

Design and Development of IoT based Drone Fumigator

¹Apurva Majumdar, ¹Nikhil Sahu, ¹Nishant K P, ²Sharath G S, ³Dr K S Narayanaswamy

¹Student, School of Mechanical Engineering, REVA University, Bengaluru, India

²Assistant Professor, School of Mechanical Engineering, REVA University,

³Director and Professor, School of Mechanical Engineering, REVA University, Bengaluru, India

Abstract: A Drone is an unmanned or un-crewed aerial vehicle that has operational control from a ground location and is inherently used to perform tasks or missions that are not feasible for engagement of a manned aeronautical vehicle. Its design and construction allow a Vertical Takeoff and Landing methodology (VTOL) configuration and its compact dynamics and remote location accessibility gives it an edge over conventional methods of performing daily life chores. Parallely, Fumigation is a manned process of spraying mosquito/ rodent repellants along the breeding areas, usually involving use of Class III category hazardous chemicals and intoxicants, that can potentially cause respiratory damages to the personnel involved for the job. The aim of the group was to coherently form a physical union between the two technologies and incorporate remote operation benefits. This project will provide better service at input stage of dealing with the chemicals, as we propose a new bio-organic mixture as a replacement to the intoxicants, possessing the same repellent properties over its counterpart. Also, at the output stage, this project eliminates the time, labor and resource invested in doing the job by allowing IoT based automation technology. The Drone design has been carried out using daily life available materials for easy maintenance and light weight operation and the electronic board controls have been carried out using ArduPilot Mission Planner system software while the IoT controls have been setup by AdaFruit IO and Google Assistant calibration. Fumigator design has been homologated as per weight considerations and channeled via nozzles for effective spraying of repellent. Basic Python coding and manual calibration has been used to setup the functionality of the project. Hence, this project sheds light over our practical knowledge & implementation skills gained from studying Mechanical Engineering. The goal of this project, Drone Fumigation is to incorporate automation to the manned task of repellent spraying and cut short the health concerns plaguing the user involved in the process.

Index Terms - Drone, Mosquito Repellent, Fumigation, IoT Automation

I. INTRODUCTION

The design, development & fabrication of a Drone facility was considered and undertaken to reduce substantial health risks involved in the job of Mosquito Fumigation, that essentially uses class III hazardous elements and petrochemical products to cater for the job but puts the operator at large risks of respiratory infections and damages, that potentially can be caused by inhalation of these chemical and hydrocarbon elements.

To address this problem statement, a basic introduction to equipment's, related terminologies, developmental procedures and current topical advancements and research credentials carried out various experts of the field have been gathered, studied upon and implemented for construction of the undertaken problem statement solution.

The term 'Drone' refers to any unpiloted aircrafts, sometimes classified as UAVs (Unmanned Aerial Vehicles), that are assigned to perform tasks where human intervention is either not needed or the assigned task is potentially a categorical risk to humans. These robotic structures are assigned to carry out tasks that range between mundane to ultra-dangerous. Because they are controlled remotely from ground stations, they can be assigned for the toughest jobs in the world. These usually range from assisting in a search for survivors after a hurricane, giving law enforcement and military activity monitoring or as a scientific mobility solution for advancing research in maybe extreme climatic conditions.

Overall, a drone can cater over a long scale of beneficiary solutions depending upon intend of use. This leads to packaging and operational size varying between as a big as an aircraft or as small as the palm of our hands.

The entire project domain has been segregated into potentially three sister domains. Pesticide and Fogging Unit research involves itself as Phase II of the degree project being carried out. While there has been significant improvement in agricultural research, especially in India, a lot of non-volatile and non-hazardous approaches have been traced out for development of Herbal based pesticides and insect repellants. These are developed using natural plant and floral extracts in appropriate mixture concentrations that provide many passive benefits along with its core job. These include better scent/perfume aftereffects, no chemical side-effects, or acquiescent interactions with bodily cells. The term pesticide is so common that the term is often treated as synonymous with plant protection product. It is commonly used to eliminate or control a variety of pests, rodents, and bugs that influx into an area.

1.1 Drones Types and Repellants classifications

Drones find their use along various domains. This flexibility in design and application of use allows segregation of this piece of technology into various types: 1. Multi-Rotor Drone 2. Fixed Wing Drones 3. Single Rotor and 4. Hybrid VTOL.

A pesticide is any substance, solid, liquid or gas that is used to kill, repel or control certain forms of plant or animal life that are considered to be pests or rodents. They are essentially grouped according to the types of pests they are chemically designed to kill:

- a. Insecticides – Insects
- b. Herbicides – Unwanted plants
- c. Rodenticides- Rodents including Rats & Mice

- d. Bactericides – Bacteria
- e. Fungicides- Fungi

2 Literature Survey

The main concept of this research is to deliver the book to the students using a robot in a library. This study is essential in order to increase the efficiency of delivering books to the student in library. In other words, it decreases the waiting time during peak hours. The robot uses a ATMEGA microcontroller to run a program with a combination of RFID technology, IR sensors for detecting the path, a simple gripper. The RFID reader is fixed on the robot itself and reads the RFID tag which is placed on the Robot. The robot will deliver respective book to the student based on the tag. The main difference in the design of this serving robot as compared to the previous research is the application of RFID technology. The RFID application allows the robot to identify the right book that is to be served.

2.1 Scope of Research

In a university, a fundamental role is played by the maintenance staff in every aspect. One of these, happen to rest on the personnel involved in the job of Mosquito Repellent fumigation. Where this process is extremely beneficial and helpful, it degrades the health of the person performing the task, due to the prolonged exposure to the categorically hazardous smoke.

To eliminate this risk, this project was approached from a standpoint where the investments made were marginally equal, the system had low maintenance concerns simultaneously the goal of eliminating the risk of the job was executed. Hence, the entire brief was bifurcated into three broad phases where the first phase dealt with mechanical design of the Quadcopter, followed by the implementation of the IoT Automation systems and the ultimate phase dealing with finding a suitable composition to a bio-extract that had equivalent capacities with respect to petrochemical based fumigators.

From a far hand perspective, this piece can be mechanically redesigned to be size friendly, where it could be miniaturized into a smaller form factor when not in use. Also, with the incorporation of certain sensors, it could practically perform jobs of repellent spraying around the designated area with full efficiency and no human supervision requirement at all.

3 DESIGN AND MODELING

3.1 Design calculation:

1. Maximum Ampere Rating

The maximum current that a fuse will carry for an indefinite period without too much deterioration of the fuse element. The maximum ampere of an ESC must be greater than the motor or propeller combination will together draw.

$$\text{ESC} = 1.2-1.5 \times \text{Maximum ampere rating of the motor}$$

2. Voltage from battery

$$\text{At 3S battery, } 11.1 \times 12 = 133.2 \text{ Watt}$$

$$\text{At 4S battery } 14.8 \times 12 = 177.6 \text{ Watt}$$

We prefer to use a 3S battery state arrangement due to efficiency limitations
Therefore,

$$\begin{aligned} \text{ESC (A)} &= 1.2-1.5 \times \text{Max. Ampere rating of motor} \\ &= 1.5 \times 12 \\ &= 18\text{A} \end{aligned}$$

And, we have chosen an ESC of 30A considering all the error margins and tolerances in calculations.

3. Thrust Calculation of Drone (Without Spraying Unit)

General Formula,

$$\text{Thrust Required} = (\text{total weight of setup}) \times 2/4$$

Therefore,

Estimating an overall weight assumption including that of frame, electronic components, motors and setup, we foresee a figure of 1500 grams. Out of which, the frame weight must be 800 grams and auxiliary equipment weight close to 700 grams.

$$\begin{aligned} \text{Required Thrust} &= 1500 \times 2/4 \\ &= 750 \text{ grams} \end{aligned}$$

Hence, from the generalized formula, we get an average thrust of about 700 grams is required from each motor in order to take off vertically for a Quadcopter arrangement.

Now, we calculate the thrust released by each motor based on its construction constraints:

$$T = \{(\eta \times P)^2 \times 2 \times \pi \times r^2 \times \text{air density}\}^{1/3}$$

Where,

η = Propeller hover efficiency (0.7-0.8)

P = Shaft Power

= Voltage x Current x Motor Efficiency

R = Radius of Propeller in meters

Air Density = 1.22 kg/m³

Voltage = 10V

Current = 18A

Motor Efficiency = 0.75

Then the thrust calculated

$$T = \{(0.7 \times 10 \times 18 \times 0.75)^2 \times 2 \times 3.14 \times 0.127 \times 0.127 \times 1.22\}^{0.33}$$

$$= 10.09533 \text{ N or } 1009.533 \text{ grams of thrust/ motor.}$$

Now since, it is a quadcopter design, the total thrust generated by all motors is given by multiplying the thrust calculated above by 4

Total Thrust T = 1009.533 x 4 gms

= 4038.132 grams.

We choose to assume a total of 75% from the motors side

= 0.75 x 3090

= 3028.599 grams

4. Thrust with Spraying Unit

The required thrust when we assemble the spraying equipment to the drone is given by:

$$T_2 = (1500 + 300) \times 2/4$$

$$T_2 = (1800 \times 2)/4$$

$$T_2 = 900 \text{ grams}$$

Since the thrust produced by an individual motor is close to 1009.533 grams and the total thrust reigns to be about 3028.59 gms with efficiency considerations, the thrust generated shall be greater than the amount of thrust required with the combination of drone and the spraying unit, so our system is supposed to work effectively under safe conditions.

5. Battery Calculations

We have to calculate the amount of energy the system is consuming; hence we now have to calculate the drainage amount required by the source.

Max Source = Discharge rate x Capacity

= 20 x 2200

= 44000 or 44 Amp

6. Discharge Rate

Discharge rate is simply how fast a battery can be discharged under safe conditions. Usually, this is termed as its 'C Rating'. As a point of concern, we are not supposed to discharge a Li-Po battery below 80% of its capacity. So, in other words, the ESCs must not exceed the maximum source 44A. However, we have selected a 30A ESC, hence it doesn't produce a problem.

7. PROPELLOR CALCULATIONS

We know,

Payload Capacity + The weight of the craft = Thrust x Hover Throttle %

For example, if we choose 3S LiPo battery power supply, our propellor must be of the order 10 x 4.7 and throttle around 75%. The weight of the craft itself is 1800 grams.

$$1000 + 1800 = T \times 0.75$$

$$T = 2800/0.75$$

$$T = 3733.34 \text{ grams}$$

This amount of thrust is produced by the 4 motors, so the individual thrust required must be

T = 3733.34/ 4
 T = 933.34 grams

Since the required thrust is 933.34 grams, as we calculated above the thrust generated by each motor is 1009.533 grams. Hence our system must run smoothly.

Hence, we can conclude to select the 4 propellers of size 10 x 4.5 inch out of which 2 are designated to rotate to CW and 2 CCW. Additionally, each propellor amounts up to 20 grams, so total weight sums up to 80 grams.

8. 2-D DRAFTING

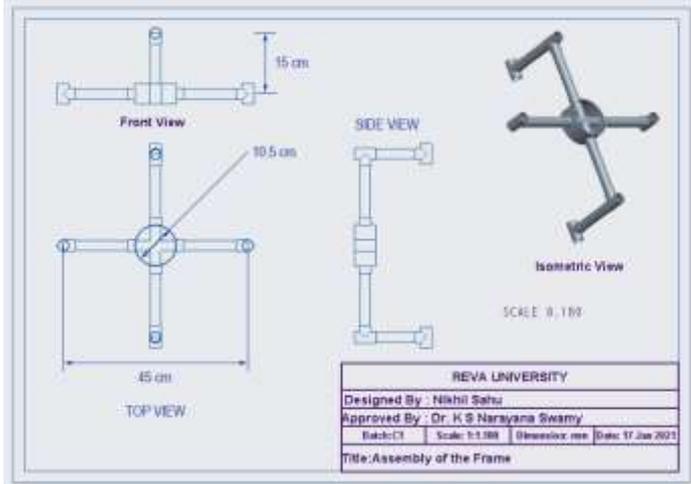


Fig 1 Final Assembly Model of Drone frame

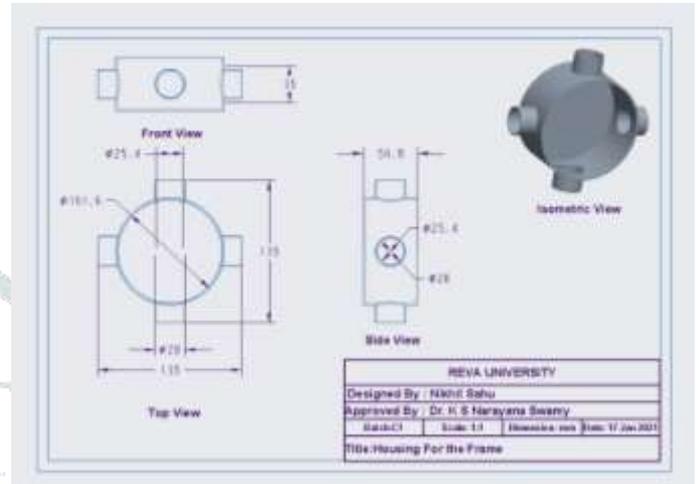


Fig 2 Dimension Specification of 4-Way

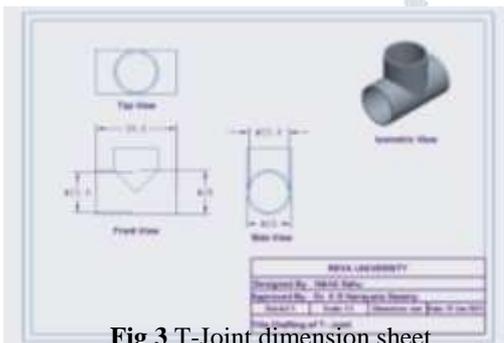


Fig 3 T-Joint dimension sheet

The figures are the isometric view of the final assembled model of the Drone Fumigator frame. The complete design was done using Creo Parametric 6.0 software.

3.2 Modelling

A total of 5 parts were designed, which were merged into a single assembly view giving us the entirety of the visualized model. The entire Assembly is shown as follows.

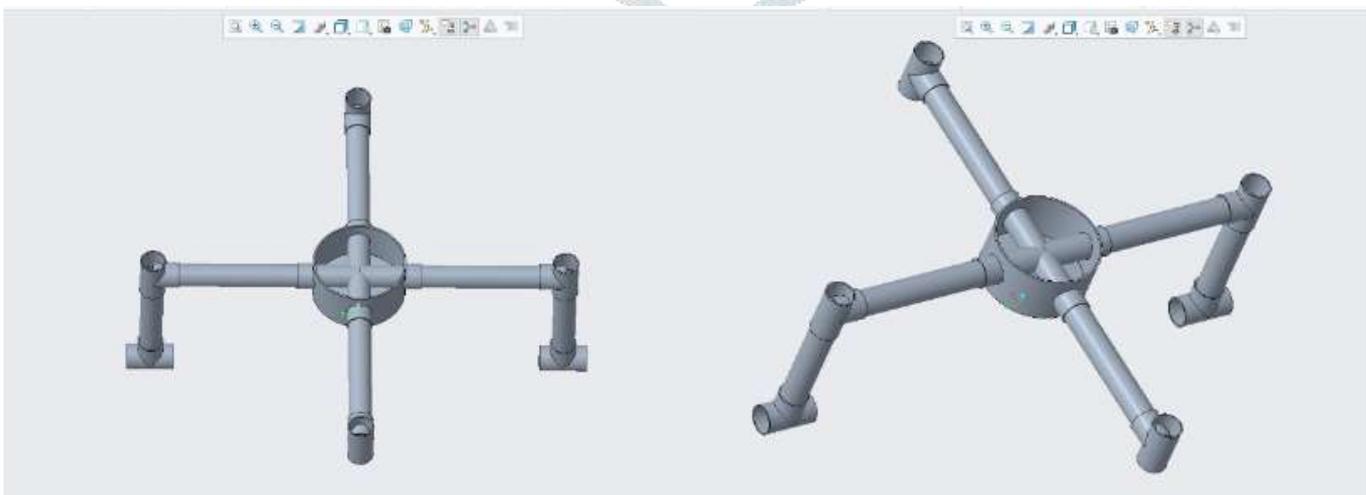


Fig 4 Assembly view of the Drone Frame

The designated components as per the model can be connected in any order as per convenience but it is advised to follow the template procedure mentioned below to avoid damage to any components:

1. The drone needs to be built using reusable PVC pipes. As per frame size calculations, the PVC pipes are cut and a crossbow four-way arm connected is used to hold and join the arms.
2. Four T-connectors are connected at each end of the arm that forms a housing for both landing gear and the motor housing.
3. The four motors are adjoined to the base of the T connectors via corrugated sheet cutouts for light weight sustenance. The motors are connected to the legs of each frame using the screws provided with the motors. The motors ought to be screwed tightly to avoid any issues whilst spinning.
4. Once the arms are ready, each arm is connected to the four-way connected joint and the power distribution board. This gives a raw look to the Quadcopter. Once the arms are in place, we have to visually decide which should be the front side and which has to be the rear. This is necessary as the flight controller uses this information to determine flight routine for the quadcopter.
5. Then we subsequently connect the ESC's to each motor. This step determines the direction the motors shall spin. Starting from the left side of the front of the quadcopter, we label it as 1. Following ones are numbered in clockwise direction as 2,3 and 4. This leaves the 4th motor being the left side of the back of the quadcopter.
6. The 1st and the 3rd motor rotate in clockwise direction, while the 2nd and the 4th motor rotate in anti-clockwise direction. The motors are 3 phase brushless DC motors (BLDC). There are 3 wires in each motor to connect to the 3 wire in the ESC. This however, follows no order. The order which we used is simply by connecting the wires in the same order as it is provided with the ESC's and the motors and so on. This is theoretically supposed to rotate the motor in clockwise direction. Hence, we perform this with the 1st and 3rd motor and alternate the wirings for the 2nd and 4th motor. This allows them to rotate in anti-clockwise direction.
7. Next step involves soldering the ESC's positive and negative terminals to the power distribution board in the frame. The ESC's are then attached to the legs of the frame using zip ties which shall prevent turbulence effects of fall off during flight.
8. Followed by this, is the housing of the flight controller in suitable self-designed case while stick it to the power distribution board. Insulation between the two must be maintained.
9. The servo connectors in the ESC's are then connected to the flight controller. There is a particular order for this and is hence printed on the flight controller itself.
10. We attach the battery in the designated case on the frame. This step requires attention as the battery unit is supposed to be heavy bringing centre of gravity in the picture. The C.O.G of the frame and the battery positioning must match suitably. A battery connector is also soldered to the power distribution board. This is used to connect to the battery terminals.
11. Then we attach the receiver to the frame and connect the channels of the receiver to the respective pins in the flight controller. The receiver should be placed at a small distance from the power source board in order to avoid interferences.
12. Once, the motor and power board construction are ready, we attach the landing gear to the T-joints. Additionally, we make use of sponge or thermocol base cushioning.
13. Next step involves building of sprayer module and the container. It is to be attached in a fashion that allows easy refill of the container with the pesticide as soon as it gets depleted.
14. The next step involves connecting the sprayer module to the MOSFET and then to the battery. The MOSFET in turn is connected to the receiver to make it work like a switch.
15. Then we following have to check whether the components are working properly. So, we crank the transmitter first and then the quadcopter on switch by connecting it to the battery and the power source. We shall receive a feedback sound from the motors.
16. The flight controller is armed by using the transmitter and is done by lowering the throttle in the transmitter and then moving it in the left direction.
17. After arming the flight controller, we raise the throttle slowly and check if the motors are spinning in the right direction. Also, whether the sprayer module turns on.
18. If the motors are spinning in the right direction, we remove the battery connection and turn off the transmitter. Then we screw the propellers tightly into the motor.
19. Once, we are done with the check and fail analysis, we test it under hostile conditions and map the results discussing future needs and priorities of its functioning.
20. All the results are duly taped and recorded for test and analysis purposes.

5.1 MAKING THE PESTICIDE COMPOSITION

The pesticide in its originalistic composition has been carefully derived from various herbal and plant-based extracts that serve, help and eliminate the need of toxic chemicals that essentially do the job but on exposure can have detrimental effects on both the environment and the animate beings. Another angle to this subject involves the perpetual use of only atomizers for the job and eliminate the concept of cold or thermal foggers that are not only complex to use but are also act as an individualistic addition to the carbon footprint in the society. If used collectively, the overall metric tons of pollutant generated in the chain of process can show up as a significant number in the pollutant chain. Hence, herbal composition makes more sense.

To create a mixture, certain specific plants ought to be used with accurate percentage of constituents as proposed in the research citing's mentioned in the references based on their chemical behavior and physical attributes. The Table below elaborates the chemicals and their respective extracts with duly mentioned percentages:

Table 5.1 List of Extracts Used in mL

Plant Name	Extract Used (Chemical Composition)	Percentage of Constituents (in mL)
Citronella Plant (Fresh Lemongrass)	Citronella Essential Oil (C10H18O)	10
Eucalyptus	Eucalyptol and Alpha-terpineol (C10H18O)	10
Tulsi	Tulsi Essential Oil	3
Clove Bud	Clove Bud Essential Oil	7
Sweet Orange Peel	Peel Extract	6
Turmeric	Essential Root Oil extract	4
Nika	Nika derivative	12
Neem Plant	Neem Leaf extract	12

- All chemicals mentioned in the table with their percentages have been sourced from the quoted references and samples have been duly tested.
- Ideal methods of oil extraction vary for each plant and shrub based on the tested extraction method. However, many believe rather than being synthetically manufactured in labs, essential oils from plant materials through removal processes that are suited to the plant part helps retain the peak characteristics and nutrients that are desired.
- Essential oils are the liquids that are isolated from plants when introduced to solvents-they are liquefied versions of the plant.
- Popular extraction methods include: Steam Distillation, Solvent Extraction, CO2 Extraction, Maceration, Enfleurage, Cold Press Extraction and Water distillation.
- The method of extraction affects essential oil quality by way of pressure and temperatures applied.
- Some methods are best suited to particular plant types and parts, for example: Cold Press extraction for our Citrus Orange peel extract is better than Enfleurage for obtaining oils from it. This actually allows the peel to be pierced and squeezed, which is not achievable by enfleurage.

5.2 Software Description

Pre-requisites

The Flight controller purchased usually comes loaded with older versions of Multiwii. It is necessary to download the latest versions of FC Firmware & MW Config&WinGUI from online sources and configure the quadcopter for its flight control update. It remains imperative that the firmware on FC & WinGUI/MW Config are same versions.

Mission Planner IDE Setup

Download the Mission Planner Open-source application from the link addressed below:

<http://ardupilot.org/planner/docs/mission-planner-installation.html>

Once, downloaded and saved, decompress the file using favored program. This segment covers minimum configuration and suggested options. More options remain available and shall be covered in appropriate areas.

Selecting the Copter Type.

Following section encodes QUADX as the default input for copter type pattern. If QUADX is not the desired type, place// before and remove them on the desired selection.

Installing Mission Planner and connecting with APM

Once the software is ready to be used, specific calibrations ought to be done. This specifically can be used to program APM and Pixhawk Flight controllers

- First step is to connect our APM flight controller to PC/Laptop using a USB or a MicroUSB cable to allow transfer of data.
- PC inherently detects the Board as “Arduino Mega” and subsequently installs driver s required for the operation.
- Once the scene is coherent, open and access Mission Planner software and select COM port at a baud rate of **115200**.
- Access the “INITIAL SETUP” tab and click on “Install Firmware” and then select the type of Multirotor setup. As per our design, we select the Quadcopter Setup and proceed giving the software further permission.
- This completes the Installation as now the device highlights “Quadrotor” as its status.

Compass Calibration and Setting up Accelerometer

- Access the Initial Setup Tab and click on Mandatory hardware. Select the Frame type as X for our Quadcopter.
- Select the Accel Calibration section and click on the Calibrate Accel.
- Under SETUP, it is advisable to perform “Onboard Calibration”. This happens to be a calibration routine that runs on autopilot, which happens to be more accurate than the older “Offboard/ Live Calibration”.

To perform the onboard calibration of all compasses:

- Click the “Onboard Mag Calibration” section’s “Start” button.
- The autopilot has a buzzer attached so we hear a single tone followed by short beep once per second.
- Hold the vehicle in the air and rotate it so that each side (front, back, left, right, top and bottom) points down towards the earth for a few seconds in turn. Consider a full 360-degree turn with each turn pointing a different direction of the vehicle to the ground. It will result in 6 full turns plus possibly some additional time and turns to confirm the calibration or retry if it initially does not pass.



Fig 5 Onboard Calibration arenas

- As the vehicle is rotated the green bars should extend further and further to the right until the calibration completes its process.
- Upon successful completion three rising tones will be emitted and a “Please reboot the autopilot” window will appear and you will need to reboot the autopilot before it is possible to arm the vehicle.
- Once, the calibration is over we can head for the compass. APM has a built-in compass and directly calibration can be carried out. We head on to the Live Calibration and rotate the APM 360 degrees. Hit finish to complete the process.

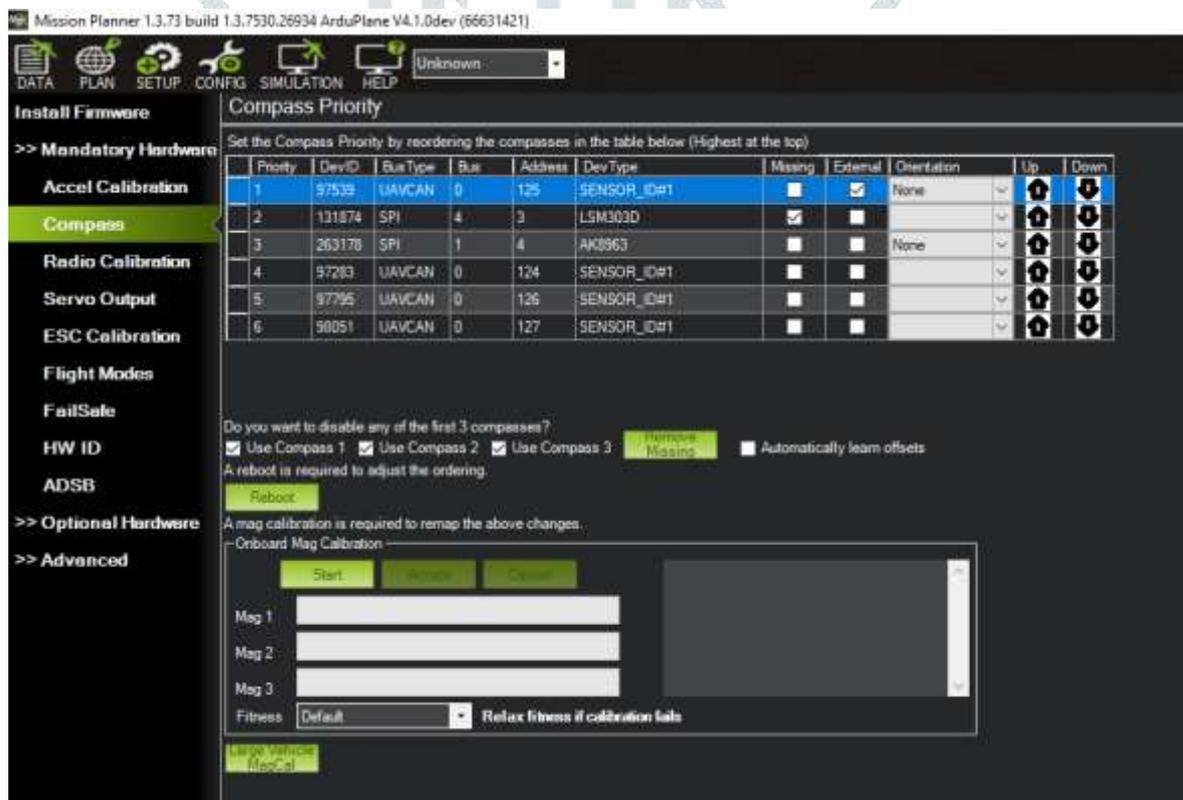


Fig 6 Mission Planner: Compass Calibration

- To verify that the system remains operational, move the APM while it is connected to Mission Planner. We observe the change in flight position and corresponding values.

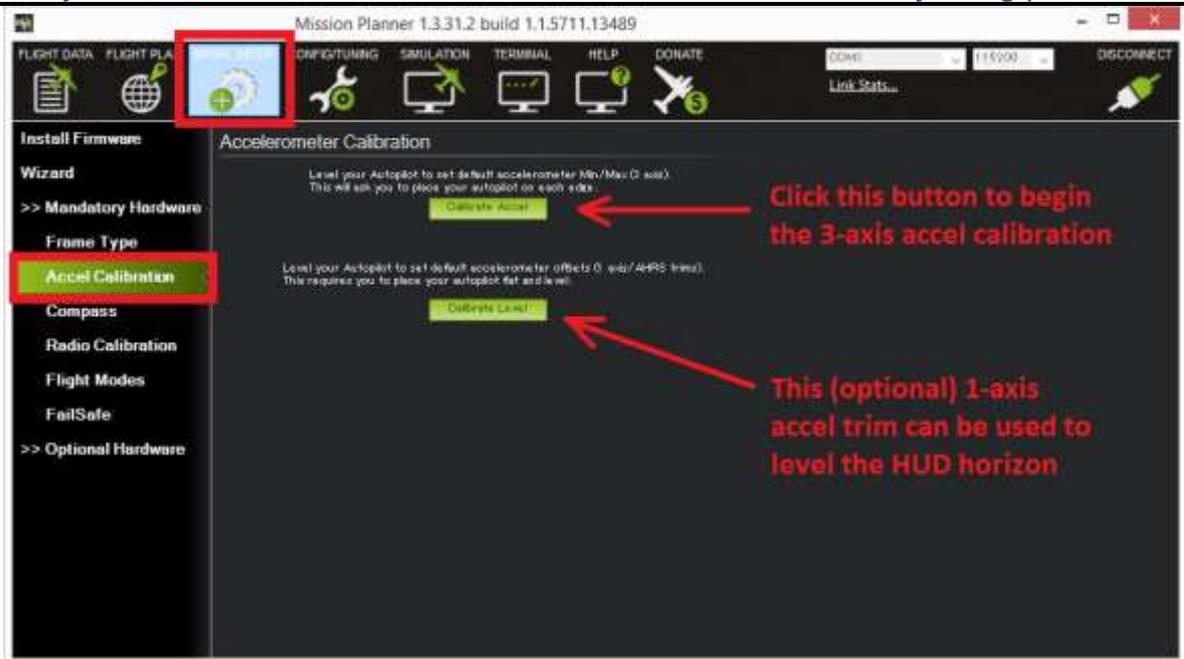


Fig 7 Mission Planner interface: Calibrate Acceleration

Connecting and Calibrating Radio Control

- We connect the Receiver Unit to the Flight Controller as per the given image that demonstrates the Pin Configuration of Input side, that is to be connected to the APM, and configuration of the Receiver FS-iA6.
- Generally, APM 2.5, 2.6, 2.8 all have similar configurations, where the outermost pin is Ground, Middle one for positive supply and Inner most for the signal transmission.



Fig 8 Correspondent channel connections



Fig 9 Channel identification columns

- Below is the PinOut for the Receiver FS-iA6. First channel is for ROLL/AILERON, second is for PITCH/ELEVATOR, third is for THROTTLE, fourth is for YAW/RUDDER and fifth and sixth are Mode selection switch. Here also, outer one is Negative switch, middle one is Positive switch and the left one or innermost one is signal pin. Channel wise setup is similar in other 6 Channel Receivers also.
- Referring the given image, we connect the receiver with the transmitter and the APM with the receiver. Once the receiver connections are done right, a red-light glow up indicating the success of calibration with the Transmitter.

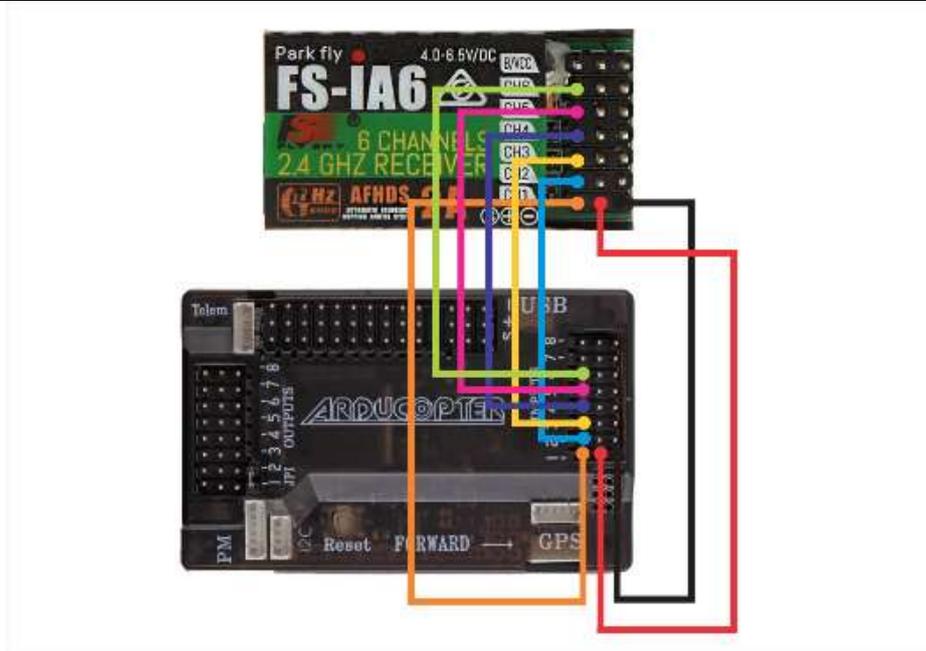


Fig 10. Calibration Layout Map

- Once the radio calibration is done on the manual front, we move on to calibrate the software portion.
- In the Install Firmware section, we click on the “Radio Calibration” section and observe different bars for varying parameters. These bars indicate any change occurring on the transmitter joystick.
- Click on the calibrate radio button and vary the parameters between their extreme ends and subsequently choose to change the knobs. We observe that Red extreme lines are captured by the mission planner for the correspondent channels. Now since the extremes are captured by the software, we click on the “Click when done” button to save the changes.

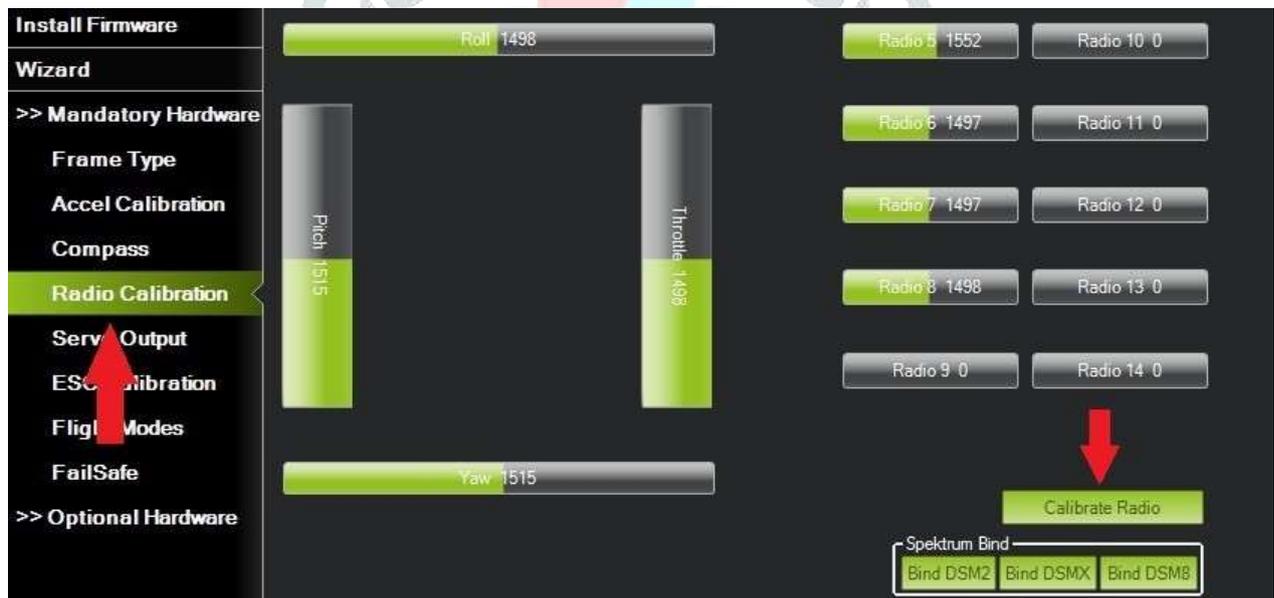


Fig 11. Radio Calibration home screen

- This signifies the end of calibration. Now we proceed with connecting the APM with the ESC’s which are then connected to the motors.
- Mission Planner will show a summary of the calibration data. Normal values are around 1100 for minimums and 1900 for maximums.

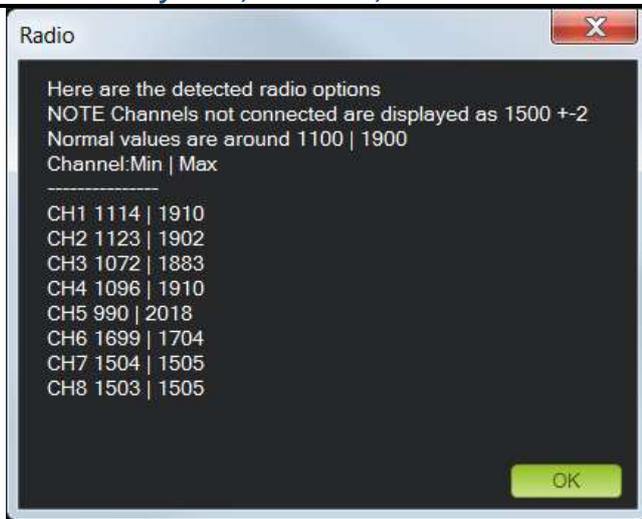


Fig 12 Mission Planner summary table

Mode 1 and Mode 2 Transmitters

There are two main transmitter configurations:

- Mode 1: Where the left stick allows pitch and yaw while the right stick controls throttle and roll.
- Mode 2: Left stick controls throttle and yaw while right stick controls pitch and roll.

Channel Mapping

Copter default channel mappings are:

- **Channel 1:** Roll
- **Channel 2:** Pitch
- **Channel 3:** Throttle
- **Channel 4:** Yaw
- **Channel 5:** Flight modes
- **Channel 6:** (optional) Inflight tuning or camera mount.
- **Channel 7:** Auxiliary function switches

ESC (Electronic Speed Controller) Calibration

ESC calibration is dependent on the brand used. However, some general checkpoints are followed by all ESC's in common. Usually, "All at Once" calibration works best for most, however if it fails, "Manual ESC-by-ESC" methods suits the proprietary best.

All at Once Calibration

1. Turn on the transmitter and hit the throttle stick at maximum.
2. Connect the LiPo battery. The autopilot's red, blue and yellow LEDs will light up in a cyclical pattern. This means the it's ready to go into ESC calibration mode the next time you plug it in.
3. With the transmitter throttle stick still high, disconnect and reconnect the battery.
4. The autopilot is now in ESC calibration mode. (On an APM you may notice the red and blue LEDs blinking alternatively on and off like a police car).
5. Wait for your ESCs to emit the musical tone, the regular number of beeps indicating your battery's cell count (i.e., 3 for 3S, 4 for 4S) and then an additional two beeps to indicate that the maximum throttle has been captured.
6. Pull the transmitter's throttle stick down to its minimum position.
7. The ESCs should then emit a long tone indicating that the minimum throttle has been captured and the calibration is complete.
8. If the long tone indicating successful calibration was heard, the ESCs are "live" now and if you raise the throttle a bit they should spin. Test that the motors spin by raising the throttle a bit and then lowering it again.
9. Set the throttle to minimum and disconnect the battery to exit ESC-calibration mode.

Manual ESC-by-ESC Calibration

1. Plug one of the ESC three-wire cables into the throttle channel of the RC receiver. (This is usually channel 3.)
2. Turn on the transmitter and set throttle stick to maximum (full up) and connect the LiPo battery.
3. After the two beeps, lower the throttle stick to full down. You will then hear a number of beeps (one for each battery cell you're using) and finally a single long beep indicating the end points have been set and the ESC is calibrated.
4. Disconnect battery. Repeat these steps for all ESCs.
5. If it appears that the ESC's did not calibrate then the throttle channel on the transmitter might need to be reversed.

6. If you are still having trouble after trying these methods (for example, ESCs still beep continuously) try lowering your throttle trim 50%.
7. You can also try powering your APM board via the USB first to boot it up before plugging in the LiPo.

Testing the Connections

Once the calibrations are completed, we test them using the LiPo battery joints without the propellers.

- We set the switch to “Stabilize Mode” and arm the copter.
- Give it a small amount of throttle via the joystick and visually check if all motors spin at the same speed and at the same time. If in other cases, the motors do not start at the same instant or at speed, the ESC’s portray a faulty calibration.

IoT Setup and Construction

IoT based response communication between the end user and the equipment widely works via an Android based smartphone device that has a downloaded or pre-built Google Assistant system in its software domain. Printed Circuit Boards or PCB modules accompanying the need of the system, have to be ordered from external sources. This can be done by uploading the Gerber designs of the board on a third-party website and choosing appropriate specifications. From a component perspective, we need the mentioned items:

1. NODEMCU ESP8266
2. Diode IN4007
3. Diode IN4148 or Resistor (330Ω)
4. Transistor BC547
5. Voltage Regulator 7805
6. LEDs
7. DC Socket
8. Terminal Connector
9. Header, and
10. Relay 5V

Proceed with the above network diagram and solder the components as per placement.

- Input a 5V power supply or a power bank to charge up the circuit.
- Download Google Assistant and Arduino Layout 1.8.3 Home Automation platform.



```

1 //Viral Science
2 // www.youtube.com/c/viralscience
3 //Google Assistant Home Automation
4 #include <ESP8266WiFi.h>
5 #include "Adafruit_MQTT.h"
6 #include "Adafruit_MQTT_Client.h"
7
8 #define Relay1      D1
9 #define Relay2      D2
10 #define Relay3      D3
11 #define Relay4      D4
12
13 #define WLAN_SSID    " " // Your SSID
14 #define WLAN_PASS    " " // Your password
15
16 //***** Adafruit IO Setup *****
17
18 #define AIO_SERVER    "io.adafruit.com" //Adafruit Server
19 #define AIO_SERVERPORT 1883
20 #define AIO_USERNAME  " " // Username
21 #define AIO_KEY       " " // Auth Key
22
23 //WIFI CLIENT
24 WiFiClient client;
25
26 Adafruit_MQTT_Client mqtt(client, AIO_SERVER, AIO_SERVERPORT, AIO_USERNAME, AIO_KEY);
27

```

Fig 13. Google_Assistant_Home_Automation | Arduino 1.8.3

- Download auxiliary libraries for the Arduino platform, available on internet sources and use digital frames 1,2,3 & 4 as a trigger for the relays.
- Access *adafruit IO* via the internet and register on the website for free. Once done, create a new dashboard under the actions with ‘IoT Drone’ as a title name and input an appropriate description.
- Add suitable buttons for the 4 relays and rearrange on dashboard for ease of access.
- Under the Arduino platform input existing Wifi name and password name under the code line


```
#define WLAN_SSID " " // wifi name
#define WLAN_PASS " " //wifi password
```
- Copy and paste the *adafruit IO* Username and activation Key generated by the website under the ‘key’ symbol in the Arduino automation portal under the code line


```
#define AIO_USERNAME " " 
```

#define AIO_KEY "....."

- Compile and upload the updated code to the NODEMCU board. This allows the PCB board and relays to accept inputs from Google assistant after calibration.
- Access *IFTTT* website and sign in via the same email id used for *adafruit IO*. This website allows user to create applets that allows input definition from the end user using google assistant.
- Locate
My Applets > Create New Applet > Search Google Assistant > Connect > Sign In (using your registered Email ID) > Allow & Select the 1st option.
Input the commands suitably as per functionality.
- Next
Click Trigger > Add '+' command option > Select Adafruit and connect > Access authorization > and Feed IP Address as Relay 1 parameter
- Follow these steps repetitively for input and registration of other commands operational by Google Assistant.

Once the inputs are registered, connections are laid and device is ready for application, check voice recognition via Google Assistant to light up connected devices as a test facility. Once the criteria are fulfilled, the connections can be reharnessed suitably onto the Drone.

6 RESULTS & DISCUSSIONS:

After arming the quadcopter, throttle is raised making the system to lift off. The quadcopter allows movement of left, right, forward and backward depending upon input provided from the transmitter receiver unit. The fumigator as per design availability and constraints happen to be manually operated via water pump and atomizers at the end of the T-joint arms of the quadcopter. Systems related to drone and fumigator happen to work fine with calibrations and readings readable by system PC. The quadcopter moves with good stability and flying over designated spraying areas makes it easy. Low-cost capital investment and easy maneuverability make it affordable to the affordable to the desired target audience.

The solution has been curated keeping the ease of service staff of REVA University in mind. As a successful model is developed, our initial target customers encircle in and around masses from REVA University.

The need for human intervention is slowly bound to dis-orient from themselves and the future evolves to scenarios where minority jobs like these would erode due to the practicality and ease of use of automated equipment. Human error and risk involved within the chores will therefore become absent from the scenario and machines will take decisions based on iterative environmental needs of the planet. This undoubtedly increases the scope for literacy and drastically eliminates hazardous activities that humans as a species are subjected to. This is the way for natural evolution.

7 CONCLUSION:

The successful completion of this methodology project, we can achieve implementational results with effective fumigation of herbal based repellents for mosquito control. The repellent liquid is categorically non-hazardous, as it is a liquefied mixture of herbal extracts with measured proportions and can be made contact with humans without ant protective equipment. This is easily be used in places non accessible areas that are usually missed by human controller thermal foggers. The cost of the development of the equipment remains relatively cheaper than its market competitors due to minimalistic design approach and use of cost-effective material composites and plastics, that are both easily available and replaceable during times of need. Fumigation is performed at low altitudes for shrubs and bushes eliminating the unnecessary mist of repellent fuse within the surrounding air zones, reducing both wastage and amplifying effectiveness. Too much of repellent can ideally be dangerous, but quadcopter facility rules out this concern due to its performance based on precision fumigation.

8 SCOPE FOR FUTURE WORK:

- With technological advancements and funds, flight and operational time of the drone can be increased so much so that the entire designated campus can be covered in one effective drive eliminating the charging constraint involved currently.
- The spray nozzles can be redesigned and atomizers can build sophisticatedly in order to control spray area and accuracy in spraying angles.

This piece can be mechanically redesigned to be size friendly, where it could be miniaturized into a smaller form factor when not in use. Also, with the incorporation of certain sensors, it could practically perform jobs of repellent spraying around the designated area with full efficiency and no human supervision requirement at all.

REFERENCES

1. Parag Parihar, Priyanshu Bhawsar, Piyush Hargod "Design & Development Analysis of Quadcopter", COMPUSOFT, An international journal of advanced computer technology, (Volume-V, Issue-VI), Pg No. 2128-2133, June-2016.
2. Igor Gaponov, Anastasia Razinkova "Quadcopter Design and Implementation as a Multidisciplinary Engineering Course", IEEE 20-23 Aug. 2012
3. Prof. A.V. Javir, Ketan Pawar, Santosh Dhudum, Nitin Patale, Sushant Patil "Design, Analysis and Fabrication of Quadcopter", Journal of Advance Research in Civil and Mechanical Engineering (ISSN: 2208-2379), 2015-03-31.

4. Parth N. Patel, Malav A. Patel, Rahul M. Faldu, Yash R. Dave “Quadcopter for Agricultural Surveillance”, Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 3, Number 4 (2013), pp. 427-432 © Research India Publications, 2013.
5. Fabrizio Sarghini “Analysis of Preliminary Design Requirements of a Heavy Lift Multicopter Drone for Agricultural Use”, CHEMICAL ENGINEERING TRANSACTIONS VOL. 58, 2017, ISBN 978-88-95608-52-5; ISSN 2283-9216, DOI: 10.3303/CET1758105
6. Prof. V. M. Pimpalkar, Damini Gattewar, Chetan Bhojar, Punam Aglawe, Payal Khobragade “IOT BASED HOME AUTOMATION USING ATMEGA328 MICROCONTROLLER”, International Journal of Engineering Applied Sciences and Technology, 2020 Vol. 4, Issue 10, ISSN No. 2455-2143, February 2020.
7. Prof. Ayad Ghany Ismaeel, Mohammed Qasim Kamal Erbil “Design an IoT Home Automation System uses Hybrid Mobile App Based Arduino and Cloud”, IEEE DOI: 10.1109/CRCSIT.2017.7965533, April 2016
8. Sarishma, Sushant Chamoli, Dr. Sumitra Sangwan, Vivudh Fore “Smart Home Automation using ESP8266 and Internet of Things”, March 2019.
9. Aung Zaw Oo, “GPS-GSM BASED LOCATION AND POSITION TRACKING SYSTEM”, J. Myanmar Acad. Arts Sci. 2019 Vol. XVII. No.2B, 2019
10. Panayotis Argyroudis; Gwain Bayley, Matthew S. Grob, La Jolla: Marc Phillips; Samir S. Soliman “WIRELESS REMOTE TELEMETRY SYSTEM”, Patent Number: 5,748,104, May 5, 1998.
11. Steven L. Geerlings, Steven Swiftney, Landon S. Foy, Jens Ohler, Jack A. Huisingsh “WIRELESS TRAINABLE TRANSCEIVER DEVICE WITH INTEGRATED INTERFACE AND GPS MODULES”, Patent No: US 9,542,834 B2, Jan. 10, 2017.
12. Dr. Sneha Agarwal, Nidhi Haldankar, Aniket Jadhav “Formulation of Natural Mosquito Repellent”, International Journal of Advance Research, Ideas and Innovation in Technology (Volume 4, Issue 1), 2018.
13. S. N. Ranasinghe, L. Arambewela, S. Samarasinghe “2. Development Of Herbal Mosquito Repellent Formulations”, International Journal Of Pharmaceutical Sciences and Research (Volume 7, Issue 9), 2016
14. Hrishikesh Badrike, Megha Sampat, Sayali More, Wilma D’Cunha “Evaluation Of Natural Oils For The Development Of Cheap And Sustainable Solution For Mosquito Problem In The Poor Community”, International Journal of Research and Development in Pharmacy & Life Science, 2017
15. Nandini Rani, Aakanksha Wany, Ambarish Saran Vidyarthi and Dev Mani Pandey “Study Of Citronella Leaf Based Herbal Mosquito Repellents Using Natural Binders”, Current Research in Microbiology and Biotechnology (Volume 1), 2013.
16. Dhara Shukla, Moratuwa “Effective Mosquito Repellent From Plant Based Formulation”.International Journal of Mosquito Research, 2017