ADAPTIVE AERIAL SOLUTIONS MULTI-TASKING DRONES FOR DIVERSE APPLICATIONS

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ABSTRACT

Technological innovations and radical products that drive the whole world forward can sometimes have an impact on different areas than planned. The drones positive impact on innovative agriculture has yet to be manifested in the stages of land and seed preparation.One of main source of income in of India is agriculture. The production rate of crops in agriculture is based onvarious parameters like temperature, humidity, rain, etc. which are natural factors and not in farmers control. The field ofagriculture is also depends on some of factors like pests, disease, fertilizers, etc which can be control by giving proper treatmentto crops. Pesticides may increase the productivity of crops but it also affects on human health. So the main aim of this project isto design agriculture drone for spraying pesticides. In this project, we are going to discuss architecture based on agriculture unmanned aerial vehicles (UAVs). The use of pesticides in agriculture is very important to agriculture and it will be so easy ifwill use intelligent machines such as drones using new technologies. This gives the general idea about various technologies used toreduce human efforts in various operations of agriculture like detection of presence of pests, spraying of UREA, spraying offertilizers, etc. This project also describes the development of Hexa copter UAV and the spraying mechanism. In this project we alsodiscuss integration of sprayer module to Hexa copter system. The discussed system involves designing a prototype which usessimple cost effective equipment like BLDC motor, Arduino, ESC wires, etc.

INTRODUCTION

1.1 Problem statement: Agriculture in India constitutes more than 60% of occupation. It serves to be the backbone of Indian economy. It is very essential toimprove the productivity and efficiency of agriculture by providing safe cultivation of the farmer. The various operations likespraying of pesticides and sprinkling fertilizer are very important. Though spraying of pesticides has become mandatory it alsoproves to be a harmful procedure for the farmers. Farmers especially when they spray urea, take to many precautions like wearingappropriate outfit masks and gloves. It will avoid any harmful effect on the farmers. Avoiding the pesticides is also not completely
possible as the required result has to be met. Hence fore, use of drones in such cases gives the best of the solutions for this type ofproblems, along with the required productivity and efficiency of the product.

1.2 Objectives: This project aims to overcome the ill-effect of the pesticides on human beings and also use to spray pesticides over largearea in short intervals of time compare to conventional spraying by using automatic fertilizer sprayer. This device is basicallycombination of spraying mechanism on a Hexa copter frame [2].This model is used to spray the pesticides content to the areas thatcannot easily accessible by humans. The universal sprayer system use to spray liquid as well as solid contents which are done by theuniversal nozzle.[3]

1.3 Previous Work

The earliest attempt at a powered unmanned aerial vehicle was A. M. Low's "Aerial Target" of 1916. Nikola Tesla described a fleet of unmanned aerial combat vehicles in 1915. A number of remote-controlled airplane advances followed, including the Hewitt-Sperry Automatic Airplane, during and after World War I, including the first scale RPV (Remote Piloted Vehicle), developed by the film star and model airplane enthusiast Reginald Denny in 1935. More were made in the technology rush during World War II; these were used both to train antiaircraft gunners and to fly attack missions. Jet engineswere applied after World War II, in such types as the Teledyne Ryan Firebee I of 1951, while companies like Beechcraft 1 also got in the game with their Model 1001 for the United States Navy in 1955. Nevertheless, they were little more than remote-controlled airplanes until the Vietnam Era.In the United States, the United States Navy and shortly after the Federal Aviation Administration has adopted the name Unmanned Aircraft (UA) to describe aircraft systems without the flight crew on board. More common names include: UAV, drone, remotely piloted vehicle (RPV), remotely piloted aircraft (RPA), remotely operated aircraft (ROA), and for those "limited-size" (as defined by the FAI) unmanned aircraft flown in the USA's National Airspace System, flown solely for recreation and sport purposes such as models and radio control (R/Cs), which are generally flownunder the voluntary safety standards of the Academy of Model Aeronautics, the United States' national aeromodeling organization.

In 2015, the Federal Aviation Administration approved Yamaha RMAX as the first drone weighing more than 55 kilos to carry fertilizer and pesticides tanks to spray plants. Drones like this are capable of spraying plants with much more precision than a conventional tractor.

A drone service start-up company in the US has used NDVI maps to direct in-season fertility applications on corn and other crops. By using drone-generated, variable-rate application (VR) maps to determine the strength of nutrition uptake with a single field, the farmer practically 300 kg/ha of fertility to you struggling areas, 200 kg/ha to medium quality areas, and 150 kg/ha to healthy areas, decreasing fertilizer costs and increasing yield .


SPRAYING PROCESS OF DRONE [A]FERTILISING PROCESS OF DRONE [A]

The term unmanned aircraft system (UAS) emphasizes the importance of other elements beyond an aircraft itself. A typical UAS consists of the:

• unmanned aircraft (UA)
• control system, such as Ground Control Station (GCS)
• control link, a specialized datalink

Fig 2.1.1
DELIVERY DRONE [B]

Fig 2.1.2
SENSOR TYPE DRONE [C]

Fig 2.1.3
LONG RANGE DRONE [D]

Fig 2.1.3
CAMERA DRONE [E]

UAV TYPES

UAVs typically fall into one of six functional categories :-

- Target and decoy – providing ground and aerial gunnery a target that simulates an enemy aircraft or missile
- Reconnaissance – providing battlefield intelligence
- Combat – providing attack capability for high-risk missions (see Unmanned combat air vehicle)
- Logistics – UAVs specifically designed for cargo and logistics operation
- Research and development – used to further develop UAV technologies to be integrated into field deployed UAV aircraft
- Civil and Commercial UAVs – UAVs specifically designed for civil and commercial applications

They can also be categorised in terms of range/altitude and the following has been advanced as relevant at such industry events as ParcAberporth Unmanned Systems forum:

- Handheld 2,000 ft (600 m) altitude, about 2 km range
- Close 5,000 ft (1,500 m) altitude, up to 10 km range
- NATO type 10,000 ft (3,000 m) altitude, up to 50 km range
- Tactical 18,000 ft (5,500 m) altitude, about 160 km range
- MALE (medium altitude, long endurance) up to 30,000 ft (9,000 m) and range over 200 km
- HALE (high altitude, long endurance) over 30,000 ft (9,100 m) and indefinite range
- HYPERSONIC high-speed, supersonic (Mach 1–5) or hypersonic (Mach 5+) 50,000 ft (15,200 m) or suborbital altitude, range over 200 km
- ORBITAL low earth orbit (Mach 25+)
- CIS Lunar Earth-Moon transfer
- CACGS Computer Assisted Carrier Guidance System for UAV

The Drones/UAV'S can also be categorised in terms of Rotor Craft i.e There are two types of RotorCraft:-

- Helicopter- one rotor system
- Multirotor- with limit upto 8 rotors

The added motors provide greater stability, redundancy, and greater lifting capacity.The most popular rotorcraft platform is the Hexacopter. This provides for a stable and simple to operate UAV that can carry a wide variety of payloads, landing and taking off in a small space, and being harder to detect than many of the other UAV configurations due to small size and quiet rotors. Examples of various rotorcraft are shown below:

EXAMPLE OF A QUADROTOR – DJI MAVIC PRO

EXAMPLE OF A HEXACOPTER – CUSTOM BUILT MODEL

EXAMPLE OF AN OCTOCOPTER – CUSTOM BUILT MODEL

ONE OF THE MOST POPULAR MULTIROTORS ON THE MARKET– DJI PHANTOM MODEL

FIG 2.2.1 TYPES OF DRONES BASED ON NO OF ROTORS

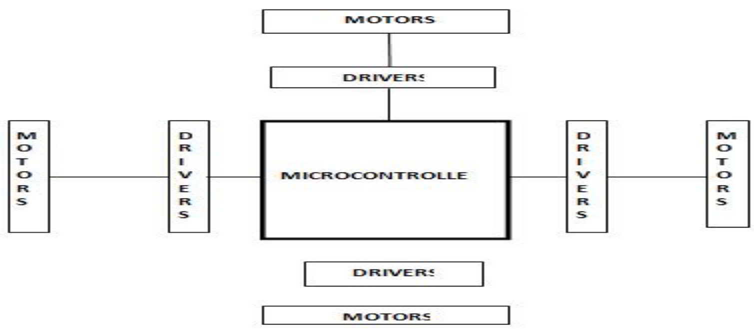
2.3 UAV TECHNICAL SPECIFICATIONS

While the overall goals, strategies and objectives have been stated, the specifications of the components will be determined as they are identified for their applicability in the project. The technical specifications are divided in the following in engineering module on the basis of application and engineering involved. The modules are represented in Table 3.1.

MECHANICAL AND ELECTRICAL MODULE	SENSOR TECHNOLOGY MODULE	EMBEDDED SYSTEM & OTHER ELECTRONIC MODULE	SOFTWARE MODULE
• QUAD ROTOR FRAME • LANDING STAND • 4x MOTORS • 4x PROPELLERS • 2300 Mah Li-Po BATTERY WITH POWER DISTRIBUTION SYSTEM	• IMU/3 AXIS DIGITAL COMPASS/DIGITAL PRESSURE SENSOR • ON-BOARD CAMERA • GPS • TELEMETRY	• FLIGHT CONTROLLER USING ARDUINO UNO BOARD • ON-BOARD PROCESSOR USING RASBERRY PI • ESC • TRANSRECEIVER	• CADSOFT EAGLE/FRITZING • MATLAB/SIMULINK(DRAKE TOOL BOX) • ARDUINO IDE,LINUX,OPENCV • PYTHON

UAV TECHNICAL SPECIFICATIONS BASED ON MODULES

2.4 UAV BLOCK DIAGRAM



MECHANISM OF HEXACOPTER & FLIGHT CONTROL

4.1 HOW A HEXACOPTER WORKS?

So how does a Hexacopter hover or fly in any direction, lift or descend at a moments touch on the remote controller stick. Drones can also fly autonomously through programmed waypoint navigation software and fly in any direction going from point to point.but in this project we use manual remote controller stick.It is the propeller direction along with the drone's motor rotation and speed, which make it's flight and maneuverability possible.

The Hexacopter's flight controller sends information to the motors via their electronic speed control circuits (ESC) information on thrust, RPM, (Revolutions Per Minute) and direction. The flight controller will also combine IMU, Gyro and GPS data before signalling to the Hexacopter motors on thrust and rotor speed
Mathematics is also used to calculate Hexacopter motor thrust while aircraft aerodynamics is used for propeller design and the movement of air above, below and around the Hexacopter.

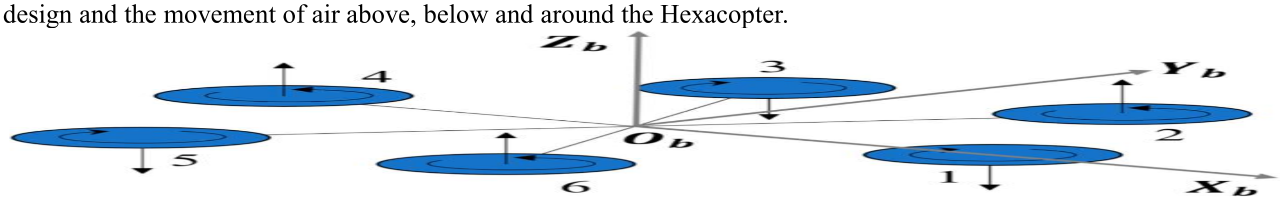


FIG 4.1.1 MOTOR ROTATION'S DIRECTION

4.2 BASIC PRINCIPLE: Basically, the movement on the remote control sticks, sends signals to the central flight controller. This central flight controller sends this information to the Electronic Speed Controllers (ESCs) of each motor, which in turn directs its motors to increase or decrease speed. Remote Control Stick Movement → Central Flight Controller → Electronic Speed Control Circuits (ESCs) → Motors and Propellers → Hexacopter Movement or Hover.

4.3 OPERATION: When the joysticks are toggled irrespective of direction. data is read and transmitted to the central flight controller system.Now the central flight controller also takes information from IMU, Gyroscope, GPS modules and obstacle detection sensors if on the Hexacopter. It makes computation calculations using programmed flight parameters and algorithms, then sends this data to the electronic speed controllers.

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Vertical Lift – Hexacopter Motor Propeller Direction

In order for a Hexacopter to rise into the air, a force must be created, which equals or exceeds the force of gravity. This is the basic idea behind aircraft lift, which comes down to controlling the upward and downward force.

Now, Hexacopters use motor design and propeller direction for propulsion to basically control the force of gravity against the Hexacopter.

The spinning of the Hexacopter propeller blades push air down. All forces come in pairs (Newtons Third Law), which means for every action force there is an equal (in size) and opposite (in direction) reaction force. Therefore, as the rotor pushes down on the air, the air pushes up on the rotor. The faster the rotors spin, the greater the lift and vice-versa.

Now, a drone can do three things in the vertical plane: hover, climb, or descend.

Hover Still – To hover, the net thrust of the four rotors push the drone up and must be exactly equal to the gravitational force pulling it down.

Climb Ascend – By increasing the thrust (speed) of the four Hexacopter rotors so that the upward force is greater than the weight and pull of gravity.

Vertical Descend – Dropping back down requires doing the exact opposite of the climb. Decrease the rotor thrust (speed) so the net force is downward.

Yaw, Pitch, Roll- Hexacopter Propeller Direction

Before delving into the Hexacopter motor and propeller setup, lets explain a bit about the terminology used when it is flying forwards, backwards, sideways or rotating while hovering. These are known as Pitch, Roll and Yaw.

Yaw – This is the rotating or swiveling of the head of the Hexacopter either to right or left. It is the basic movement to spin the Hexacopter. On most drones, it is the achieved by using the left throttle stick either to the left or right.

Pitch – This is the movement of Hexacopter either forward and backward. Forward Pitch is achieved generally by pushing the throttle stick forward, which makes the Hexacopter tilt and move forward, away from you. Backward pitch is achieved by moving the throttle stick backwards.

Roll – Most people get confused with Roll and Yaw. Roll is making the Hexacopter fly sideways, either to left or right. Roll is controlled by the right throttle stick, making it fly either left of right.

i. **Hexacopter Motor Direction For Yaw**

The movement on the remote control ground station sends signals to the flight controller which in turn sends data for the Hexacopter ESC circuits which control the motor configuration and speed to the motors.

FIG 4.3.1 MOTORS MOVEMENT YAW DIRECTION

In this above diagram, you can see the Hexacopter motor configuration, with the 2 / 4 motors are rotating counterclockwise (CCW motors) and the 1 / 3 motors are rotating clockwise (CW motors). With the two sets of Hexacopter motors configured to rotate in opposite directions, the total angular momentum is zero.Angular momentum is the rotational equivalent of linear momentum and is calculated by multiplying the angular velocity by the moment of inertia i.e is similar to the mass, except it deals with rotation. Angular momentum depends on how fast the rotors spin.If there is no torque on the Hexacopter motors, then the total angular momentum must remain constant which is zero. To understand the angular movement of the above Hexacopter, think of the 2 and 4 blue counterclockwise rotors having a *positive* angular momentum and the green clockwise Hexacopter motors having a *negative* angular momentum. I'll assign each motor a value of -4, +4, -4, +4, which equates to zero To rotate the drone to the right, then a decrease in the angular velocity of motor 1 to have an angular momentum of -2 instead of -4. If nothing else happened, the total angular momentum of the Hexacopter would now be +2. Now, that can't happen. The drone will now rotate clockwise so that the body of the drone has an angular momentum of -2.

Decreasing the spin of rotor 1 did indeed cause the drone to rotate, but is also causes a problem. It also decreased the thrust from motor 1. Now the net upward force does not equal the gravitational force and the Hexacopter descends. Also the Hexacopter motor thrust are not the same so the Hexacopter becomes unbalanced. The Hexacopter will tip downward in the direction of motor 1.To rotate the drone without creating the above imbalances, then a decrease in the spin of motors 1 and 3 with an increase in the spin for rotors 2 and 4.The angular momentum of the rotors still doesn't add up to zero, so the drone body must rotate. However the total force remains equal to the gravitational force and the drone continues to hover. Since the lower thrust rotors are diagonally opposite from each other, the drone can still stay balanced.

Hexacopter Propeller Direction For Pitch And Roll

Because most Hexacopters are symmetrical & there is no difference between moving forward or backward. It is also the same for side to side motion.
In order to fly forward, an increase in the Hexacopter motor rpm (rotation rate) of rotors 3 and 4 (rear motors) and decrease the rate of rotors 1 and 2 (front motors) is required. The total thrust force will remain equal to the weight, so the drone will stay at the same vertical level.
Also, since one of the rear rotors is spinning counterclockwise and the other clockwise, the increased rotation of those motors will still produce zero angular momentum. The same holds true for the front rotors, and so the drone does not rotate. However, the greater force in the back of the drone means it will tilt forward. Now a slight increase in thrust for all rotors will produce a net thrust force which has a component to balance the weight along with a forward motion component.

FIG 4.3.2MOTORS MOVEMENT OF ALL DIRECTIONS INCLUDING PITCH AND ROLL

HARDWARE SPECIFICATIONS

HEXACOPTER FRAME & PROPELLERS

HEXACOPTER FRAME:

It is the important part of the Hexa copter it should be made of fiber or light weighted and strong material . in our project we use alminium discs as main frame at centers and arms are made up of steel. this aluminium is a well thought out Hexa frame built from quality materials.The frame here that is used isF450 Multi-Copter Hexacopter Rack Frame which is made by advanced engineering material, super strong & smooth kit.It also comprises of new design PCB board for standard 50mm controller board like MK, KK, FF, MWC.Its arm size is about 21.5*4*5cm.

FIG 5.1.1 F-450 FRAME OF HEXACOPTER

- **DIMENSIONS:** Its dimensions are as follows:
  - Width: 363 mm
  - Height: 40 mm
  - Weight: 270g (w/out electronics)
  - Motor Mount Bolt Holes: 16/19mm

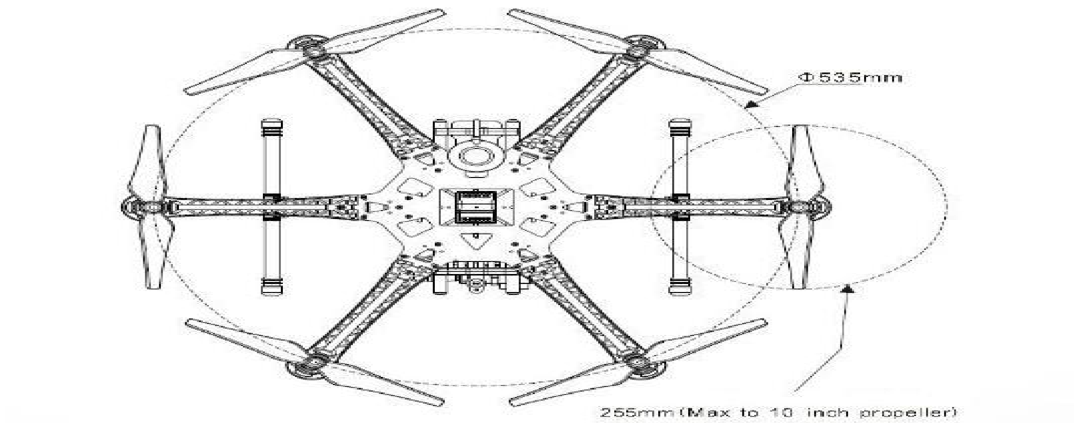

FIG 5.1.2DIMENSION OF F450-FRAME

A) PROPELLERS:

A propeller is a type of fan that transmits power by converting rotational motion into thrust. A pressure difference is produced between the forward and rear surfaces of the airfoil-shaped blade, and a fluid (such as air or water) is accelerated behind the blade. Propeller dynamics can be modelled by both Bernoulli's principle and Newton's third law. A marine propeller is sometimes colloquially known as a screw propeller or screw.

FIG 5.1.3PROPELLERS

It is also main part of the Hexa copter for flying, there are two types of propellers used in the Hexa copter they mostly left hand propellers and right hand propellers. 25 Left hand propellers are also called as normal propeller and they are mounted to the motor which is moving in counter clock wise direction. Right hand propellers are also called as pusher propellers and they are mounted to the motor which is moving in the clock wise direction. We are using four propellers controlled by motors and ESC's. Using gyroscopes we can measure the orientation of prototype in X,Y and Z directions. These are used to adjust the RPM of each motor.

5.2 MULTI ROTOR CONTROL BOARD

The KK.2 multicontroller is a flight control board for remote control multicopters with 2,3,4 and 6 rotors. Its purpose is to stablise the aircraft during flight. To do this it takes the signal from the three gyros on the board (roll, pitch and yaw) and feeds the information into the Integrated Circuit (Atmega IC).

This then processes the information according the the KK software and sends out a control signal to the Electronic Speed Controllers (ESCs) which are plugged onto the board and also connected to the motors. Depending upon the signal from the IC the ESCs will either speed up or slow down the motors (and tilt the rear rotor with a servo in a Tricopter) in order to establish level flight.

The board also takes a control signal from the Remote Control Receiver (RX) and feeds this into the IC via the aileron, elevator, throttle and rudder pins on the board. After processing this information, the IC will then send out a signal to the motors (Via the M1 to M6 pins on the board) to speed up or slow down to achieve controlled flight (up, down, backwards, forwards, left, right, yaw) on the command from the RC Pilot sent via his Transmitter (TX).The v.5.5 has an Atmega168 chip on board and an ISP header which gives users the option to tweak and upload their own controller code.

Specifications: -

Size: 50.5mm x 50.5mm x 12mm

Weight: 21 gram (IncPiezo buzzer)

IC: Atmega324 PA

Gyro: InvenSense Inc.

Accelerometer: Anologue Devices Inc.

Auto-level: Yes Input Voltage: 4.8-6.0V

AVR interface: standard 6 pin.

Signal from Receiver: 1520us (5 channels)

Signal to ESC: 1520us

The schematics of IC involved in this part is included in Appendix-A

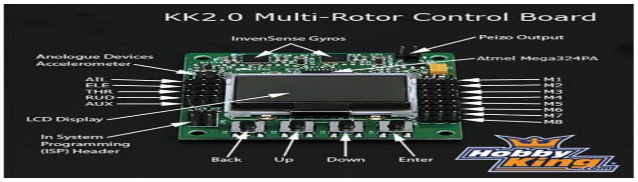

FIG 5.2.1 KK2.0 FLIGHT CONTROLLER

5.3 ELECTRONIC SPEED CONTROLLERS (ESC

An electronic speed control or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brake. ESCs are often used on electrically powered radio controlled models, with the variety most often used for brushless motors essentially providing an electronically generated three-phase electric power low voltage source of energy for the motor.

FIG 5.3.1 ESC

FUNCTIONS:

- Regardless of the type used, an ESC interprets control information not as mechanical motion as would be the case of a servo but rather in a way that varies the switching rate of a network of field effective transistor , or FETs The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.
- It also allows much smoother and more precise variation of motor speed in a far more efficient manner than the mechanical type with a resistive coil and moving arm once in common use.

- Most modern ESCs incorporate abattery eliminator circuit (or BEC) to regulate voltage for the receiver, removing the need for separate receiver batteries. BECs are usually either linear or switched mode voltage regulators.
- DC ESCs in the broader sense are PWM controllers for electric motors.
- The ESC generally accepts a nominal 50 Hz PWM servo input signal whose pulse width varies from 1 ms to 2 ms.
- When supplied with a 1 ms width pulse at 50 Hz, the ESC responds by turning off the DC motor attached to its output.
- A 1.5 ms pulse-width input signal drives the motor at approximately half-speed. When presented with 2.0 ms input signal, the motor runs at full speed.

The schematics of IC involved in this part is included in Appendix-B

5.4 BRUSHLESS DC MOTORS

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors which are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor (AC, alternating current, does not imply a sinusoidal waveform but rather a bi-directional current with no restriction on waveform); additional sensors and electronics control the inverter output amplitude and waveform and frequency (i.e. rotor speed).

The motor part of a brushless motor is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor. Brushless motors may be described as stepper motors; however, the term stepper motor tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position. Here we use DC Outrunner . The term outrunner refers to a type of brushless motor primarily used in electrically propelled, radio-controlled model aircraft. This type of motor spins its outer shell around its windings, much like motors found in ordinary CD-ROM computer drives.

The stationary (stator) windings of an outrunner motor are excited by conventional DC brushless motor controllers. A direct current (switched on and off at high frequency for voltage modulation) is typically passed through three or more non- adjacent windings together, and the group so energized is alternated electronically based upon rotor position feedback. The number of permanent magnets in the rotor does not match the number of stator poles, however. The difference between the number of magnet poles and the number of stator poles provides an effect that can be understood as similar to planetary gearing. The number of magnet poles divided by 2 gives the ratio of magnetic field rotation speed to motor rotation speed. Consequently the advance of the electromagnetic impulse around the motor axis proceeds much faster than the rotor turns. With more magnet poles the maximum torque is increased, while the speed of rotor advance is decreased in proportion to the ratio of magnet poles to stator poles.In our project we use

SPECIFICATION OF BRUSHLESS MOTOR:

- RPM/V: 3000 Rpm/V
- Input Voltage: 7.4~11.1V
  - No-load Current: 0.4A
  - Load Current: 12A
- Shaft Diameter: 3mm / 0.12in - Cable Length: 60mm / 2.4in
- Dimensions: 38 x 30 mm / 1.5 x 1.2in(L x Dia.)

FIG 5.4.1 BRUSHLESS DC MOTOR & ITS INTERNAL MECHANISM

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LITHIUM POLYMER (LI-PO) BATTERY

LiPo batteries (short for Lithium Polymer) are a type of rechargeable battery that have become very popular because of their power to rate ratio. In other words, more electricity in a lighter package. Obviously, this is ideal for anything you're trying to get to fly.

Another advantage is that LiPo's have a high discharge rate – which means they can deliver large amounts of power at once.

Specifications:

- **Battery Configuration**: 11.1V 2200mAh 3cell
- **Battery Capacity**: 2200mAh
- **Max Continuous Discharge (C-rate/current)**: 20C Max Burst (3Sec)
- **(C-rate/current): 45C**
- **Approx Dimensions H x W x L (mm):** 22.0 x 35 x 104
- **Approx Weight (g):** 266.5 Max Charging rate: 2C.

FIG 5.5.1 LI-PO BATTERY 11.1V

RF TRANSMITTER AND RECEIVER

An RF Module (Radio Frequency Module) is a usually small electronic circuit used to transmit and/or receive radio signals on one of a number of carrier frequencies. RF Modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. Here we are using fly sky (fs) ct6b transmitter and receiver.The 6 Channel RF Remote Controller designed using CC2500 RF Transceiver modules and PIC16F1847 micro-controller from microchip. Transmitter provided with 6 tact switch, 4 Address Jumpers to pair multiple unit so they don't interfere with each other. Board provided with power LED, valid transmission LED. Project works with 5 V DC, On board LM1117-3.3V regulator for CC2500 Module. Two in one PCB can be used as Transmitter & Receiver.Receiver works with 5V DC. 4 Jumper to paring RX& TX units, valid signal LED, power LED, and 9 Pin connector for outputs. Same PCB is used as transmitter and receiver.

All outputs are Latch Type and TTL 5V Signal for easy interface with other devices like Relay Boards, Solid State Relays.

FIG 5.6.1 DRONE RECEIVER

FIG 5.6.2DRONE TRANSMITTER

Receiver specification :

- **Channel**: 6
- **IC used**:
- **Frequencyband**: 2.4GHz
- **Powerresorce**: 1.5V*4''AA''battery
- **Programtype**: GFSK
- **Modulationtype**: FM
- **RFreceiversensitivity**: -76db
- **Staticcurrent**: ≤85mA Size: 45*23*13.5mm
- **Weight**: 25G
- **Antenna length**: 26mm

Transmitter specification:

- **Channels**: 6
- **Frequencyband**: 2.4GHz
- **Simulatorport**: PS-2
- **Powerresource**: 1.5V*8"AA"
- **BatteryProgramtype**:GFSK
- **Modulationtype**: FM RF power:19db
- **Staticcurrent**: ≤250mA
- **Antennalength**: 26mm

The schematics of IC involved in this part is included in Appendix-C,D & E

S-500 FRAME

The main great advantage of this frame is the arms have a slight upsweep, this gives the Hexacopter a dihedral effect which helps to make it very stable, especially when descending from altitude. The arms have a carbon fibre rod through the centre for making the strongest arms we have seen to date in this style of frame. This S500 Hexa copter Frame is made from Glass Fiber which makes it tough and durable. They have the arms of ultra-durable Polyamide-Nylon which are the stronger moulded arms having a very good thickness so no more arm breakage at the motor mounts on a hard landing. The arms have support ridges on them, which improves stability and provides faster forward flight.It has an adjustable battery mount to achieve the perfect weight distribution. The S500 has strong, light, and have a sensible configuration including a PCB(Printed Circuit Board) with which is used to directly solder our ESC's to the Hexacopter. The S500 Hexacopter Frame is highly flexible frame during mounting of various components like flight controller, battery etc. Its ground clearance is 200 mm.

RESULTS

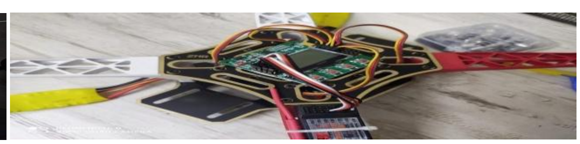

FIG 6.1 FIXED ARMS,MOTORSFIG 6.2 FIXED RECEIVER ANF FLIGHT & ESC'S CONTROLLER

FUTURE SCOPE

Drones can be a large part of the critical solution to this exponential increase in demand, along with closer collaboration between governments, tech leaders, and industry. Drones can assist famers in a range of tasks from analysis and planning, to the actual planting of crops, and the subsequent monitoring of fields to ascertain health and growth. As farms become larger and more efficient to meet this escalating demand, drones will prove invaluable in precisely managing a farm's vital operations. Engineered to accomplish all of these farming applications, drones UAVs not only offer farmers the longest flight times on the market, they are particularly resilient in harsh, unpredictable weather. The drones simplifies flight planning, monitoring, and analysis, allowing farmers to survey their fields precisely and consistently. Modular payloads also make Microdrones systems versatile and efficient in a wide variety of applications including crop-monitoring, where multi-spectral imaging and thermal mapping are needed, or field analysis. Microdrones is also working diligently on its LiDAR solutions for mapping, and this technology should also prove useful in areas of precision agriculture.

Currently, the agricultural industry's largest obstacle is the low efficiency in crop monitoring resulting from the massive scale of industrial farming, exacerbated by increasingly unstable weather conditions that intensify risk and maintenance costs. Drones allow real-time monitoring at a far more accurate and cost-effective level than previously used satellite imagery. The drones is specifically tailored to this purpose, offering users an aerial imaging package designed to monitor nutrients, moisture levels, and overall cop vigor in order to help keep crops healthy and estimate yields.Hence a wide variety of aspects can be considered for future.

CONCLUSION

The main advantage of our drone will be helpful for farmers in spraying fertilizers, pesticides and crop protection products while being controlled by a single person operating from a safe and secure location. The prototype which is being created is one of its kind and has not been tested ever. This can be a boon for the future of drones and robotics which can bring a variable change in development for the mankind.This is a trial and error method which have been tested again and again to get favourable results for the requirement of proper setting and functions of the drone.The drone has a lot of potential for development and enhancement of different parts and proper research can lead to a remarkable evolution in the field of robotics.

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