Chapter 1
INTRODUCTION

The agriculture sector in India is by far most significant one in terms of GDP (Gross Domestic Product) and is important in terms of employment also, as it provides over 50% of national human work force. This is sufficient to understand the dependence of our country on agriculture. Even with these figures, our country has not yet deep dived into the full potential of agriculture which could be accounted to improper or manual methods of farming, such as pesticide spraying. There are over 35 start-ups in drones that are currently working on raising the technical standards of agriculture and reduce the cost of drones that can be used in agriculture.

Pesticides are vital part of production of crops in agriculture. Farmers use the in order to check point the insects and pests. Using these have remarkably increased the yield of crop. Over one-third of the products of agriculture are depending on application of pesticides. Thus, they play a crucial part in reducing the plant/crop diseases and hence increasing the output.

It is inevitable that agriculture serves as the backbone of economy of India. Hence, it is very critical to improve the efficiency and output of agriculture while simultaneously providing safe cultivation measures to a typical farmer. Even though it is mandatory and very important to spray pesticides in a farm for better yield of crops, it also proved to be a hazard for the health of farmers. Hence, they need to take all the necessary precautions before tasking up such activities. They carry the sprayer on their back which can potentially strain them as they need to wear them throughout the activity. Also, it is not possible that pesticides are spread evenly across the farm, as there are some locations which cannot be accessed by human.

WHO (World Health Organisation) conducted a survey, according to which, the estimated number of farmers/workers who are affected by poisoning of pesticides is about 3 million and out of these numbers about 18000 people die. Hence, this project has an objective to prevent such cases where the heath of farmers is affected and also to provide a better way of agriculture with minimal intervention of humans and a better and efficient way of spraying pesticides. In this model we use components such as APM 2.8 flight controller, which is a main component for functioning of drone and controls it according to

the plan. The model uses various components to attain calibration of drone and also has a feature of live tracking using satellite connection, thus resulting in precision.

1.1 IOT

Internet of Things (IoT) is a system of inter-related, inter-connected objects that have the ability to collect the data and transfer it over internet/wireless network. In Iot objects can be sensed and can be remotely controlled across a network (existing network), thus it is used for interaction of the physical components (hardware) and computer-based software components and is used for integration of both. Iot can be used for performing remote sensing, actuation, live monitoring of some specific kind of data. Iot devices can perform live data exchange and can collect data from other devices.

Thus the IOT can be defined as: "A dynamic Global Network Infrastructure with self-configuring capabilities based on standard and interoperable communication to protocol where physical and virtual things have identities, physical attributes, and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network ,often communicate data associated with user and their environment."

A typical Iot device consists of various wired/wireless interfaces such as-I/O interface for sensors, interface to connect to internet, interface for audio/video, interface for memory and storage.

1.2 IOT APPLICATIONS IN AGRICULTURE

With increased demand in agriculture, Iot is being extensively used in various parts of world for improvising agricultural activities, so that the production loss is less and farming is efficient. In order to achieve this automation of various cultivation activities is practiced such as robots, drones etc. In the project a drone is used to carry out various features and mainly used to spray pesticides in an automated way without manual work.

- Iot based drone (quadcopter) is used to go to areas which are to be sprayed, using an external compass set along with the drone, reach the specified coordinates and perform spraying activity.

- Follows the plan setup in the system and can run in automate flight mode which requires no human interaction, satellite view is provided for a better view of drone activity, to assess height, speed and throttle of drone and if needed, to make changes.

Chapter 2

PROBLEM STATEMENT

In the view of farming activities, we see many people(farmers) spending their time for spraying pesticides in their fields, spraying manually to cover the entire area of farm. Some times when farmers are spraying poisonous spray, their eyes are getting affected and their health is being damaged and also requires lot of manual work and labor. Our project aims to overcome these problems, by using IOT application called Pesticide Spraying Drone. This drone comes with a special function in such a way that, it has a capability of spraying. This helps to reduce human effort and save lot of time and money. This drone also helps to spray in all the locations, where human can't go and spray and covers all the locations efficiently and equally.

Chapter 3
LITERATURE SURVEY

The main objective of spraying pesticides using drone is to make best use of technology. Prof. P. P. Mone, Chavhan Priyanka Shivaji, Jagtap Komal Tanaji, Nimbalkar Aishwarya Satish have given details about implementation of Agriculture drone for automatic spraying mechanism. In this paper, they gave problem statement of World Health Organization where it estimates that there are 3 million cases of pesticide poisons in each year and up to 220,000 deaths, primarily in developing countries. In this paper they also explain what precautions the farmer should have to use to avoid harmful effects of pesticides and fertilizing effects as well as cost effective technology using components such as PIC microcontroller for the control of agriculture robots [1].

The drone follows the path specified by the user, which makes use of GPS to outline a path. Spoorthi S et al. deployed a drone to spray pesticides wherein a farmer can control the drone using an android app.Wi-Fi module(ESP 8266) is used to interface the app with the drone. It creates a route map of farmers land using GPS regardless to the type of crop or the land. They used an Arduino board to interface with GPS and Wi-Fi modules. The system is called FREYR drone which is a quadcopter mainly used to save time and increase yield using a user-friendly interface [2].

Various components are required for drone to operate which are provided by the study paper published by Prof. S.R. Kurkute, Prof. B. D. Deore, Payal Kasar, Megha Bhamare, Mayuri Sahane published a paper called “Drones for Smart Agriculture: A Technical Report” which provides information about various technologies used in order to reduce human efforts in agriculture such as pesticide and fertilizer spraying. A uniform spraying mechanism across the field takes less time using drone, the system is time effective as well as cost effective, as the power taken by drone costs lesser than the human mechanism which is of more cost comparatively. Provides information on ESC controller and BLDC motors as well as RF 2.4 GHz remote controller [3].

In-order for the drone to fly properly, it is significant that we can control the position of the drone for a safe flight and back. Dr. Madhukar S. Chavan has implemented a spraying drone using Wi-Fi and a micro controller AT80C51, creating an interactive user design, open-source electronic platform with Wi-Fi and GPS is used. The project aims at uniform distributed spraying of pesticides across the field

using gps module to create a route. The software components were interfaced using Arduino IDE. Flight controller, which is a main component to control and balancing of the drone and takes care of the drone orientation [4].

Flight controller and ESC controllers are main components of controlling a drone. ESC controllers are attached to each of the hands of drones or propellers of drone. Prof. K. B. Korlahalli, Mr. Mazhar Ahmed Hangal, Mr. Nitin Jituri, Mr. Prakash Frances Rego, Mr. sachin M. Raykar published a paper entitled “An Automatically Controlled Drone based Aerial Pesticide Sprayer”. In this paper authors have implemented and produced the details of Agriculture Wonder Drone System. They used GPS, BLDC motor, ESC etc. The flight control board is used for controlling the movements of drones such as lifting, movement etc. This drone system can operate in two modes, autonomous and manual mode [5].

The features such as auto pilot and return to launch ensure that the drone is crash proof and less faulty. Prof. P.S. Mhetre , Deepali Soni , Akshay Nerkar , Harsh Vishal have implemented such features where the drone containing four motors ,is enabled to change the direction of its motion according to the users requirement ,by changing speed of rotation and direction of rotation and thus follows the path or specific direction in which user wants it to travel i.e. landing, forward path, backward path etc. The project’s goal was to improve and modify the existing drone system to maintain a stable flight and operate according to GPS information and it can also perform the auto-motive commands, for instance, auto-landing [6].

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Chapter 4

SOFTWARE REQUIREMENTS SPECIFICATION

Software Requirement Specification is an initial part of the software development process. As the system became inevitably complex, it was apparent that the goal or objective of the entire system is difficult to comprehend easily. The main purpose of software requirement specification is to bridge the communication between the developers of the project and clients, by taking into consideration the opinions and ideology of the clients on their requirements for the software project. The SRS puts the input data (needs of the clients) and shapes it to a formal document.

4.1 Purpose

The purpose of the project is to output a drone which helps the farmers to perform activity like pesticide spraying, by establishing calibration, setting height of the drone from the land, setting coordinates to make the drone go to the remote places and the ability to spray pesticides by following a plan that is set in the system using a software, which improves the efficiency of spray as well as reduces labor work.

4.2 Scope

This project's scope is to spray pesticides faster than in normal manual practice, to reduce human effort. It can do a work in such a way that it takes about a time span of 10 minutes to cover across 1 acre of land(approximately).

4.3 Objective

The objective of this project is to provide safe farming by spraying pesticides using drone thus, reducing the load on farmers and increasing efficiency by accessing every possible area to be covered using the drone.

4.4 Existing System

In the existing system, the activity of spraying pesticides is an effort by a person and is done by a spray bag on the farmer and spraying is done non-uniformly using such manual methods wherein it takes up a lot of time. This conventional method can also affect health due to contamination by contact with the pesticides.

4.5 Proposed System

In the proposed system a drone quadcopter is used to automate the above process with minimal interaction with humans and uses Iot to perform the activity. A remote using radio waves is used for sending and receiving signals in a wireless transmission mode (radio controller), it has features of live tracking using gps module and the facility to make a plan of the travel of the drone, it can also be done in autopilot mode which doesn't require radio controller to go and return. It provides a much safer, time saving and efficient way for performing this activity.

4.6 REQUIREMENTS

4.6.1 FUNCTIONAL REQUIREMENTS

F450 FRAME:

A 450mm frame (for quadcopter) is built with materials of quality. This version of the frame implements PCB connections for ESC's direct soldering. It also removes the need for multi-connectors or power distribution boards, thus keeping the layout clean. It also has strong arms, ensuring no breakage on hard-landing.

Fig. 4.1. F450 Drone Frame

PROPELLERS:

These are the devices that make the transformation of the rotatory motion into linear thrust. These are the main component of the system which provide the ability to fly for a drone by creating an airflow ,with their movement(spinning).Propellers are arranged in pairs in such a way that some of them move in clock wise direction and some in anti-clock wise direction ,which creates a balance. In the drone system the speed of the propeller is varied for performing critical activities such as hovering, landing,

ascending, descending etc.

Fig. 4.2. Propellers

1000 KV BLDC MOTORS:

These motors are made exclusively to power the quadcopters and multi rotators. As mentioned, it is a 1000 kV motor. BLDC motors are-Brushless DC electric motors which are also called as electronically commutated motors (ECMs) or synchronous DC motors. These synchronous motors are powered by DC electric current via a power supply which is switching, wherein it produces an AC current for driving each phase of the motor. Using these motors in our drone system is perfectly suitable for our quadcopter as 4 of these motors along with the propellers give a thrust of 3.2 kg. Thus, helping us build an efficient and powerful quadcopter.

Fig. 4.3. BLDC Motor (1000 kv)

ESC 30A:

Electronic Speed Controller are used in the system to mainly control the speed of the drone by controlling the power supply that is reached to the motors. ESCs are attached to each of the 4 sides of the drone frames, and are connected to the BLDC motors. It hence provides a better speed control of the motor and gives efficient performance of flight. It works on LiPo batteries of 2S-3S range. It can also control the direction and act as a dynamic brake to the system.

Fig. 4.4. ESC 30A

6 CHANNEL TRANSMITTER AND RECIEVER:

The fly-sky FS-i6 is a 2.4 GHz transmitter and receiver and it uses the Automatic Frequency Hopping Digital System (AFHDS) spread spectrum which is reliable. It also contains a channel 6 receiver which is FS-iA6.It has antenna which is low profile, therefore FS-i6 is an easy to store transmitter. In order to the adjustment or changing of flight modes, this FS-i6 has a switch which is 3- positioned and also has two knobs which are adjustable and are used of the range of signal screen in the transmitter is used for the display of the status of flight etc. The FS-iA6 receiver uses radio signals, it can catch the signals over a range of 2km.

Fig. 4.5. FS-iA6 Receiver

GPS COMPASS:

This is a high precision GPS module (NEO-M8N) with a built-in compass with low power consumption and high accuracy. This GPS module is like a secondary brain to the system. It automates the work by connecting to a minimum of 4 satellites. Using this we can implement some significant features in the build of the system such as return to launch which enables the system to return to the point of launch incase the signal is lost and functions such as stabilize which is used to make the drone remain at a specific point which is fixed. This has the ability to give the status of live tracking in order for us to identify where the drone is positioned.

Fig. 4.6. GPS Module

AMP 2.8:

The APM 2.8 multicopter flight is an auto pilot system which is open source. It is the main controller of our quadcopter system. It has the ability to control up to a octa copter (with 8 motors). It consists of an in-built compass for the clarity of front and back direction. The inputs to the APM 2.8 controller is given from the receiver (FS-iA6). The output of this controller is given to the ESC from output pins and has a gps pin to connect to the gps module. It consists of a USB pin which is used to connect to the system. Hence, the code from the system is dumped into the controller first from which it gives commands to run the drone.

Fig. 4.7. APM 2.8

6 V DC WATER PUMP

It is a low-cost motor pump which can be operated in a voltage range of 3-6 v. By connecting the pipe to the motor outlet and pour water in it and supply power. It is used to store liquid pesticide in our system and spray it whenever required using the rc switch which is operated through the transmitter.

Fig. 4.8. Water Pump

4.1.1 NONFUNCTIONAL REQUIREMENTS

Performance:

The performance is measured in terms of the output generated by the model i.e., the caption generation. The model performance can be increased by using multiple classifiers. Performance of a system is estimated by the output and the constraints that specify the response time. As soon as the plan is set and the code is dumped into the controller, the system responds and takes the necessary action. Therefore, performance is high.

Fault tolerance:

The drone travels according to the plan in the software and also uses satellite information for tracking and live location and uses radio frequency for transmission and receival which can cover up to long range, resulting in less fault rate and crash control.

Cost:

The cost of entire drone system is comparatively less when seen with drones in the market, as it uses open-source software to execute the structure of flight of drone. Thus, system is cost effective and budget friendly for farmers.

Flexibility:

The modes of system can be adjusted according to the situation, whether it should return to launch position if signal is lost, to hold when the conditions of environment are not suitable etc. are the features available in the system which provide the required options in different scenarios making the system flexible to the needs of user.

Hardware requirements:

- F450 Drone Frame
- APM 2.8 Controller
- GPS Compass(module)
- 1000 KV BLDC Motors*4

- Propellers*4
- ESC (Electronic Speed Controllers) *4
- 6 Channel Transmitter and Receiver
- 6V DC Water Motor
- Mini Water Storage Tank and Water Pipes
- 4200mah 4S Battery

Software Requirements:

- Operating system: Linux, Windows 10 and Mac OSX.
- IDE: Ardo pilot open-source software and Mission Planner Application.

Chapter 6
METHODOLOGY

This drone is made up of several components. Each component performs its own task. Before Launching drone, we have to check weather every part is working fine because one small defect can lead to drone crash.

- First, we need to select the components that are suitable for our drone because, weight matters a lot in drone. if it is over weighted, then it will be difficult to carry weight on drone. Once the components are fixed according to the need, then we need to start assembling in the following way.
- Prepare an F450 frame first. Once the Frame is formed, check weather the frame is having balanced weight on 4 sides. Next attach motors to the corners of the frame. To control the speed of motors we need to use a device called ESC (Engine Speed Control). From this ESC, the current supply passes to the motor. This ESC input is given to power unit of the drone and there is another input hat will be given to the main controller of the drone. Here we use APM 2.8 as main controller to our Drone. Assemble all thee 4 motors in the same way by connecting ESC to all the motors.
- Once all the ESC's are attached to the main controller that is APM 2.8, then we need some device such that it should help APM to know what commands are given by user.
- For this, we use 6Channel transmitter and receiver. Transmitter is the controller that was used by the pilot to control the drone. On the other hand, receiver is attached to the drone. The output pins of the receiver is attached as the input to the APM2.8. with this receiver, the drone can work according o the commands given by the user. Here, for this drone we need to set auto pilot mode. So for this, we need to use GPS module device because it connects with satellite. This device is attached to APM 2.8. This device keeps tracking of the drone. This shows the drone for which path it needs to be travelled.
- Whenever transmitter sends the command, the receiver receives the command and it sends this instructions to APM 2.8 Flight Controller. Then the task given by the user can be performed.
- Once the drone is assembled, we need to configure it's calibration and the speed of the drone and also we need to configure its front, back an side directions.

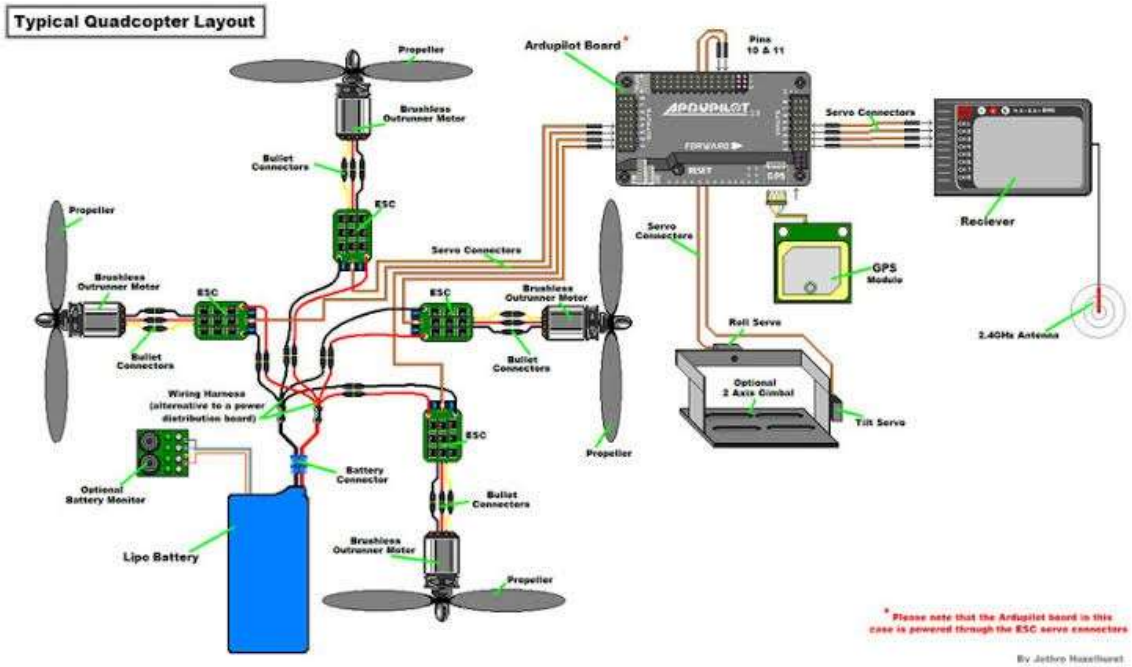

Fig. 6.1. Drone Layout

- For this we use an application called mission planner. In this software we configure all this and we should also design plan so that we can perform task automatically.
- Here we attach additional switch because our drone need to spray in the desired locations. For this, we used device called RC switch. This is attached between receiver and 6V water motor. Whenever the user performs spray action, then the switch automatically performs it. This motor is attached under the bottom of the drone. We attach water tank and pipes under the drone for passing the water. We have to check the weight of water and tank because if it is over weighted, the drone can't lift it. In this following way, the drone works.