PESTICIDE SPRAYING DRONE

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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INTERNAL EXAMINER	**EXTERNAL EXAMINER**

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ABSTRACT

In the present era, there are too many developments in precision agriculture for increasing the crop productivity. Especially, in the developing countries like India, over 70% of the rural people depends upon the agriculture fields. The agriculture fields faces dramatic losses due to the diseases. These diseases came from the pests and insets, which reduces the productivity of the crops. Pesticides and fertilizers are used to kill the insects and pests in order to enhance the crop quality. The WHO (World Health Organization) estimated as one million cases of ill effected, when spraying the pesticides in the crop filed manually. This led to the development of The Unmanned aerial vehicle (UAV) – aircrafts are used to spray the pesticides to avoid the health problems of humans when they spray manually. UAVs can be used easily, where the equipment and labors difficulty to operate. The UAV is provided with a spraying mechanism consisting of a pump, a storage tank, four nozzles to atomize the liquid into a fine spray, an octocopter configuration frame, an appropriate landing frame, Brushless Direct Current (BLDC) motors with appropriate propellers, and a suitable Lithium-Polymer. The drone can be equipped and transmitter to keep tabs on the spraying procedure and any plant pest attacks. Using this pesticide spraying drone cuts down on application time, man hours, and money. By altering the pump's flow discharge, this sort of drone can be used to spray disinfection substances over structures, water, and densely populated regions.

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LIST OF ABBREVIATION

WHO	World Health Organization
UAV	Unmanned aerial vehicle
USB	Universal Serial Bus
FPV	First person view
GPS	Global positioning system
MOSFET	Metal-Oxide-Semiconductor Field-Effect
IGBT	Insulated-Gate Bipolar Transistor
ESC	Electronic speed controller
IMU	Inertial measurement environment
PWM	Pulse Width Modulation
BEC	Battery eliminator circuit
USB	Universal serial bus
IDE	Integrated development environment

BLDC	Brushless Direct Current Motor
LCD	Liquid Crystal Display
DC	Direct Current
SC	Switched Capacitor
RPM	Revolutions per minute
Li-Po	Lithium polymer
UART	Universal asynchronous receiver transmitter
RX	Receiver
TX	Transmitter
I2C	Inter Integrated Circuit
SPI	Serial Pheripheral Interface
LED	Light Emitting Diode
FET	Field Effect Transistor
AI	Artificial Intelligent

CHAPTER 1

INTRODUCTION

Agriculture in India constitutes quite 60% of occupation. It serves to be the backbone of Indian economy. it's very essential to enhance the productivity and efficiency of agriculture by providing safe cultivation of the farmer. the varied operations like spraying of pesticides and sprinkling fertilizer are vital. Though spraying of pesticides has become mandatory it also proves to be a harmful procedure for the farmers. Farmers especially once they spray urea, fancy many precautions like wearing appropriate outfit masks and gloves. it'll avoid any harmful effect on the farmers. Avoiding the pesticides is additionally not completely possible because the required result has got to be met.

Hence fore, use of robots in such cases gives the simplest of the solutions for this sort of problems, alongside the specified productivity and efficiency of the merchandise consistent with survey conducted by WHO (world health organization) it's estimated that each year about 3 million workers are suffering from poisoning from pesticides from which 18000 die.

This project aims to beat the ill-effect of the pesticides on citizenry and also use to spray pesticides over large area briefly intervals of your time compare to standard spraying by using automatic fertilizer sprayer. This device is essentially combination of spraying mechanism on a quad copter frame. This model is employed to spray the pesticides content to the areas that can't easily accessible by humans. The universal sprayer system uses to spray liquid also as solid contents which are done by the nozzle.

Pesticides and fertilisers are both sprayed using the global pipeline, however fertiliser spray is Not currently done so; instead, pesticide spray is done using a pressure pump. GPS may be utilized to remotely pilot the quadcopter and autonomously direct it across wide distances. The RF Transmitter and motors of the quadcopter are controlled by automatic control and paid upload.

The potential health effects of pesticides include asthma, allergies, and hypersensitivity, and pesticide exposure is additionally linked with cancer, hormone disruption, and problems with reproduction and fatal development. use of aircrafts is becoming increasingly common in completing this task mainly due to reduction in farmland,labor shortage, unscientific and outdated method.

To tackle the issues, An agricultural drone which will help in reducing the human interference within the spraying of fertilizer and pesticide within the field and hence saving lives. The drone which we are developing uses BLDC motor to sprinkle pesticide and fertilizer to the numerous and uneven terrain where pesticides and fertilizers can't reach. It uses containers to store the chemicals and by the actions on pumps, releases it, which increases the efficiency and reduces harmful impact because it is going to be precise.

1.1 TYPES OF DRONE

1.1.1 FIXED WING DRONES:

Fixed wing drones consists of a rigid wing (Non movable wing), fuselage (main body of the aircraft) and tails which use a motor and propeller as their propulsion system. They have the advantage of being able to fly at higher speeds for longer duration and that can cover wide range of possible environments (ex: jungle, desert, mountain, maritime etc.). But these drones have the disadvantage of requiring runway or launcher for take-off and landing and not being able to hover.

1.1.2 ROTARY WING DRONES:

These drones will have the rotary blades or propeller- based systems they are called rotatory wing drones. Unlike the fixed wing models these drones can fly in every direction, horizontally, vertically, and also have the ability to hover and have a high maneuverability. These characters make them perfect drones for surveying hard to reach areas (pipelines, bridges). They are similar to helicopters generate lift from the constant rotation of the rotor blades. But these too have disadvantage of low speed and short flight range.

1.1.3 TETHERED SYSTEMS DRONES:

A tethered drone system uses a permanent physical link, in the form of a flexible wire or cable, to provide power and communications to a UAV (unmanned aerial vehicle). Due to the inability of fixed-wing drones to hover, UAV tethered systems utilize quadcopters or other multirotor drones, as well as aerostats. They are used for situations where the required flight endurance is greater than that of the free- flying drone, and only a minimal operating area is needed.

1.2 CLASSIFICATION OF DRONES

1.2.1 ACCORDING TO SIZE:

1. Very small drones: They can be designed with a common size range varying from a large sized insect to a 50 cm long unit. Two most common designs in this category are: Mini Drones and Nano/ Micro Drones. The nano drones are widely used due to their tiny structure and light weight construction and can be used for spying and biological welfare.

2. Mini drones or small drones: They have a size little bigger then micro drones that means will go above 50 cm but will have maximum 2m dimension. Many of the designs in this category are based on the fixed wing model, whereas few can have rotary wings. Due to their small size they lack in power.

3. Medium drones: This category of drone's presents that are too heavy to be carried by one person but are smaller than the light aircrafts. These drones can carry weight up to 200Kgs and have average flying capacity of 5 to 10 minutes. One of the most popular designs under this category is UK watch keeper .

4. Large drones: Large drones are somewhat comparable to size of aircraft and are most commonly used for military applications. Placed that cannot be covered with normal jets are usually captured with these drones. They are main device for surveillance applications. Users can also classify them further into different categories depending upon their range and flying abilities.

1.2.2 ACCORDING TO ALTITUDE

1. **Low altitude system:** They can fly up to 105-200m height, with in the site of the pilot and its limits the area with a single mission.

2. **Medium altitude systems:** Operate in same space as in air traffic little use for civil or scientific community.

3. **High altitude systems:** Mostly fixed wing aircraft and Sun is the power source. Classification of drone according to range is listed in table 1.2 .

DRONE RANGE	FLIGHT DISTANCE	FLIGHT TIME	USE
Very-close RangeDrones	5 km	1 Hour	• Recreation
Close-range drones	up to 50 km	1-6 Hours	• Military surveillance • Aerial photography
Short-range drones	up to 150 km	8-12 Hours	• Large-scale surveillance • Mapping and surveying • Utility inspection
Mid-range drones	644 km	24 Hours	• Military combat and surveillance
Long-range drones	More than 644 km	More than 24	• Military surveillance and espionage • Weather tracking • Geographic mapping

Table 1.2 Classification of Drone according to drone range

Classification of drone according to size is listed in table 1.2.1

SIZE	LENGTH	PROPELLOR DIAMETER	WEIGHT	USE
Very small drones	150mm (15cm, 6 inches) or less	51mm (2 inches) or less	200 grams (0.2kg, 0.44lbs) or less	• Military Surveillance
Small Drones	Up to 300mm (12 inches)	76-152mm (3-6 inches)	200-1000 grams (0.44-2.2lbs)	• Indoor equipment inspections • Recreation and photography
Medium Drones	300-1200mm (12 inches – 4 feet)	150-640 mm (6-25 inches)	1-20kg (2.2-44 pounds)	• Professional applications • Amateur photography
Large Drones	120cm (4 feet) and up	64 cm (25 inches) and up	20kg (44 pounds) and up	• Enemy detection and combat capabilities • Civil applications such as drone deliveries or filmmaking.

Table 1.2.1 Classification of Drones according to their sizes

CHAPTER 2

LITERATURE SURVEY

Ritesh Banpurkar, et.al.,[1] have proposed a paper on “Fertilizer Spraying UAV-A Agriculture Drone” Reducing Human efforts and using machines instead, In the world full of AI technology, we are so immersed in updating all the natural processes in mechanized process. And at the same time, we need to take care from harmful chemicals present in pesticides. The WHO estimated 1 million cases of ill affected when spraying the pesticides manually in crop. So, aim is to design a drone with pesticides with spraying mounted mechanism. This will reduce the human effort in various operations of agriculture like spraying of UREA, spraying of fertilizers etc. This pesticides drone reduces the time, cost, labor in agriculture application. This paper describes the development of hexa-copter and spraying mechanism. The discussed system involves designing a prototype which uses simple cost effective equipment’s like, BLDC motor, Arduino, ESC wires, etc. This type of drone can also be used to spray disinfectant liquid over buildings, water bodies and in densely populated areas by changing the flow discharge of pump.

A.Boni, et.al.,[2] has published a paper on “Application of Unmanned Aerial Vehicles in Agriculture” The authors first provide an overview of the current challenges facing agriculture, including the need to increase productivity while reducing costs and minimizing the impact on the environment. The authors then provide examples of how UAVs have been used in agriculture, including crop mapping, yield estimation, and plant health monitoring. They also discuss the potential for UAVs to be used in precision agriculture, where data collected by UAVs can be used to optimize inputs such as fertilizer and water.

The article goes on to describe the various types of UAVs currently available, including fixed-wing and multirotor drones, and their respective advantages and limitations. The authors also discuss the different types of sensors that can be attached to UAVs to collect data, such as RGB cameras, multispectral sensors, and thermal cameras.

S. S. Sarode,et.al.,[3] has proposed a paper on “Agricultural Drones”,This is a research paper on agricultural drones, which provides a comprehensive review of the technology, applications, and challenges of using drones in agriculture. The paper covers various aspects of agricultural drones, such as the types of drones used, the sensors and imaging systems they carry, the software used for data processing, and the benefits and limitations of using drones in agriculture. Additionally, the paper also discusses some case studies and applications of agricultural drones in different regions around the world.

Z.Zheng,et.al.,[4] has proposed "Agricultural Drone Technology” The authors begin by discussing the background and motivation for the use of drones in agriculture, including the increasing demand for food due to population growth and the need to reduce costs and increase efficiency in farming operations. The article then delves into the various applications of agricultural drones, including crop monitoring, mapping, and spraying. The authors discuss the sensors and imaging technologies that are commonly used in agricultural drones, such as RGB and multispectral cameras, LiDAR, and thermal sensors. They also highlight the benefits of using drones in agriculture, such as increased efficiency, reduced labor costs, and improved crop yields.

Abdul Hafeez,et.al.,[5] has proposed a paper based on topic “Implementation of drone technology for farm monitoring & pesticide spraying” The world receives more than 200 thousand people in a day and it is expected that the total world population will reach 9.6 billion by the year 2050. This will result in extra food demand, which can only be met from enhanced crop yield. Therefore, modernization of the agricultural sector becomes the need of the hour.This paper presents an analysis of drone technologies and their modifications with time in the agriculture sector in the last decade. The application of drones in the area of crop monitoring, and pesticide spraying for Precision Agriculture (PA) has been covered. The work done related to drone structure, multiple sensor development, innovation in spot area spraying has been presented. Moreover, the use of Artificial Intelligent (AI) and deep learning for the remote monitoring of crops has been

Karan Kumar Shaw,et.al.,[6] has published “Design and Development of a Drone for Spraying Pesticides, Fertilizers and Disinfectants” There are too many technologies involved in today’s Agriculture, out of which spraying pesticides using drones is one of the emerging technologies. The WHO (World Health Organization) estimated as one million cases of ill affected, when spraying the pesticides in the crop field manually. This paved the way to design a drone mounted with spraying mechanism having 12 V pump, 6 Litre storage capacity tank,4 nozzles to atomize in fine spray , an octocopter configuration frame ,suitable landing frame, 8 Brushless Direct Current (BLDC) motors with suitable propellers to produce required thrust about 38.2 KG(at 100% RPM) and suitable LithiumPolymer (LI-PO) battery of current capacity 22000 mAh and 22.2 V to meet necessary current and voltage requirements. A First-Person View (FPV) camera and transmitter can also be fixed in the drone for monitoring the spraying process and also for checking pest attacks on plants.

Y. Huang,et.al.,[7] has proposed a paper on “Development of a spray systems for an Unmanned aerial vehicle platform” Agricultural chemical application is frequently needed at specific times and locations for accurate site-specific management of crop pests. Piloted agricultural aircraft are typically used to treat large, unobstructed, continuous acreage crops and are not as efficient when working over small or obstructed plots. An Unmanned Aerial Vehicle (UAV), which can be remotely controlled or fly autonomously based on pre-programmed flight plans, may be used to make timely and efficient applications over these small area plots. This research developed a low volume spray system for use on a fully autonomous UAV to apply crop protection products on specified crop areas. This article discusses the development of the spray system and its integration with the flight control system of a fully autonomous, unmanned vertical take-off and landing helicopter. Sprayer actuation can be triggered by preset positional coordinates as monitored by the equipped Global Positioning System (GPS). The developed spray system has the potential to provide accurate, site-specific crop management when coupled with UAV systems.

S L Patel,et.al.,[8]has published “Orchard spraying systems for unmanned aerial vehicles” Mango is the most important commercial grown fruit crop and world’s mango production is averaging about 22 million metric tons per year. India is largest fruit producer after china. However, the country having advantages over mango producing countries, but productivity continues to be low. To increase the overall plant health and fruit yield as well as to protect the tress from harmful fungal diseases, spraying is necessary for mango orchard. As mango is important fruit crop of Konkan region and its spraying operation is done conventionally, the operation is time consuming. UAVs are commonly used for spraying orchards. In conventional method of spraying results in excessive application of chemicals and less uniformity which further leads to more production cost. Application of pesticides with the help of UAV could have advantage of spray over crops and covering large areas quickly. UAV fly at proper height can increase pesticide penetrate effectively. This paper presents details study about development of orchard spraying system for unmanned aerial vehicle which can reduce spraying cost and loss pesticide.

Shubhangi g.rajput,et.al.,[9]has proposed a paper on“A Review on Agricultural Drone Used in Smart Farming” In today’s era, there are many developments in precision agriculture for increasing the crop productivity. Mostly in developing countries like INDIA, around 70 to 75 % of rural people depends upon agricultural fields. Agricultural processes are chains of systematic, repetitive, and time-dependent tasks. Agricultural drone helps farmers to optimize operations performed in agriculture. Farmers Can see their farms from sky with the help of agricultural drone. The drones or UAVs collect information and communication technologies, robots, artificial intelligence, big data, and the Internet of Things. UAVs are easier to use and efficient also, farmers can easily operate drone. The UAV’S can also operate on the relay driver and commands given by the transmitter. This paper introduces a quad copter which is used for pesticide spraying in agriculture field Using UAVs, helps the farmer to improve the agricultural production and management of crops in ecofriendly way.

Jalu A. Prakosa,et.al.,[10]has made a research on “Speed Control of Brushless DC Motor for Quad Copter Drone” Quad copter drone usually uses Brushless Direct Current (BLDC) motor as rotor due to high efficiency and small volume. The BLDC motor speed control is very important for drone position and velocity determent. The optical sensor can be used to measure the rotation speed of BLDC motor when tested in the laboratory. The calculation of rotation speed, use of Pulse Width Modulation (PWM) technique for speed control and serial interface can be implemented using a microcontroller. The purpose of this research is to control the speed of BLDC motor for ground test of drone rotor.

Davide Liuzza,et.al.,[11] have proposed a paper on the topic “A review on the use of drones for precision agriculture” In recent years, there has been a strong activity in the so-called precision agriculture, particularly the monitoring aspect, not only to improve productivity, but also to meet demand of a growing population. At a large scale, precise monitoring of cultivated fields is a quite challenging task. Therefore, this paper aims to propose a survey on techniques, applied to precision agriculture monitoring, through the use of drones equipped with multispectral, thermal and visible cameras. For each application, the main limitations are highlighted and the parameters to be considered before to perform a flight are reported.

Swee King Phang,et.al.,[12] has researched about “Design and Implementation of an Agricultural UAV With Optimized Spraying Mechanism” In this era of modern technologies, the structure of rural labour force throughout the whole world has changed drastically. It has increased the contradiction regarding the demand and lack of rural labour force available therefore agricultural equipment with higher efficiency is sought after in order to serve for the agricultural production. Besides that, crop diseases and pests are major factors affecting the quality and yield of crops. Chemical pesticides will be the main solution in order to control and prevent this from happening. The selection of the equipment to be used is a critical factor for chemical pest control. In China, there are more than 88% of manually operated sprayers that includes manual air-pressure or electric knapsack sprayer and knapsack mist-blower sprayer. The agricultural industry has embraced drone technology where these advanced tools are being used to modernise the traditional farming.

Emad Ebeid,et.al.,[13] have proposed a paper on "A Survey on Open-Source Flight Control Platforms of Unmanned Aerial Vehicle" Recently, Unmanned Aerial Vehicles (UAVs), so-called drones, have gotten a lot of attention in academic research and commercial applications due to their simple structure, ease of operations and low-cost hardware components. Flight controller, embedded electronic component, represents the core part of the drone. It aims at performing the main operations of the drone (e.g., autonomous control and navigation).

Dr. Prashant S. Kadu,et.al.,[14] has made a research on "Design and Development of Agricultural Spraying Drone" Designing the drone for spraying has become one of the essential concerns in recent developments in technology in order to avoid human involvement in the spraying phenomenon. While designing the spraying drone it is important to design the components according to according to specifications. In this paper a tank carrying a spraying liquid of 3 lt. for spraying herbicide over rice crop. This paper deals with the selection of spraying liquid and spraying system required for the spraying operation. The spraying system includes the pump, nozzle and carrying media(pipes). The spraying tank is analyzed for drag and lift at different angles of the front face is titled at different angles between 0 to 60° with the vertical. The optimum tank configuration has been selected for the design. The paper also includes selection of herbicide, pump and nozzles for the drone spraying assembly.

Collin Pond,et.al.,[15] has given a detailed review on "Drone Motors and ESC" One of the primary concerns with all quad copter drones is the limited energy supply available. It is vitally important to have efficient energy use and efficient motor rotation to help achieve maximum thrust and flight time. The brushless DC

(BLDC) motor is the most popular and efficient motor in quadcopters due to the minimal friction and energy loss in the motor. This is especially important for our project because and loss in efficiency would decreased the package size that the drone can carry or reduce the flight time. Additionally, the speed of the motors must be carefully controlled using the electric speed controllers (ESCs) to ensure a stable and precise flight. Any variation could result in one motor running faster or slower than the other three and drive the drone off course or even cause a crash. The general setup for a quadcopter consists of two pairs of identical fixed pitched propellers, two clockwise and two counter clockwise propellers.

CHAPTER 3

SYSTEM DESIGN

3.1 EXISTING SYSTEM:

Automation is an extremely important part of engineering and has become necessary in all domains. As it is presently observed there is a shortage in farm labour. The proposed ‘Automated Drone’ is designed to enable spraying of fertilizers. Unlike the present available drones, it has many features and advantages which will reduce labour and time thereby increase effectiveness of farming. The ‘Automated Drone’ will work on GPS technology and also regulated by sensors. The main feature of this ‘Automated Drone’ is that it does not require any manual control or interfaces while working. This ‘Automated Drone’ is an effective gadget which can be used in all agricultural farming's to reducing the burden of the farmers and also being cost effective.

3.2 PROPOSED METHOD:

In our proposed system , A programmed controller which gets the inputs from GPS module, RADIO transmitter and controller gives the output to flight control to take off the drone. Then the works of drone where done means then the drone goes to the specified location to land by itself. The main advantages of this agricultural drone is to reduce man power, cost effective, low time consuming, and even spraying. The flight controller is the main board in the UAV is embedded with the most advanced firmware and responsible for the actual flight. Flight controller controls lot of things simultaneously during the flight or UAV. It built with a micro controller and communicates to the four brushless motors. BLDC motor connect with the rotors in directions of the UAV configuration model. These BLDC motors are controlled by the Electronic Speed controllers (ESC).The propesd system block diagram is shown in figure 3.1.

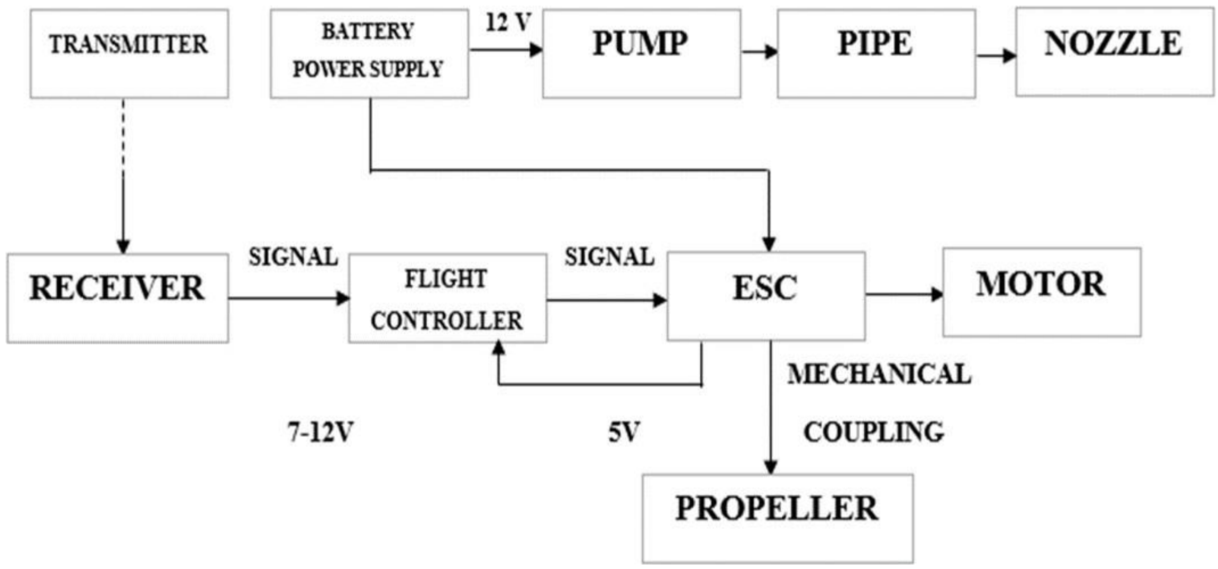

Figure 3.1 Block Diagram of Proposed System

3.2.1 PROPOSED SYSTEM WORKING:

- The signals will be transmitted from transmitter and it will be received by the receiver in the drone. From the receiver the signal goes to the flight controller where the signal will be processed with gyroscope sensors.
- The processed signal will be sent to the ESC, which allows specific amount of current to the motor based on the signal it receives.
- The propellors are mechanically coupled to the motors so that they rotate and produce thrust.
- The pump takes current supply from li-po battery and pressurizes the liquid from the storage tank then the pressurized liquid flows through the pipeline and enters the nozzle then gets sprayed.
- The flow rate of the pump can be controlled by varying the input current which can be controlled from the transmitter

3.3 CIRCUIT DIAGRAM:

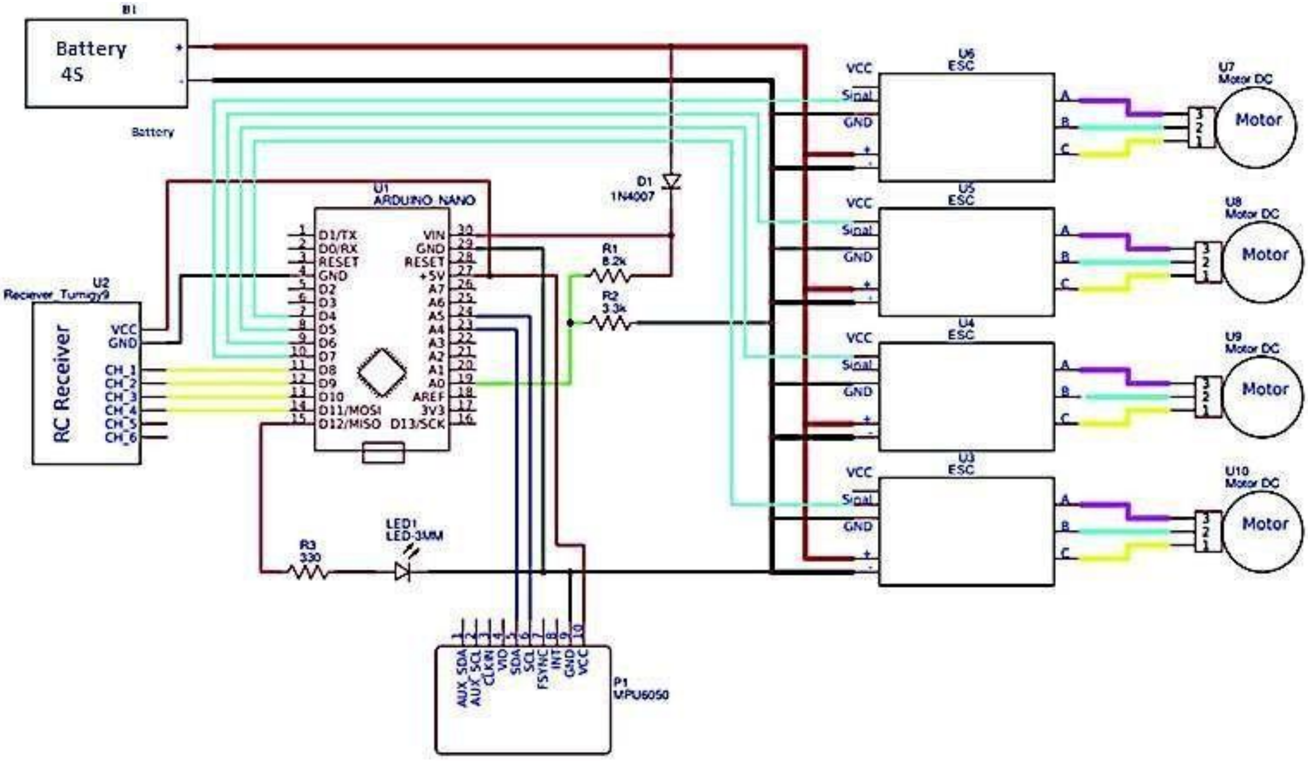

Figure 3.2 Circuit diagram

3.3 HARDWARE COMPONENTS:

3.3.1 Flight Controller (KK2.1):

The flight controller is the brain of a drone. A small box filled with intelligent electronics and software, which monitors and controls everything the drone does. And just like the brains of different organisms, flight controllers also vary in sizes and complexity.

- The subsequent stage in the development of the rotor rotation has arrived!! The KK2.1 Multi-rotor LCD Flight Control Board With 6050MPU And Atmel 644PA has been upgraded in terms of its sensors, memory, and header pins, which allows it to carry a significant power punch.
- The KK2.1.5 is the next significant step forward in the advancement of the KK flight control boards used in the first generation. Installing and configuring the device is made much simpler thanks to the built-in LCD screen and software.

3.4.1.1 Perception (sensing):

The flight controller is connected to a set of sensors. These sensors give the flight controller information about like its height, orientation, and speed. Common sensors include an Inertial Measurement Unit (IMU) for determining the angular speed and acceleration, a barometer for the height, and distance sensors fordetecting obstacles. Just like how we perceive as humans, the drone filters a lot of this information and fuses some to get more efficient and precise information. Advanced flight controllers can sense more precisely and detect differences more quickly.

3.4.1.1 Controlling:

Aside from sensing what's going on, a flight controller… unsurprisingly controls the motion of the drone. The drone can rotate and accelerate by creating speed differences between each of its four motors. The flight controller uses the data gathered by the sensors to calculate the desired speed for each of the four motors. The flight controller sends this desired speed to the Electronic Speed Controllers (ESC's), which translates this desired speed into a signal that the motors can understand.

3.4.1.2 Communicating:

A key part of a flight controller is communication. A part of the sensor's job is to give out information that needs to be translated clearly for a pilot to read, which means efficiently. An obvious thing to communicate is its battery level, which can decide if a pilot wants to fly further or return to the charge.

But communication goes further than from flight controller to human pilot; with the entrance of auto-pilot programs in the drone industry, flight controllers need to communicate with other computer systems about its flight destination and how to get there. Communication is mostly done with wi-fi and radio frequencies right now, but cellular solutions are also already in use.The image of flight controller is shown as figure 3.3

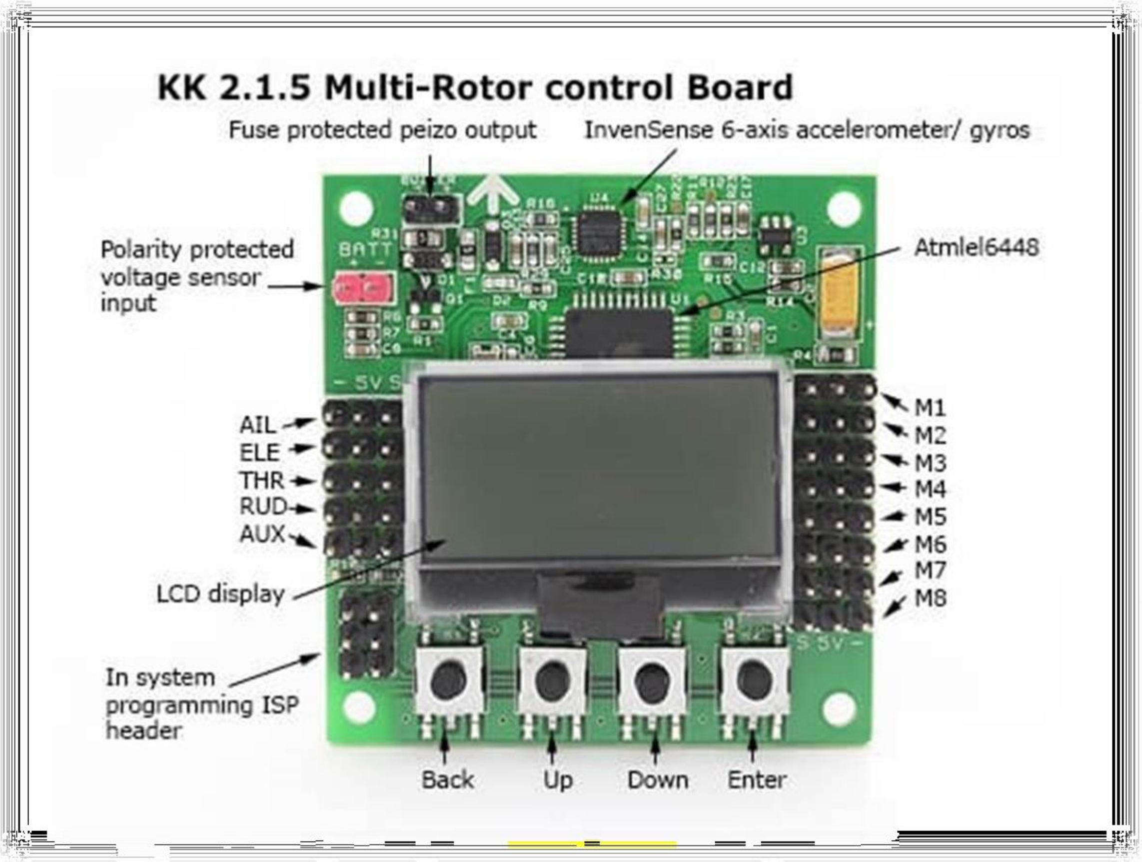

Figure 3.3 Pin diagram of Flight controller

Model	KK2.1.5
Input Voltage (V)	4.8V-6.0V
Firmware	Pre-installed firmware
Sensors	6050 MPU
Auto-level	Yes
Processor	Atmel 644PA
AVR interface	Standard 6 pin
Micro-SD Card Slot	No
Signal from Receiver	1520us (5 channels)
Signal to ESC	1520us
Length (mm)	50.5
Width (mm)	50.5
Height (mm)	12
Weight (gm)	21

Table 3.1 Specifications of Flight Controller

3.3.2 FLYSKY CT6B 2.4GHZ 6CH TRANSMITTER WITH FS- R6B RECEIVER:

FlySky CT6B 2.4Ghz 6 Channel Transmitter and Receiver(FS-R6B) Remote is the popular 6 Channel Radio CT6B manufactured by FlySky. CT6B FLYSKY 2.4GHZ 6CH TRANSMITTER is an entry level 2.4 GHz radio system offering the reliability of 2.4 GHz signal technology and a receiver with 6 channels. CT6B FLYSKY 2.4GHZ 6CH TRANSMITTER radio is a value for money, entry level 6 channel transmitter, ideal for quadcopters and multicopters that require 6 channel operation.

The FlySky FS CT6B radio is very lightweight and handy design with two retract switches and proportional flap dials in easy reach for channels 5 and 6. It can be powered by 8 x AA Size Batteries or a 12 Volts Power Supply. It comes with a trainer port to help beginners learn flying.

FlySky FS CT6B kit comes with FS-R6B receiver which is one of the best receiver we had in the class in very reasonable cost. we received many happy and satisfactory feedback from our hobbyist buyers for the same. It can be configured by connecting it to the computer. Use the T6 config software to configure your radio on a computer.The pin description of transmitter and receiver is shown in figure 3.4 and figure 3.5.

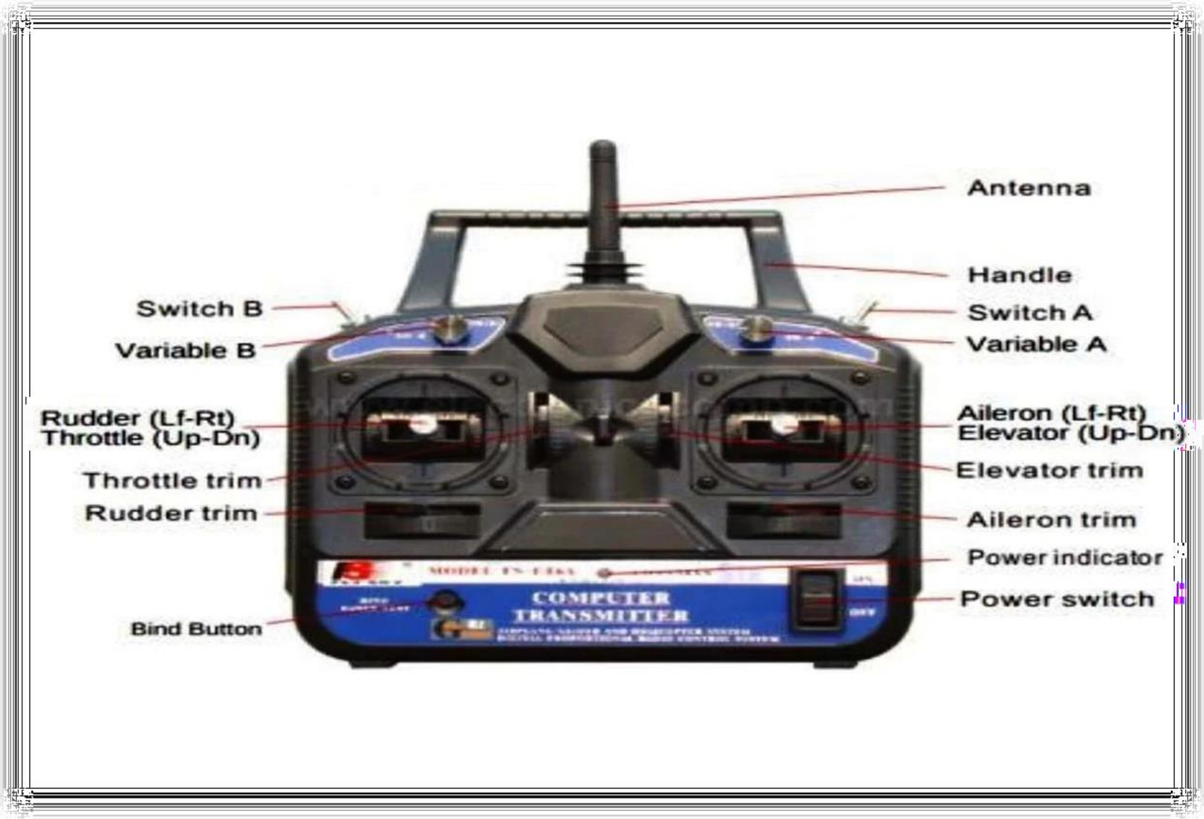

Figure 3.4 Pin description of Transmitter

Figure 3.5 Pin Diagram of Receiver

3.3.2.1 Specification of Fly Sky FS-CT6B 6-Channel 2.4 Ghz Transmitter and Receiver:

- MODEL NO : FLYSKY CT6B
- MODE TYPE : Airplanes, Helicopter, Glider.
- STICK MODE : Left hand or Right hand
- MODULATION : Frequency Modulation
- ANTENNA LENGTH : 88 mm
- CODE TYPE : PPM/GFSK
- POWER : 12V DC(1.5V AAA x 8 Not included)
- Weight : 696 gm
- Dimensions : 180 x 220 x 70 mm(LxWxH)
- Color : black
- Certificate : CE FCC
- RF POWER : Less than 0.8W
- APPLICATION : Multirotors, RC Planes, RC Boats, Rc Helicopters, etc.
- CHANNELS : 6 channels TX RX
- MATERIAL & COLOR : NA& Black and Blue

3.3.2.2 Receiver Test:

Displays the receiver signal inputs.

• Use the transmitter trims to set the Roll, Pitch and Yaw values to zero.

• Ensure the Throttle is 0 and says “Idle” at low throttle and at full throttle, it is greater than 90 and says “Full”. Adjust transmitter throttle trim for low throttle and end point for high throttle.

• Roll, Pitch and Yaw should all read between -100 to -90 and 90 to 100 at maximum stick travel. Adjust transmitter end points to achieve this. Do not exceed +/-110.

• Ensure Roll, Pitch and Yaw stick commands are correctly shown as Left, Right, Forward, Back. If not, reverse the throws in your transmitter.

• Arm Test will normally show "Safe Zone". At minimum throttle (throttle 0) and full right yaw, it should display "Arm". At minimum throttle (throttle 0) and full left yaw, it should display "Disarm". Providing there are no ERRORS on the SAFE screen, your multicopter should arm and disarm.

• If "No signal" is displayed, check connection to the receiver. Also ensure your receiver is working with your transmitter by connecting a servo to a spare receiver output.

• Check the Auxiliary channel input and reverse the channel in your transmitter if necessary.

• Do not use dual rates on your transmitter. Use Stick Scaling instead. This is very important on the Yaw channel as a low rate on the Yaw will prevent Arming and Disarming.

• If the receiver values appear random, check the following: -

- Receiver connections.
- Mode Settings, Receiver is correct.
- If Mode Settings Channel Map is "Yes", check Receiver Channel.

3.3.2.3 Mode Settings :

Various settings – First option listed is the default

• Self-Level

- Aux – AUX channel controls the self-levelling function.
- Stick – Turn on Self-levelling by holding the aileron to the right when arming or disarming. Turn it off with left aileron. Note, if you only connect a 4

channel receiver to the KK2.1.X with Roll, Pitch, Throttle and Yaw then set Self-Level to Stick.

- **Link Roll Pitch**
  - Yes – Changes to the PI Settings for both Roll and Pitch when you make changes.
  - No – You need to update the Roll and Pitch PI Settings separately.
- **Auto Disarm**
  - Yes – will automatically disarm after 20 seconds when armed and throttle is set to zero. Note, if Lost Model Alarm is set to “Yes” then you can’t switch Auto Disarm Off.
  - No – No Auto Disarm and no Lost Model Alarm.
- **Receiver** (if you change the receiver, you need to power cycle the KK2.1.X)
  - Std – Standard PPM receiver with 4 or 5 (inc Aux) connections to the KK2.1.X inputs.
  - CPPM – Combined PPM receiver connection. This is all receiver channels combined/multiplexed onto one cable that should be connected to input 1 (top input).
  - DSM2 – A DSM2 satellite receiver (not a main DSM2 receiver) connected to input 3 (middle input) via a level changing cable. Note that the receiver needs to be bound to the KK2.1.X, not a normal receiver. To bind the DSM2 satellite, hold buttons 2&3 down on power up. The satellite will flash rapidly and you should follow your transmitter/receiver binding process. Beware that some receivers bind and set the channels to a failsafe position. You may need to rebind after you set the correct directions using the Receiver Test menu.
  - DSMX – A DSMX satellite receiver (not a main DSMX receiver) connected to input 3 (middle input) via a level changing cable. Note that the receiver needs to be bound to the KK2.1.X, not a normal receiver. To bind the DSMX satellite, hold button 3 down on power up. The satellite will flash rapidly

and you should follow your transmitter/receiver binding process. Beware that some receivers bind and set the channels to a failsafe position. You may need to rebind after you set the correct directions using the Receiver Test menu.

  - SBus – An SBus receiver connected to input 3 (middle input) via an inverter cable.

- **Channel Map**
  - No – With a standard receiver, it is generally assumed that you will not map any channels.
  - Yes – Swap channel order using Receiver Channel Map.
- **Lost Model Alarm**
  - Yes – When the KK2.1.X Auto Disarms, it will sound the buzzer. Note that Auto Disarm is forced on when “Yes” is selected.
  - No – Lost Model Alarm disabled. Set to “No” to allow you to set Auto Disarm to “No”.

3.3.2.4 “SAFE”Screen Information :

- **Pre-flight:**

• If the SAFE screen says ERROR, you must fix that error before you can arm it.

• You will see the actual error on the display.

• You may have to power cycle the KK2.1.X to clear an error after fixing it.

• Top right displays the profile being used (P1 or P2) or tells you which stick scaling and PI profile you are using (PI1 or PI2).

• It will tell you if Self Level is on or off.

• The Battery (Batt) voltage will be displayed if you have connected the flight battery +ve to the KK2.1.X battery monitor pin (pin closest to the edge of the board).

• Temp is the MPU6050 internal temperature.

• Roll and Pitch Angle will appear after arming and disarming. They display the angle of the KK2.1.X after arming and disarming.

• If you have the Alternative SAFE screen layout selected in Misc Settings 2, it displays the last Motor Layout selected (this is just a guide as you may have changed the settings in the Mixer Editor).

• Pressing button 4 takes you into the MENU.

- **Post-flight:**

• If the SAFE screen says ERROR, you must pay attention.

• You will see the actual ERROR on the display. It will most likely be "Error: no yaw input" which means you had a receiver failure during flight.

• The top left corner will display a number if the KK2.1.X code took longer than expected to execute during flight, the number of times this happened will be displayed. This shouldn't happen. If it does, it could indicate a fault with the board.

• The Roll and Pitch Angle will appear.

• Pressing button 4 takes you into the MENU.Safe mode display is shown in figure 3.6

Figure 3.6 Safe Mode Display

3.3.2.5 FEATURES:

- Super active and passive anti-jamming capabilities.
- Very low power consumption.
- High receiving sensitivity.
- 8 model memory, digital control.

- We can program by PC with the included software.
- Full range 2.4GHz 6-channel radio.
- 4 Types (Airplane, Heli90, Heli120, Heli140).
- Use a linear spread of fine paragraph by an excess antenna.
- It covers the entire bandwidth of the antenna bandwidth range.
- High quality and stability.

Model Type	Digital Radio Transreceiver
Antenna Length	Receiver: 26 mm
Modulation Type	GFSK
Sensitivity	1024
Code Type	Digital
Band-Range	2.4055 – 2.475GHz
Bandwidth	500 KHz
DSC Port	Yes (3.5mm:output:PPM)
Charging Port	Yes
Default Operating Mode	Mode 2 (Left-Hand Throttle)
Color	Black
Low Voltage Warning	Yes(at less than 9V)
No. of Channels	6
Operating Voltage	12V DC (1.5AA x 8 Battery)
RF Power	Less Than 20 dbm
Dimensions (mm) LxWxH	189 x 97 x 295
Weight (gm)	511

Table 3.2 Specifications of Transreciever

3.3.3 ARDUINO NANO:

Arduino Nano is one type of microcontroller board, and it is designed by Arduino.cc. It can be built with a microcontroller like Atmega328. This microcontroller is also used i**n** Arduino UNO. It is a small size board and also flexible with a wide variety of applications. Other Arduino boards mainly include Arduino Mega, Arduino Pro Mini, Arduino UNO, Arduino YUN, Arduino Lilypad, Arduino Leonardo, and Arduino Due. And other development boards are AVR Development Board, PIC Development Board, Raspberry Pi, Intel Edison, MSP430 Launchpad, and ESP32 board.

This board has many functions and features like an Arduino Duemilanove board. However, this Nano board is different in packaging. It doesn’t have any DC jack so that the power supply can be given using a small USB port otherwise straightly connected to the pins like VCC & GND. This board can be supplied with 6 to 20volts using a mini USB port on the board.Arduino nano pinout is shown in Figure 3.7

3.3.3.1 Communication:

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX).

An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino firmware) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board flash when data is being transmitted via the FTDI chip and the USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also supports I2C and SPI communication. The Arduino software includes the Wire library to simplify use of the I2C bus.

3.3.3.2 Specifications:

- Microcontroller: Microchip ATmega328P
- Operating voltage: 5 volts
- Input voltage: 5 to 20 volts
- Digital I/O pins: 14 (6 optional PWM outputs)
- Analog input pins: 8
- DC per I/O pin: 40 mA
- DC for 3.3 V pin: 50 mA
- Flash memory: 32 KB, of which 2 KB is used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock speed: 16 MHz
- Length: 45 mm
- Width: 18 mm
- Mass: 7 g
- USB: Mini-USB Type-B
- ICSP Header: Yes
- DC Power Jack: No

3.3.3.3 Arduino Nano PINOUT:

Power Pin (Vin, 3.3V, 5V, GND): These pins are power pins

RST Pin(Reset): This pin is used to reset the microcontroller

Analog Pins (A0-A7): These pins are used to calculate the analog voltage of the board within the range of 0V to 5V

I/O Pins (Digital Pins from D0 – D13): These pins are used as an i/p otherwise o/p pins. 0V & 5V

Serial Pins (Tx, Rx): These pins are used to transmit & receive TTL serial data.

External Interrupts (2, 3): These pins are used to activate an interrupt.

PWM (3, 5, 6, 9, 11): These pins are used to provide 8-bit of PWM output.
SPI (10, 11, 12, & 13): These pins are used for supporting SPI communication.
Inbuilt LED (13): This pin is used to activate the LED.
IIC (A4, A5): These pins are used for supporting TWI communication.
AREF: This pin is used to give reference voltage to the input voltage

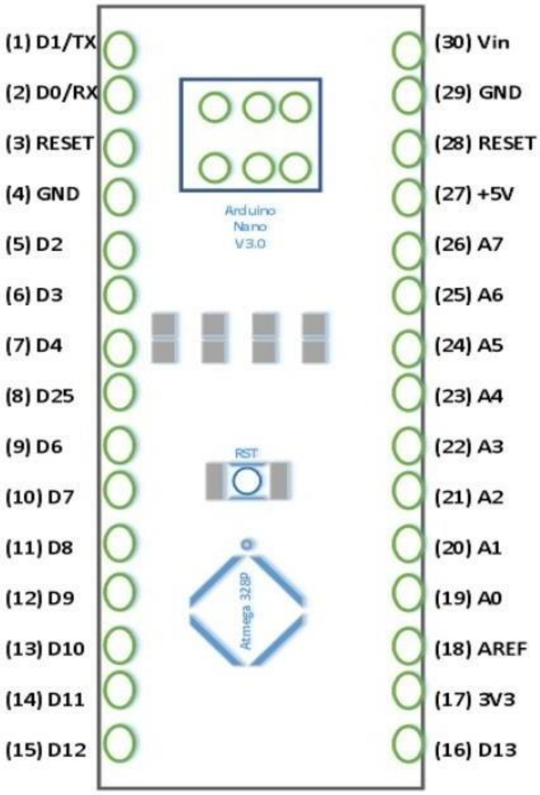

Figure 3.7Arduino Nano Pinout

3.3.4 ESC (ELECTRONIC SPEED CONTROLLER):

The term ESC stands for "electronic speed control is an electronic circuit used to change the speed of an electric motor, its route, and also to perform as a dynamic brake. These are frequently used on radio-controlled models which are electrically powered, with the change most frequently used for brushless motors providing an **electronically produced 3-phase electric power** low voltage source of energy for the motor. An ESC can be a separate unit that lumps into the throttle receiver control channel or united into the receiver itself, as is the situation in most toy-grade R/C vehicles. Some R/C producers that connect exclusive hobbyist electronics in their entry-level vehicles, containers, or aircraft use involved electronics that combine the two on a sole circuit board.

3.3.4.1 ESC Design:

- An electronic speed controller can be designed with three essential components like a voltage regulator/ BEC (Battery Eliminator Circuit)), a Processer & the switching includes FETs. The BEC is a separation of the electronic speed control that will transmit power back to your receiver after that to servos.
- This also includes one secondary function like when the motor is operated through a battery then the motor gets its smallest voltage, then the BEC will keep some power for the flight control in dangerous situations so the motor doesn't consume total the power from the battery. At present, the processor is completely enclosed within a single Si semiconductor chip.

- The main function of this processor is to decode the data being provided to it from the receiver within the model as well as to regulate the power toward the motor using FETs. In an ESC, this transistor plays a key role by performing all the works. It observes the complete current & voltage of the motor as well as a battery. This transistor works like a switch to control the current flow to throttle the electric motor.

3.3.4.2 Types of an Electronic Speed Controller:

There are two kinds of electronic speed controllers based on the specific requirements, you can acquire the exact one existing in RC Models shops such as brushed ESC and brushless Electronic Speed Control.Types of ESC is shown in Figure 3.8

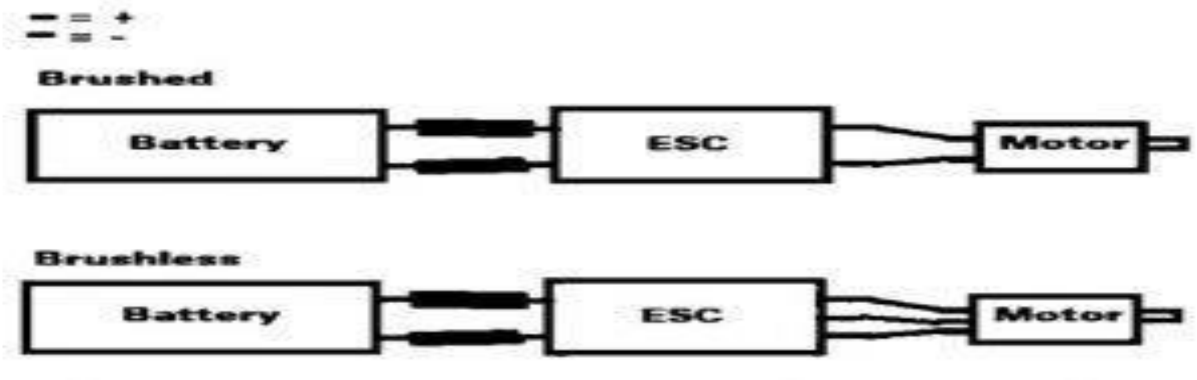

Figure 3.8 Types of ESC

- **Brushed ESC:**

Brushed ESC is the first electronic speed controller, which has been around for several years. It is very cheap to use in various RTR electric RC vehicles.

- **Brushless ESC:**

Brushless ESC is the modern advancement in technology once it comes to Electronic Speed Controls. It is also a bit more costly. Connected to a brushless motor, it carries more power higher performance as compared to the brushed ones. It can also last a longer period.

3.3.4.3 Electronic Speed Controller Circuit:

The term ESC is frequently used as a contraction for ‘electronic speed controller. The basic function of ESC is to change the amount of power to the electric motor from the aircraft battery based upon the location of the throttle stick. In earlier, speed controllers are mainly used in remote control boats and cars which use a variable resistor with a wiper that was stimulated by a servo motor.ESC is shown in Figure 3.10

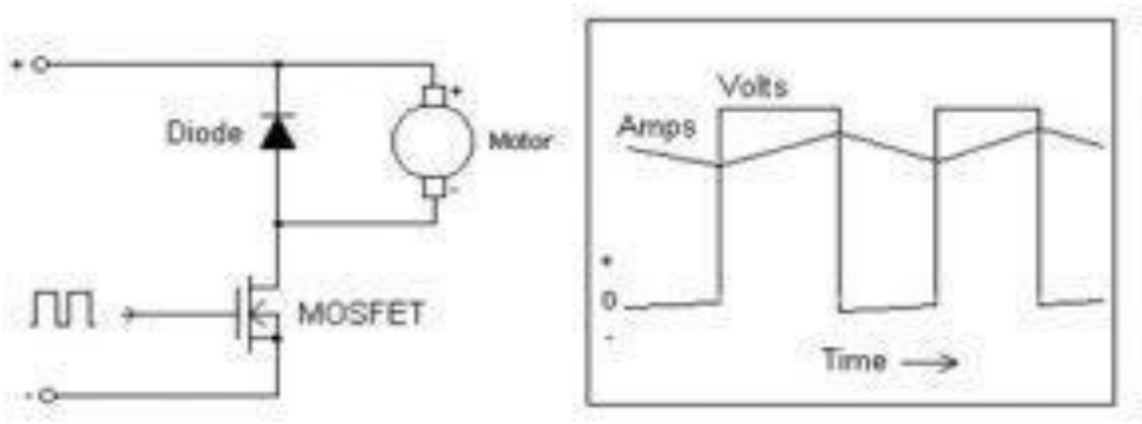

Figure 3.9 ESC Circuit

This technique works reasonably at full throttle as the battery is associated straight to the motor, though at part throttle situations the flow of current through the resistor producing power to be lost in the form of heat. As a model, the aircraft will use most of its time at the portion of the throttle. This is not a very practical means of power control.

Current speed controllers differ the power to the motor by fast switching the power ON and OFF. Here, MOSFET Transistor is used as a switch instead of a mechanical device, and the amount at which it is switched is about 2000 times a second. So, the power to the motor is diverse by changing the amount of ON time, against off time in a specified cycle.

When the MOSFET is switched ON, the current rises as the magnetic field in the windings of the motor increases. When the MOSFET is switched OFF, magnetic energy stored in the windings has to be absorbed by the ESC. By cabling a diode across the motor, we return the energy into the motor as current, which rises down as the magnetic field fails.

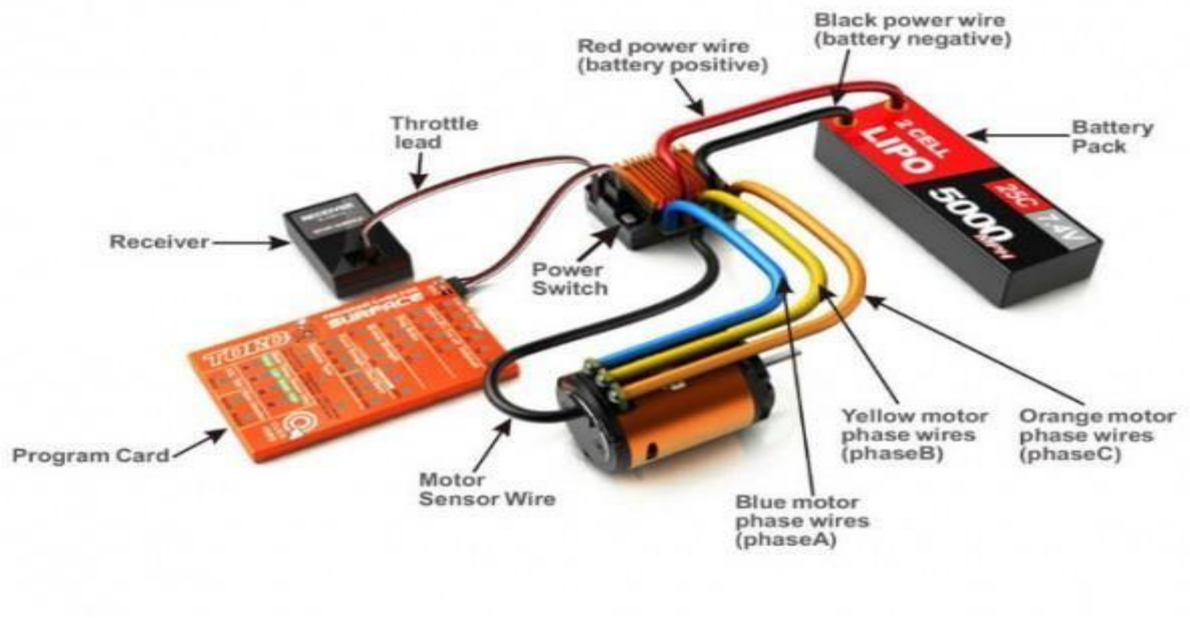

Figure 3.10 Electronic Speed Controller

3.3.5 BLDC Motor:

This is a A2212 brushless outrunner motor specifically made to power Quadcopters and Multirotors. It is a 1000kV motor. It provides high performance, super power and brilliant efficiency. These motors are perfect for medium size quadcopters with 8 inch to 10 inch propellers. With out 3S LiPo battery, our 30A ESC and our high efficiency 10" propellers these motors provide upto 800gms. Using 4 of these motors on a quadcopter with our propellers will give you a total of 3.2 kg thrust. Use this to build powerful and efficient quadcopters.

The brushless motor has two main parts, the rotor and a stator. The rotor consists of a permanent magnet that has two north and two south poles going N,S,N,S that can either be on the inside of the motor in an in runner brushless motor or on the outside for an outrunner brushless motor. The stator consists of the spokes of the motor with coils on the spokes with a current passed through the coil in order to create a magnetic field. The magnetic field created by the current through the coil will attract the magnetic poles of the rotor which creates the rotation needed for the propellers to turn. Two opposite coils can be wound together to generate opposite poles to the rotator poles which doubles the attraction force and rotates the motor more efficiently.The image of BLDC motor is shown in figure 3.11.

Figure 3.11 BLDC Motor

Two coils can be energized at the same time creating alternative magnetic fields so that one coil has an opposite magnetic charge, pushing the motor along as the other coil has an attracting magnetic force, pulling the motor forward. This contributes to creating an efficient motor with high torque and minimal energy loss.

3.3.5.1 Specifications of BLDC Motor:

- KV: 1000
- No load Current : 10 V : 0.5 A.
- Current Capacity: 12A/60s

- No Load Current @ 10V: 0.5A
- No. Of Cells: 2-3 Li-Poly
- Motor Dimensions: 27.5 x 30mm
- Shaft Diameter: 934;3.17mm
- Shaft diameter : 3.175mm.
- Minimum ESC Specification: 18A (30A Suggested)
- Thrust @ 3S with 1045 propeller: 800gms approx
- Thrust @ 3S with 0945 propeller: 475gms approx
- Thrust @ 3S with 0845 propeller: 475gms approx

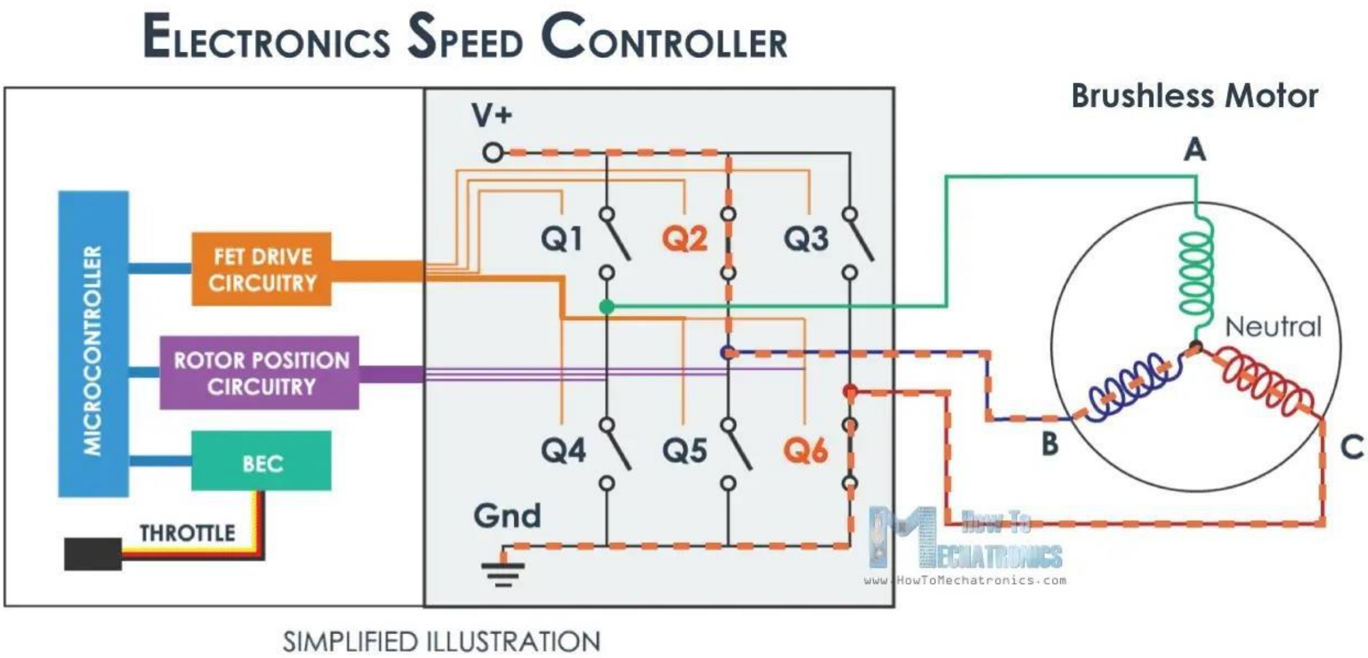

Figure 3.12 BLDC Motor Connected with a ESC

BLDC ESCs convert power from a DC supply into a dynamic voltage to drive BLDC motors. This conversion process is flexible, varying the voltage to increase or decrease the motor speed.The input supply can take the form of a battery or power supply.The circuit in which BLDC motor connected with ESC is shown in figure 3.12.

3.3.5.2 Specifications and Features:

- MODEL: STANDARD 30A BLDC ESC ELECTRONIC SPEED CONTROLLER
- WEIGHT: 23g
- DIMENSIONS: 45 x 24 x 9 mm(LxWxH)
- Color: Yellow/Red(Depends on Availability)
- CURRENT (A): 30A
- BEC: 3A
- Li-Poly: 2-3
- Ni-Mh/Ni-CD: 4-10 Ni-Mh
- CONSTANT CURRENT: 30A Max 40A<10s
- Li-Poly 2-3 CELLS; Ni-MH 4-10 CELLS Auto Detect
- Break On/Off
- Auto Low BATTERY Slow down at 3.0V/cell Lipo, cut-off at 2.9V/cell lipo

3.3.6 Li-Po Battery:

A lithium-polymer battery (LiPo) is a rechargeable battery that, in the case of true LiPo, uses solid polymer for the electrolyte and lithium for one of the electrodes.

True LiPo batteries have not reached commercial viability. The batteries referred to as LiPo in commercial use offer reduced thickness, flexibility and weight.Their qualities make LiPo batteries suited to thin smartphones, tablets and wearables. While LiPo made a splash in radio-controlled hobbies and still remain an option, LiIon (lithium ion) are making a return due to their better discharge abilities.

While pouch-type standard LiIon batteries exist, they still require external casing to prevent expansion that would otherwise become a performance and safety issue. Li-Po battery is shown in figure 3.15.

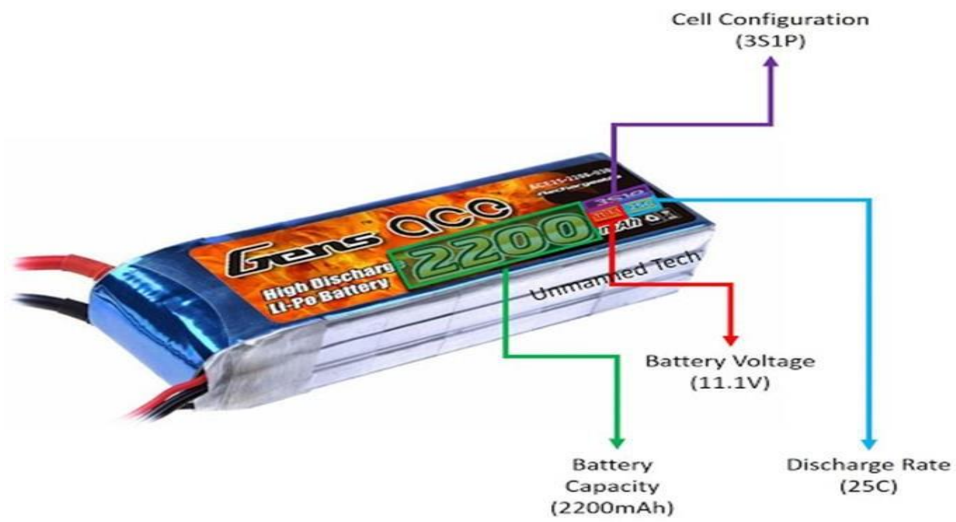

Figure 3.15 Li-Po Battery

3.3.6.1 Cell Configuration

A battery is constructed from rectangular cells which are connected together to form the battery. A cell which can be considered a battery in itself, holds a nominal voltage of 3.7V. By connecting more of these in series, the voltage can increase to 7.4V for a 2 cell battery, 14.8V for a 4 cell battery and so on. By connecting more batteries in parallel the capacity can be increased. Often you will see numbers like 3S2P, which mean the battery as 4 cells (4S) connected in series, and there are 2 cell sets connected in parallel (2P) , giving a total number of 6 individual sells in the battery. So the number of cells is what defines the voltage of the battery. Having a higher voltage means the battery can provide more power to drive bigger motors, however more power does not necessarily mean the battery will provide energy for longer, that is defined by the battery capacity.

Battery Voltage

A LiPo cell has a nominal voltage of 3.7V, and a lipo cell = 1 cell = 1S = 3.7V. For the 14.8V battery above, that means that there are four cells in series (which means the voltage gets added together). This is sometimes why you will hear people talk about a “4S” battery pack – it means that there are 4 cells in Series. So a four-cell (4S) pack is 14.8V, a three-cell (3S) pack is 11.1V, and so on.

The voltage of a Lipo battery pack is essentially going to determine how fast your vehicle is going to go. Voltage directly influences the RPM of the electric motor (brushless motors are rated by kV, which means ‘RPM per Volt’). So if you have a brushless motor with a rating of 3,500kV, that motor will spin 3,500 RPM for every volt you apply to it. On a 2S LiPo battery, that motor will spin around 25,900 RPM. On a 3S, it will spin a whopping 38,850 RPM. So the more voltage you have, the faster you’re going to go.

When you select lipo battery, you need to know your motor of rc model, Voltage has an impact on motor, and motor influence the speed. The higher voltage is, the higher power(P) of the motor is, and here is the formula:

$$P=V*I$$

“P” is power, “V” is voltage, “I” is current. As you know, the voltage influence the power of the motor of battery, and the power has an impact on the RPM of the motor, that means speed. So in some racing, pilots need the batteries are of high voltage to meet the needs of their rc model to get a high burst.

3.3.6.2 Battery Capacity

The 1300mAh on the picture means the capacity of the lipo battery. Capacity is used to measure how much power a battery can hold.and the unit of capacity is milliamp hours (mAh), which means 1300mAh can be put on the battery to discharge it in one hour. Milliamp also can be converted to amps(A), here is the conversion:

1300mAh=1.3 Amp Hour(1Ah)

Generally, capacity can determines how long you can run before you have to recharge. A larger capacity pack may give you longer flight times but being heavier it will adversely affect performance. But it`s also influenced by the speed, the more quick you can flying your plane, the less time your flight time is. Because high speed means you need more power to drive your plane or others, so your power lost quickly.

3.3.6.3 Battery Discharge Rate and Capacity

Probably the most important, but often overlooked factor to is the check the battery discharge C rating is the optimum for your drone or car. Using a discharge rate (C rating) that is too low, can result in your battery being damaged, and your drone or car under-performing the battery cant release current fast enough to power your motors properly. Since higher C rating batteries are heavier, if the battery you are using has a C rating that is too high, you will just be carrying extra weight around that you dont need, ultimately reducing the running time.

3.3.6.4 How to calculate the maximum continuous current output for your battery

In order to know what the total current draw of your drone system is, we cab calculated it based on this simple formula:

- Max continous Amp draw (A)= Battery capacity (Ah) x Discharge rate (C)

For a example, we have a 5100mAh 3 cell Lipo battery with a 10C rating. To find the maximum continuous amp draw, we first convert the 5100mAh to 5.1Ah, and multiply that number by 10C, to give a total continuous output of (5.1 x 10) = 51A

3.3.6.5 How to find the optimum C rating

As choosing the battery is often the last step to building your own drone, we will already know what motors and ESC we are using. Since the motors will draw the most amount of energy from your battery we can base our calculation around this.

3.3.6.6 The battery C rating depends on the capacity

There is no fixed C rating that you will need to use as the maximum current output of a battery depends on the capacity and C rating. The smaller the capacity of a battery, the higher the C rating needs to be, this is why for many high capacity multi-rotor batteries you will find very low C ratings in the range of 10-15C.

3.3.6.7 How much capacity do I need?

Now that you know the required current draw from your battery, the capacity and C rating can be found. In general its best to get teh highest possible capacity battery that you can, which still keeping the total weight of your quadcopter including the battery and other equipment at aroung 50-70% of the maximum motor thrust.

So sticking to our quadcopter example, we know that 50% thrust is around 500g per motor (or 2Kg thrust in total). Our frame, electronics and motors weight come to 1.2Kg. That leaves 800-1000g that we can use for the battery. So you should try to find the highest capacity LiPo that you can find that weights less than this.

3.3.6.8 Battery Voltage

The battery voltage, or cell count is another important decision that you will need to make. Higher voltage batteries allow your motors to produce more power, however the higher voltage batteries are heavier since they contain more cells.

There is no golden rule to follow when it comes to battery voltage, but the way you can find the best voltage for your drone is to look through your motor thrust data tables and compare the efficiency. You will find that motors are generally more efficient and powerful when using higher cell count lipos (higher voltage), but some of the efficiency bonus is negated by the increase in weight and cost of the battery. So depending on how many motors you are using you will need to choose what is best for your current setup.

One thing to bear in mind is to also make sure that your motors/ESC and other electronics are able to support the voltage of your battery. Some motors will only support a specific cell count lipo, or a specific range of voltages which might make the decision easier.

3.3.7 Propellor

Propellers are responsible for lifting of the UAV. The propellers have two characteristics i.e. diameter and pitch of the propellers. Pitch of the propellers can be defined as the traveling distance per single revolution. A propeller with lower pitch value is capable of heavy lifting as it generates more torque and the motors do not have to work much harder to carry heavy payloads. As a result the motors will draw less current from the battery and hence the flight endurance time of UAV would increase. Whereas if the propellers with higher pitch values are used then they would not be able to generate much torque and hence would cause turbulence.

The flight efficiency of the UAV is dependent on amount of air contacting the surface of the propellers. A large diameter propellers will have more contact with air than the small diameter propellers and hence they are more efficient. Propellers are the motor units that are located on either side of a multicopter.

3.3.7.1 TYPES OF PROPELLORS

1. Quadcopter
2. Hexacopter
3. Octocopter

3.4.7.2 Quadcopter:

Quadcopters consists of four propellers or motor units, tricopters consists of three propeller units, and hexacopters consist of six propeller units and so on. If you are looking for a UAV for sale or dronesfor sale, make sure that you check the propellers of a particular drone or quadcopter before investing in it. If you are looking to build your own quadcopter, always seek a low pitch propeller for perfect stability and vibration.

Figure 3.14 Propellors for a Quadcopter

3.3.8 Water Pump

As the name implies, water pumps pump water. Whether that be in a vehicle, at a business, in the home, or in a well, shoppers can probably find a water pump to fit their vehicle or to help them draw water from the ground in a self-dug well to be used in pressure tanks within the location. Vehicle water pumps help regulate the flow of water through a vehicle's cooling system; when the seal on these go bad, the whole pump must be replaced.

3.3.8.1 Product Description:

A pump motor is a DC motor device that moves fluids. A DC motor converts direct current electrical power into mechanical power. DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Figure 3.15 Water Pump motor

3.5.9 Steps For Operating Drone:

STEP 1: Switch ON the joystick module.

STEP2 : Once it is switched on plug the supply connected to the flight controller.

STEP3: The propellor starts to find an angle and aligns its position.

STEP4: Once the propellor is set ,the LCD displays safe mode.

STEP5: The joystick is moved to downwards and then right to get armed.

STEP6: Then the LCD will show ARMED

STEP7: Once it is armed,gets to take off by adjusting the joystick module toggle switch.

STEP8: The pump is activated by controlling the switch in the joystick,which is powered by 9v Li-po battery.

STEP9: After the drone reaches certain height,the switch is accuated and the drone starts spraying.

STEP10: After the drone settled down then disconnect the wire and OFF the joystick module. .

CHAPTER 4

SYSTEM IMPLEMENTION AND RESULT

4.1 SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C

4.1.1 Arduino IDE:

Arduino is an open-source electronics platform based on easy-to-use hardwareand software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating amotor,turning on an LED, publishing something online. You can tell your board what todo by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novicesand experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing,and embedded environments.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors.

4.1.2 Embedded C:

In every embedded system based projects, Embedded C programming plays a key role to make the microcontroller run & perform the preferred actions. At present, we normally utilize several electronic devices like mobile phones, washing machines, security systems, refrigerators, digital cameras, etc. The controlling of these embedded devices can be done with the help of an embedded C program. For example in a digital camera, if we press a camera button to capture a photo then the microcontroller will execute the required function to click the image as well as to store it.

4.1.2.1 Embedded System Programming

As we discussed earlier, the designing of an embedded system can be done using Hardware & Software. For instance, in a simple embedded system, the processor is the main module that works like the heart of the system. Here a processor is nothing but a microprocessor, DSP, microcontroller, CPLD & FPGA. All these processors are programmable so that it defines the working of the device.

An Embedded system program allows the hardware to check the inputs & control outputs accordingly. In this procedure, the embedded program may have to control the internal architecture of the processor directly like Timers, Interrupt Handling, I/O Ports, serial communications interface, etc.

So embedded system programming is very important to the processor. There are different programming languages are available for embedded systems such as C, C++, assembly language, JAVA, JAVA script, visual basic, etc.

So ,this programming language plays a key role while making an embedded system butchoosing the language is very essential.

4.1.2.2 Steps to Build an Embedded C Program

There are different steps involved in designing an embedded c program like the following.

- Comments
- Directives of Processor
- Configuration of Port
- Global variables
- Core Function/Main Function
- Declaration of Variable
- The logic of the Program.

4.1.2.3 Embedded C Programming

Embedded C programming builds with a set of functions where every function is a set of statements that are utilized to execute some particular tasks. Both the embedded C and C languages are the same and implemented through some fundamental elements like a variable, character set, keywords, data types, declaration of variables, expressions, statements. All these elements play a key role while writing an embedded C program.

The embedded system designers must know about the hardware architecture to write programs. These programs play a prominent role in monitoring and controlling external devices. They also directly operate and use the internal architecture of the microcontroller, such as interrupt handling, timers, serial communication, and other available features.

```
#define SCL 8
#define SDO 9
byte Key;

byte Read_TTP229_Keypad(void)
{
  byte Num;
  byte Key_State = 0;
  for (Num = 1; Num <= 16; Num++)
  {
    digitalWrite(SCL, LOW);
    if (!digitalRead(SDO))
      Key_State = Num;
    digitalWrite(SCL, HIGH);
```

```
  }
  return Key_State;
}


boolean count1 = false;

unsigned long startMillis;  //some global variables available anywhere in the program
unsigned long currentMillis;
const unsigned long period = 3000;  //the value is a number of milliseconds

void setup()  {

  pinMode(SCL, OUTPUT);
  pinMode(SDO, INPUT);
  Serial.begin(9600);  //start Serial in case we need to print debugging info

  startMillis = millis();  //initial start time

}

void loop() {


  Key = Read_TTP229_Keypad();
```

```
  if (Key == 1) {
    Serial.println("press key 1 ");
    count1 = true;
  }



  if (count1 == true)  {

    currentMillis = millis();   //get the current "time" (actually the number of milliseconds since the program started)
    Serial.println(millis());
    if (currentMillis - startMillis >= period)  {
      Serial.print("currentMillis "); Serial.println(currentMillis);
      Serial.print("    startMillis ");   Serial.println(startMillis);
      startMillis = currentMillis;  //IMPORTANT to save the start time of the current LED state.
      count1 = false;
    }

  }
}
```

4.2 System Prototype:

Fig 4.1 System prototype

4.3 LIMITATIONS :

- Connecting issue.
- An average farmer may struggle to understand drone functions.
- Need to obtain government clearance to use it.
- Drones with more features are expensive

4.4 APPLICATIONS:

Indian agriculture needed production and protection materials to achieve high productivity. Agriculture fertilizer and chemical frequently needed to kill insects and the growth of crops. Drones can be used to spray chemicals like fertilizers, pesticides, etc. based on the spatial variability of the crops and field. The amount of chemicals to be sprayed can be adjusted depending upon the crop conditions, or the degree of severity of the insect-pest attack.

The integration of UAV with sprayer system results a potential to provide a platform to pest management and vector control. This is accurate site specific application for a large crop fields. For this purpose heavy lift UAVs are required for large area of spraying. Researcher proposed the Quad copter (QC) system which is low cost, and lightweight, also known as Unmanned Aerial Vehicle (UAV) . These quadcopter is small size, and this system can be used for indoor crops as well as outdoor crops.

Quadcopter is an autonomous flight for spraying pesticides and fertilizer using the android device. Between the quadcopter and android device communication is done by Bluetooth device in real time operation. This system is used to reduce agriculture field related problems, and also increases the yield of agriculture. The efficiency of the spraying system which is mounted to the UAV increases through the PWM controller in the pesticide applications.

A blimp integrated quad copter aerial automated pesticide sprayer (AAPS) was developed for pesticide spraying based on the GPS coordinates in lower altitude environment. To, overcome this low cost user flexible pesticide spraying drone “Freyr” was developed which is controlled by an android app. A laboratory and field evolutions are analyzed for discharge and pressure rate of the liquid, spray uniformity and liquid loss, droplet density and sizes of a developed hexa copter mounted sprayer. To reduce the wastage of pesticides an electrostatic sprayer introduced and designed on electrostatic spray technology with a hexa rotor UAV. The WHO (World Health Organization) estimates there are more than 1 million pesticide cases every year. In that more than one lakh deaths each year, especially in developing countries due to the pesticides sprayed by a human being.

The pesticide affects the nervous system of human and leads to disorders in the body. A remote controlled UAV (Unmanned Aerial Vehicle) is used to spray the Pesticide as well as fertilizer to avoid the humans from pesticide poison . Crop dusting: Drones able to carry tanks of fertilizers and pesticides to spray crops with far more precision than a tractor. This helps reduce costs and potential pesticide exposure to workers who would have needed to spray those crops manually.

Pesticide application by drone can be used in all situations, especially in the places where labours are hard to find, environmental pollution can be reduced when it sprayed from lower altitude also it has a great potential to enhance pest management for small as well as the large crop field to entail highly accurate site-specification application. Some scientist studied the impact of UAV (UAV N-3) spraying parameters at different working height and varying concentration of spraying pesticide on the wheat canopy and the prevention of powdery mildew in Asian countries .

This ultimately increases the efficiency of the chemicals applied, thereby reducing their adverse impacts on the environment by decreasing the soil and water pollution. Thus, it can lead towards sustainable agriculture. Drones spray chemicals at a faster rate as compared to other methods. It can also result in the saving of the amount of chemicals applied, which can reduce input cost. A major economic input for any agricultural season is the application of fertilizers (e.g., nitrogen, phosphate, potash), and micronutrients (e.g., sulphur, magnesium, zinc).

Fertilizer is applied by on-ground equipment (tractor powered sprayers or pressurized irrigation systems) or by manned aircraft. The latter is the most preferred by producers with multiple and large land units. They generally use a single application rate for all fields being sprayed because changing wind speed and direction conditions during fertilizer application and the elevation of the aircraft make more precise application impossible.

Ground equipment application is used as a complement to aerial spraying to maintain stable crop nutrient status across the irrigation season. UAV estimation of crop nutrient status can directly benefit the application rate recommendations by producer or agronomist consultant by including the entirety of the field.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

Conclusion:

In this paper we have described a design of a drone mounted spraying mechanism for agricultural purpose and for spraying disinfectants.This method of spraying pesticides and fertilizers on agricultural fields reduces the number of labours,time,cost and the risk involved to the personnel involved in spraying the liquids. This drone can also be used in spraying disinfectant liquids over water bodies and highly populated areas. UAVs in precision agriculture is still in its early stage and maybe a scope for further development in both the technology and the agriculture applications. Providentially, it is expended that with the development of UAV'S technology, improved image processing techniques, lower costs, flying times, batteries, new camera designs, low volume sprayers, and nozzle types. A significant number of experimental studies of UAV'S based remote sensing for agriculture application. It will be a more prominent advantages of these systems in precision agriculture and environmental monitoring.

Future scope:

1. Under the covid 19 pandemic situation,it can be used to Sanitize large hotspot areas without actually going there in operation.

2. Manual control can be changed into autonomous control with GPS technology and auto return home option.

3. With image processing techniques,the drone can be involved in surveillance to determine the pest attack on the plants.

4. Colored images collected by quadcopter are very good in giving a complete image of normal area problems & health.

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