.1Object Modeling

The Object Modeling is an approach for software modeling and designing. The purpose is to easily understand the visualization of the designs made. The complexity of the system can be reduced through performing various design techniques. The static, dynamic models can be known and implemented according to it. The following static and dynamic models are made according to the requirement.

The Static model can be defined as model that represents a phenomenon at a given point in time. Static Diagrams describes the structure of the system.

The Dynamic model represents the behavior of an object over time. It represents the sequence of events, state and operations that occur within a system of objects.

Class Diagram

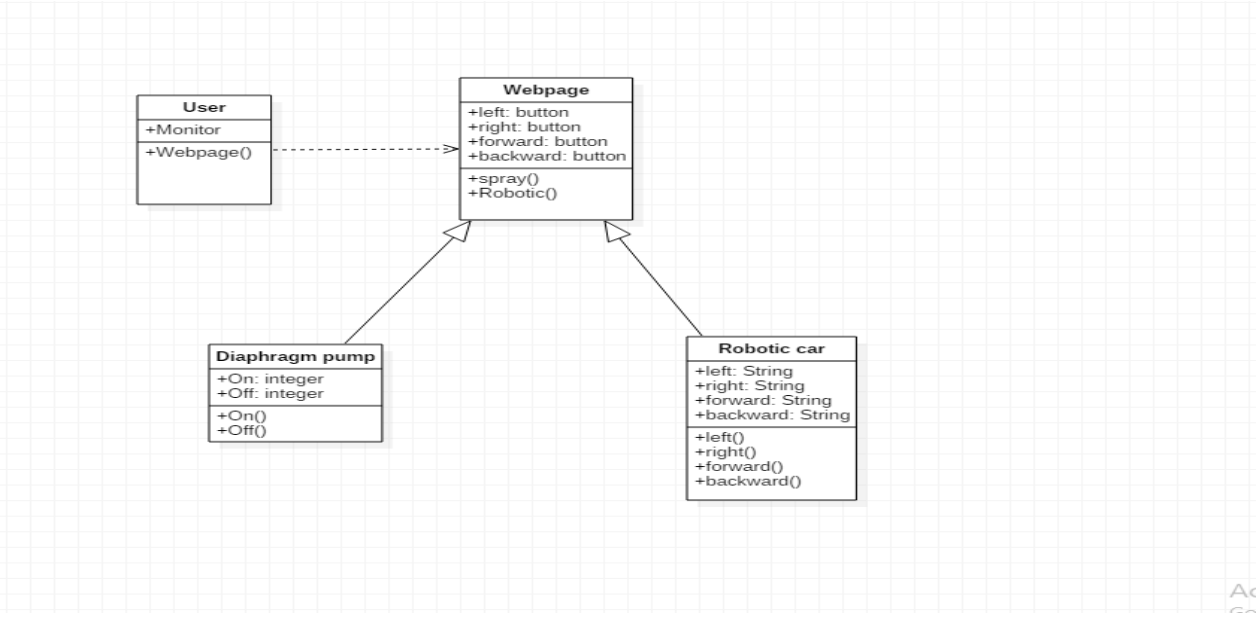

Fig 4.2 Class Diagram of Automated pesticide spray

The class diagram describes the main elements and interactions among the in the application. The above Fig 4.2 shows the static view of an application. It describes objects such as diaphragm pump, Robotic car , Tkinter interface and the relationships that exists between them. It also gives an overview of a system by displaying its classes, attributes, operations and relationships.

4.2.2 Dynamic Modeling

Dynamic models are generally models that contain or depend upon an element of time, especially allowing for interactions between variables over time. A separate idea with the same name is models that are updated over time with new data.

The dynamic model represents the time–dependent aspects of a system. It is concerned with the temporal changes in the states of the objects in a system. The main concepts are −

- State, which is the situation at a particular condition during the lifetime of an object.
- Transition, a change in the state
- Event, an occurrence that triggers transitions
- Action, an uninterrupted and atomic computation that occurs due to some event, and
- Concurrency of transitions.

Use case Diagram

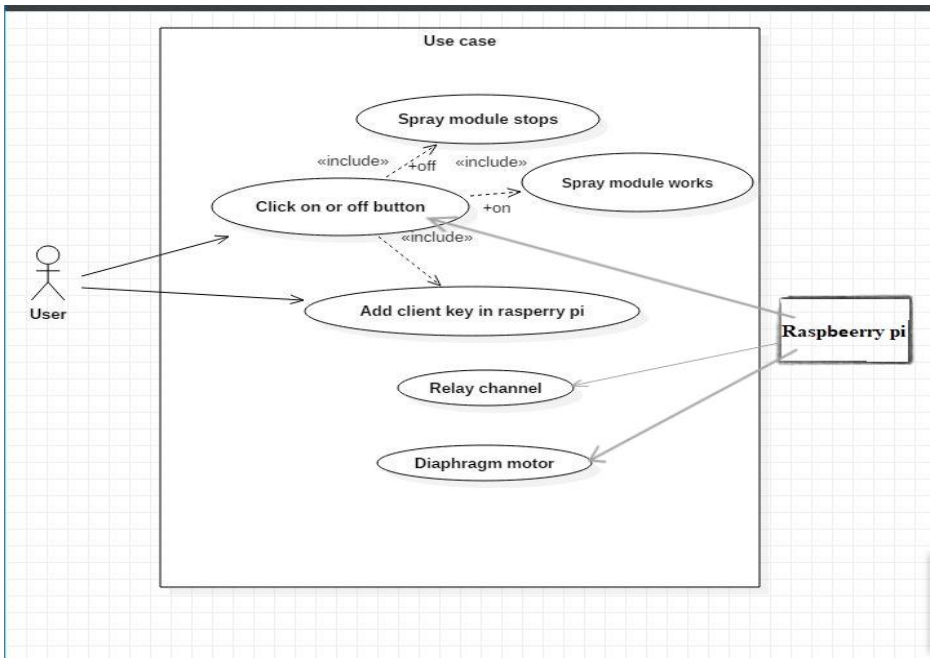

Fig 4.3 Use Case Diagram of Automated pesticides Spray

Fig 4.3 shows the actors as well as the functionality that will be performed by the actors. These functionalities will ease the work of the actors to perform spraying operation.

Sequence Diagram

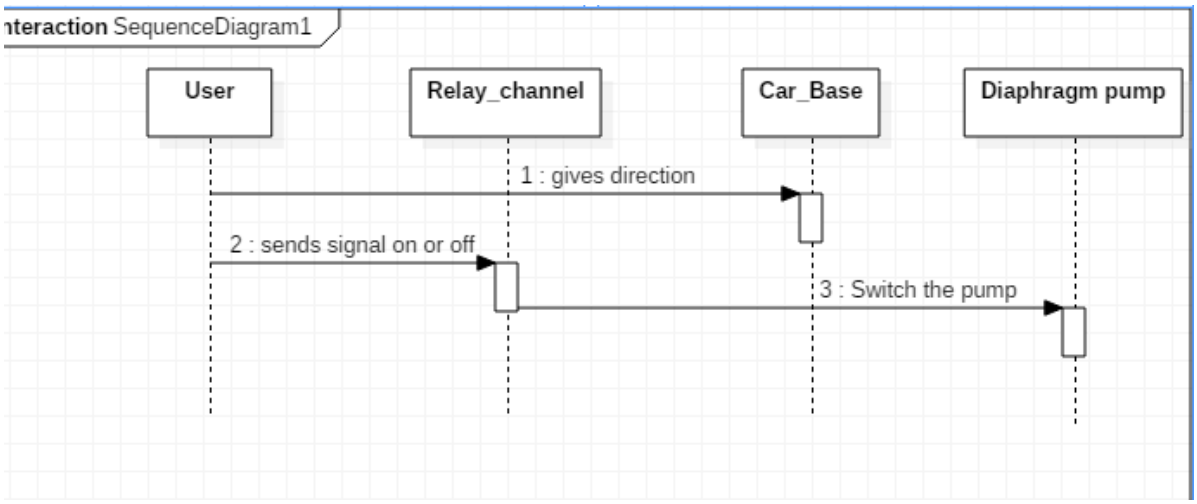

Fig 4.4 Sequence Diagram for Automated pesticides spray

Fig 4.4 shows the sequence of flow of activities in which user controlling the carbase and diaphragm pump.

Activity Diagram

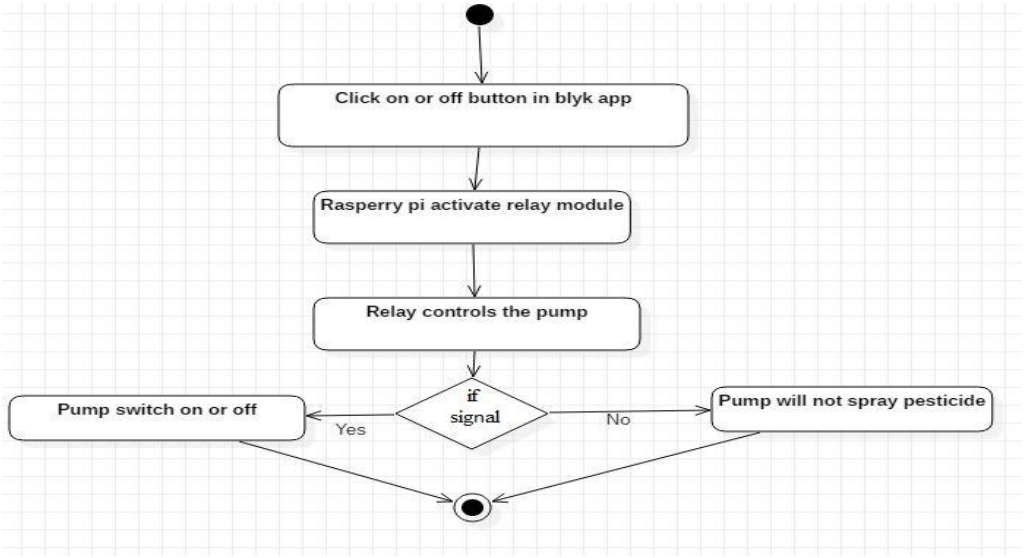

Fig 4.5 Activity Diagram of Automated Pesticides Spray

Fig 4.5 shows the activity diagram of all the activities that are happening sequentially like when the user click ON\OFF button in Blynk App, relay module is activated by raspberry pi and relay controls the pump.

5. Implementation

Prototype consists of a Diaphragm pump, relay channel, 12V Battery, raspberry pi and Nozzles. The connection is made to build a system that can automatically spray the pesticide according to the user instructions and avoids the contact of pesticide with the user.

Step 1: Setting up the raspberry pi and installation of the operating system from raspberrypi.org. Here the raspbian OS is used.

Step 2: Install the required packages in the pi using suitable commands in the terminal window and connect the pi to Blynk App using the following steps.

Step 3: In order to install node.js ,refresh local package index first and then install from Repositories- sudo apt-get update

curl -sL https://deb.nodesource.com/setup_6.x | sudo -E bash –

sudo apt-get update and && sudo apt-get upgrade

sudo apt-get install build-essential nodejs -y

Step 4: Install npm, which is node.js package manager –

sudo npm install -g npm

sudo npm install -g onoff

sudo npm install -g blynk-library

Step 5: Now connect Raspberry pi and Blynk using auth token

blynk-client “auth token”

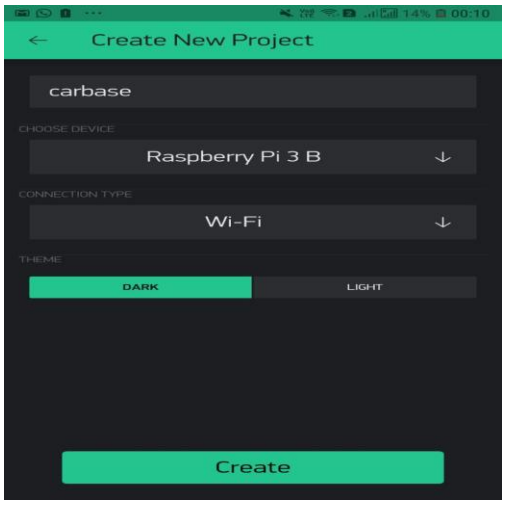

Fig 5.1 Creation of project in Blynk App

Fig 5.1 shows the creation of project in Blynk App in which ON/OFF button created and configured.

Source code of CarBase Module

```
import RPi.GPIO as gpio
import time
import sys
import tkinter as tk
def init():
        gpio.setmode(gpio.BOARD)
        gpio.setup(7, gpio.OUT)
        gpio.setup(11 ,gpio.OUT)
        gpio.setup(13 ,gpio.OUT)
        gpio.setup(15 ,gpio.OUT)
def forward(tf):

        gpio.output(7, False)
        gpio.output(11, True)
        gpio.output(13, True)
        gpio.output(15, False)
        time.sleep(tf)
        gpio.cleanup()

def reverse(tf):
        init()
        gpio.output(7, True)
        gpio.output(11, False)
        gpio.output(13, False)
        gpio.output(15, True)
        time.sleep(tf)
        gpio.cleanup()
```

```
def turn_left(tf):

        gpio.output(7, True)
        gpio.output(11, True)
        gpio.output(13, True)
        gpio.output(15, False)
        time.sleep(tf)
        gpio.cleanup()

def turn_right(tf):

        gpio.output(7, False)
        gpio.output(11, True)
        gpio.output(13, False)
        gpio.output(15, False)
        time.sleep(tf)
        gpio.cleanup()

def pivot_left(tf):

        gpio.output(7, True)
        gpio.output(11, False)
        gpio.output(13, True)
        gpio.output(15, False)
        time.sleep(tf)
        gpio.cleanup()

def pivot_right(tf):
        gpio.output(7, False)
        gpio.output(11, True)
        gpio.output(13, False)
```

```
        gpio.output(15, True)
        time.sleep(tf)
        gpio.cleanup()

def key_input(event):
        init()
        print('Key:', event.char)
        key_press = event.char
        sleep_time = 0.030

        if key_press.lower() == 'f':
                forward(sleep_time)
        elif key_press.lower() == 'b':
                reverse(sleep_time)
        elif key_press.lower() == 'l':
                turn_left(sleep_time)
        elif key_press.lower() == 'r':
                turn_right(sleep_time)
        elif key_press.lower() == 'p':
                pivot_left(sleep_time)
        elif key_press.lower() == 'q':
                pivot_right(sleep_time)
        else:
                pass

command = tk.Tk()
command.bind('<KeyPress>', key_input)
command.mainloop()
```

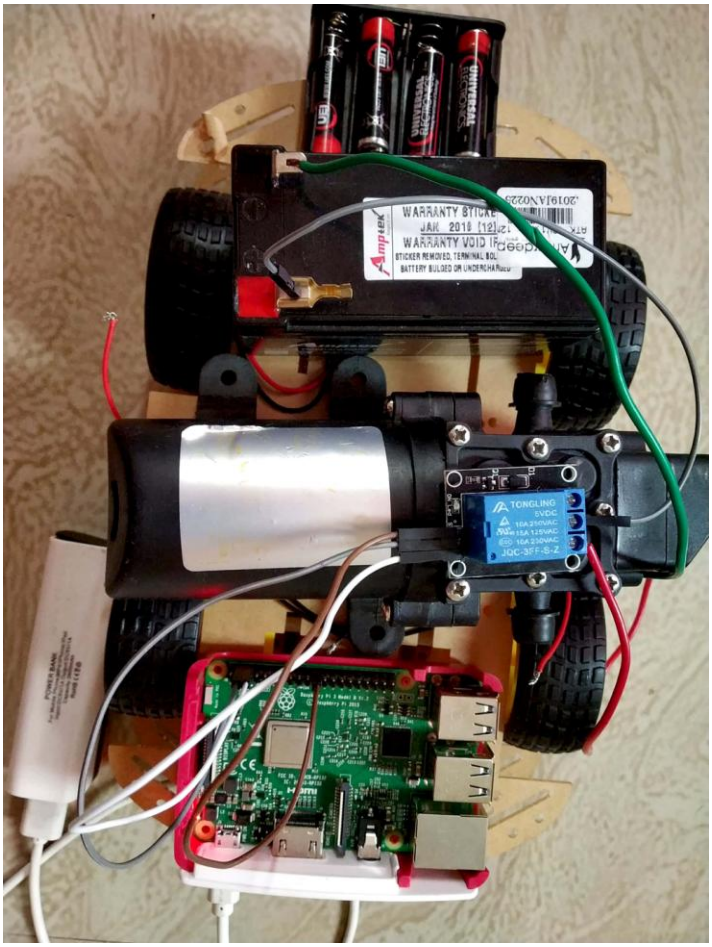

Fig 5.2 Working of Diaphragm pump and Carbase

Fig 5.2 shows the working of diaphragm pump and carbase and its connection with Raspberry pi and Relay.

6. Testing

Table 6.1: Testing of the connectivity of the devices

Test ID	Description	Sample Input	Actual Output	Expected Output	Remarks
T01	Blynk App working	ON	Starts spraying	Starts spraying	Pass
T02	Blynk App working	OFF	Stops spraying	Stops spraying	Pass
T03	Pump working	Signal from relay channel	Pump starts/stops spraying	Pump starts/stops spraying	Pass
T04	Car Base working	User gives direction	Moved instructed direction	Moved to instructed direction	Pass
T05	Anti-clock rotation of car base	Direction	Does not rotate	Rotate Anti-clock	Fail

7. Conclusion

The proposed system is very efficient and can be used in agriculture field very effectively. This technology is most suitable for place where there is less manpower. This system is user friendly as it avoid contact of pesticide with the operator. This sprayer is economical than that of the conventional engine operated sprayers. As the current passes from battery to DC Motor vehicle starts moving. At the same time DC Pump run and sprays pesticides with many nozzles. This machine will be operated by remote with maintaining some distance; therefore no harm effect will occur to human health. Also it covers larger area in less time so lots of time will be saved with this and also labor cost will reduce and money saved. Based on the present work the followings are some important conclusions have been drawn.

1. It is found that the existing pesticide spraying machine runs on human power. That portable backpack sprayer type machine may cause health problems for person as he directly comes in contact with pesticide.

2. In advent of avoiding such problems enlisted in first point, an automatic pesticides pesticide spraying machine seems an alternative concept.

3. Comparison between the existing machineries and present machine shows that the tricycle operated machine can work very efficiently with respect to covering area, time and cost of spraying process. Also it seems economical.

4. During testing the speed of vehicle varies continuously; it is because of varying track resistance. Further it is assumed that the spraying would be stopped partially but the pressure generated in spraying pump continues to spray the pesticide because the pressure developed in the pump is sufficient enough to spray for few minutes

Future Scope: Since the designed system is used only for spraying of pesticides controlled through internet of the thing, the following features can be added for enhancing the current project work: pH meter can be in order to determine the pH of the soil which helps to identify the suitable pesticide/fertilizer to be employed Moisture level sensor can be employed to know about the moisture content present in the soil of the farmland.

References

[1] A. H. KargarBideh, A. Shirzadifar, (2012) "Real-time stereo-vision based herbicide spraying, Proceeding ofIran's third International Conference on Industrial Automation

[2] R. Joshua, V. Vasu and P. Vincent “Solar Sprayer – An Agriculture Implement”, “International Journal of Sustainable Agriculture 2 (1): 16-19, 2010 ISSN 2079-2107”

[3] Nitin Das, Namit Maske, Vinayak Khawas, Dr. SK Chaudhury, Er. RD Shete “Agricultural Fertilizers and Pesticides Sprayers - A Review”,International Journal for Innovative Research in Science & Technology| Volume 1, Issue 11, April 2015.

[4] Dhiraj N. Kumbhare, Vishal Singh, PrashikWaghmare, Altaf Ansari,Vikas Tiwari, “Fabrication of Automatic Pesticides Spraying Machine”,International Research Journal of Engineering and Technology (IRJET), vol 3,issue 4, Apr – 2016.

[5] Shalini D V, “Automatic Pesticide Sprayer for Agriculture Purpose”,International Journal for Science and Research in Technology, vol 2, issue 7,Jul 2016