MULTI-PURPOSE DRONE

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CERTIFICATE

This is to certify that research work embodied in this project report entitled **"MULTI-PURPOSE DRONE"** was carried out by **Madhu Jenish (201902100110006), Unnithan Pranav (201902100110007), Master Kathan (201902100110018).** At Chhotubhai Gopalbhai Patel Institute of Technology for the fulfillment of Diploma degree to be awarded by UKA TARSADIA UNIVERSITY. This research work has been carried out under my supervision and is to our satisfaction.

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ACKNOLEDGEMENT

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It's a pleasure for us to be part of CGPIT and therefore we would like to thank all the teaching and non-teaching staff members of CGPIT for their support. Their inspiration and encouragement have leaded us to come with a successful task.

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ABSTRACT

The No. of drones in the air is expected to increase rapidly in the coming years. This will put enormous pressure on the system of permits and exemptions that most countries require for drone use. Large no. of drones will also put the enforcement of such rules under purser. Banning drones from society is note a realistic option. Thus, properly regulating the use of drones in order to avoid or minimize the risk associated with the use of drones becomes critical. Expanding the possibilities for drone use while maintaining safety requirements would meet the demands of particular drone user groups would help to regulate technology developments.

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ACRONYMS

CW	CLOCKWISE
CCW	COUNTER-CLOCKWISE
RPM	REVOLUTION PER MINUTE
LIPO	LITHUM POLY
USB	UNIVERSAL SERIAL BUS

CHAPTER 1: INTRODUCTION

1.1 Introduction

A drone, in a technological context, is an unmanned aircraft. Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot. The aircraft may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS.

In the recent past, UAVs were most often associated with the military, where they were used initially for anti-aircraft target practice, intelligence gathering and then, more controversially, as weapons platforms. Drones are now also used in a wide range of civilian roles ranging from search and rescue, surveillance, traffic monitoring, weather monitoring and firefighting to personal drones and business drone-based photography, as well as video-graphy, agriculture and even delivery services. Origin of a drone can be traced with special techniques to provide relevant information to the military. The very first aircraft with reusable type radio control mechanism was designed in the 30s and it worked like a base model for all new advancements of today's world.

Later, the military drones were developed with classic sensors and camera units and now they have been fixed inside missiles too. With so much advancement in technology, now you can easily find so many variants of drones. Few are used for military applications but others are finding the potential role in many big companies. Drones in today's world have also been an important part of the film industry and news reporters are also using them to carry information from inaccessible locations. A typical unmanned aircraft is made of light composite materials to reduce weight and increase maneuverability. This composite material strength allows military drones to cruise at extremely high altitudes.

UAV drones are equipped with a different state of the art technology such as infrared cameras, GPS and laser (consumer, commercial and military UAV).
Drones are controlled by remote ground control systems (GSC) and also referred to as a ground cockpit. An unmanned aerial vehicle system has two parts, the drone itself and the control system. The nose of the unmanned aerial vehicle is where all the sensors and navigational systems are present. The rest of the body is full of drone technology systems since there is no space required to accommodate humans. The engineering materials used to build the drone are highly complex composites designed to absorb vibration, which decrease the sound produced. These materials are very lightweight.

1.2 Types of Drones

Quad-copters are known by different names, including: Quadro copter, quadrotor, quad-copter. There are series of Bi-copters, Tri-copters, Quad-copters , Hexa-copters and Octo-copters.

A Quad copter is a multirotor copter that is lifted and propelled by four rotors.

All the four arms have a motor and a propeller at their ends each. The Lift is generated by a set of rotors and vertically oriented propellers, hence and quadcopters are classified to rotorcrafts.

1.3 Classification of Drone

There are many types of Drones are made for different purpose such as:

1. Toy Drone
2. Camera Drone
3. Industrial Drone
4. Military Drone
5. Commercial drone
6. Racing Drone

CHAPTER 2: COMPONENTS

The Selection of Component are done which are used in Multi-Purpose Drone.

2. List Of Components Use for Drone

Sr.No.	Product	Quantity
1.	Propeller Pair 10*4.5 Inch	2 No (set of 2 in one)
2.	Quadcopter Frame 4-Axis- Integrated PCB Wiring	1 No
3.	BLDC Brushless Motor	4 No
4.	11.1V - 2200mAh LiPo Rechargeable Battery- 30C	1 No
5.	B3 Lithium Polymer (LiPo) Battery Charger for 2S-3S LiPo	1 No
6.	Landing Gear	1 No
7.	ESC30A	4 No
8.	XT60	1 No
9.	DC Water Pump	1 No
10.	FS-CT6B Remote controller with Receiver	1 No
11.	ESP- 32 Cam	1 No
12.	Servo motor	2No
13.	Jumper Wire (Female to Female)	LS
14.	KK 2.1 Flight controller Board	1 No
15.	Relay Module	1

Table 1 : List of Components

2.1 Propeller Pair 10*4.5 Inch

Figure 1: Propeller 10*4.5

The purpose of the propeller is to provide a method of propulsion, so the aircraft is able to move forward through the air. The propeller itself consists of two or more blades connected together by a central hub that attaches the blades to the engine shaft.

Working:

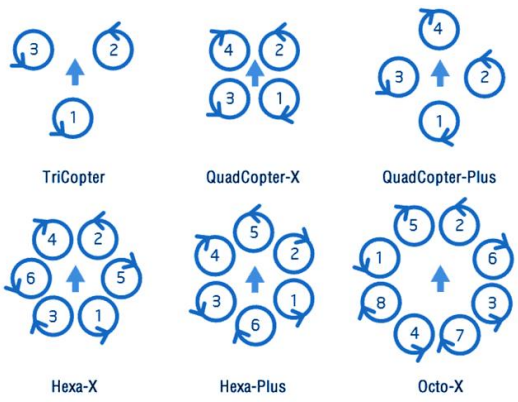

Figure 2 : Rotation of propeller for different Drone

Drone propellers are practically made up of multiple blades that are spun by a motor at amazing speed rotation. The more power the motor generates, the faster the blades spin. Moreover, the faster they spin, the more lift they create. The motor's power and

capacity have a lot to do with the flight performance. However, there are also other characteristics that can influence the efficiency of the drone propellers.

2.2 Quad-copter Frame 4-Axis- Integrated PCB Wiring (F 450)

F450 quad-copter frame is a 450mm quad frame built from quality materials. The mainframe is glass fibre while the arms are constructed from ultra-durable poly-amide nylon. This version of the F450 features integrated PCB connections for direct soldering of your ESCs.

Figure 3 :Quad-copter Frame 4 - Axis Integrated PCB (F 450)

Features:

- Built from quality glass fibre and poly-amide nylon.
- Integrated PCB connections for direct soldering of your ESCs
- PR-threaded brass sleeves for all of the frame bolts.
- Coloured arms for orientation to keep you flying in the right direction.
- Large mounting tabs on main frame bottom plate for easy camera mounting.
- Easy assembly.

Specifications:

- Weight: 450mm

- Height: 55mm

2.3 2450KV BLDC Brush-less Motor

Figure 4 : 2450KV BLDC Brush-less Motor

A brush-less DC electric motor (BLDC motor or BL motor), also known as an electronically com-mutated motor (ECM or EC motor) or synchronous DC motor, is a synchronous motor using a direct current (DC) electric power supply. It uses an electronic controller to switch DC currents to the motor windings producing magnetic fields which effectively rotate in space and which the permanent magnet rotor follows. The controller adjusts the phase and amplitude of the DC current pulses to control the speed and torque of the motor. This control system is an alternative to the mechanical commutator (brushes) used in many conventional electric motors.

Rotation of Motor :

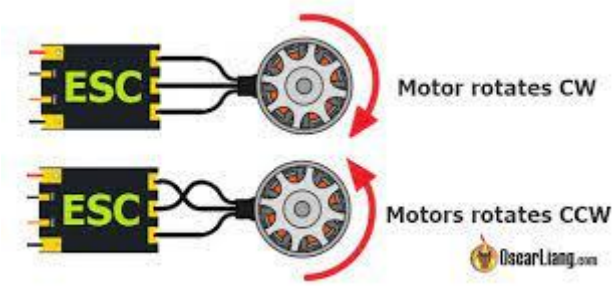

Figure 5 : Rotation of Motor

Specifications:

- KV : 2450KV

- DC Voltage: 9 - 14 V
- Current: 20 - 30A
- Torque: 5T

Note: Less Number of Torque the more Number of speeds.

E.g.: The speed of 2450KV BLDC Motor is More speed and Torque is less. (This Motor is used for racing of drone)

The Speed of 1000KV motor is less speed and Torque is More. (This Motor is used to weight Lifting of drone.)

2.4 11.1V - 2200mAh LiPo Rechargeable Battery- 30C

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. Commercially available LiPo are hybrids: gel polymer or liquid electrolyte in a pouch format, more accurately termed a lithium-ion polymer battery.

Figure 6 :11.1V - 2200mAh LiPo Rechargeable Battery- 30C

Features:

- Minimum Capacity: 2200mAh
- Battery Voltage: 11.1V / 3Cell
- Charger Type: Lipo Charger
- Battery Type: Lipo Battery

2.5 B3 Lithium Polymer (LiPo) Battery Charger for 2S-3S LiPo

Figure 7 : B3 Lithium Polymer (LiPo) Battery Charger for 2S-3S LiPo

The iMax B3 Pro LiPo battery charger has a built in internal 100-240V AC switch. This B3 Lipo Charger features high precision balance circuit can supply larger current up to 850mA series. The imAx B3 Pro AC charger is integrated with double colour LED can display the process of charging (RED: charging; GREEN: full). This B3 Pro Lipo battery charger is compact and light, especially there is separated corresponding balance port for each battery pack. Package Includes: 1 x iMax B3 AC Lipo Battery Charger.

2.6 Landing Gear

Figure 8 : Landing Gear

The technology consists of a landing gear for aircraft, in particular for electric aircraft with vertical take-off such as drones, which in addition to having a structural support function can be used for additional features, such as charging the batteries of the aircraft by cable (wired) or wireless.

2.7 ESC 30A

Figure 9 : ESC 30A

Simonk 30A BLDC ESC Electronic Speed Controller can drive motors which consume current up to 30A. It works on 2S-3S LiPo batteries. This electronic speed controller offers a battery eliminator circuit (BEC) that provides 5V and 2A to the receiver, so no extra receiver battery is required.

2.8 XT60

Figure 10 : XT 60

These connectors are made from high-temp nylon with gold-plated spring pins or sockets molded in. The shape of this generic XT60 prevents reverse polarity, and when plugged in the connection is super-solid. Perfect for applications up to 65A continuous draw. Sold in pairs of 1 male and 1 female connector.

2.9 ESP- 32 CAM

Figure 11 : ESP - 32 CAM

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload.

2.10 DC Motor Pump

Figure 12 : DC Motor Pump

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32

volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

2.11 Servo Motor

Figure 13 : Servo Motor

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

2.12 Relay Module

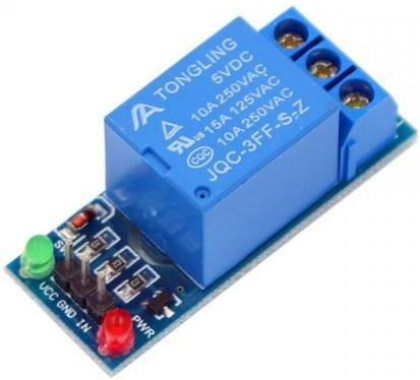

Figure 14 : Relay Module

Relays consist of three pins normally open pin , normally closed pin, common pin and coil. When coil powered on magnetic field is generated the contacts connected to each other.

Features

- Contact current 10A and 250V AC or 30V DC.

- Each channel has indication LED.
- Coil voltage 12V per channel.
- Kit operating voltage 5-12 V
- Input signal 3-5 V for each channel.
- Three pins for normally open and closed for each channel.

2.13 KK 2.1 Multi Rotor Flight Controller Board

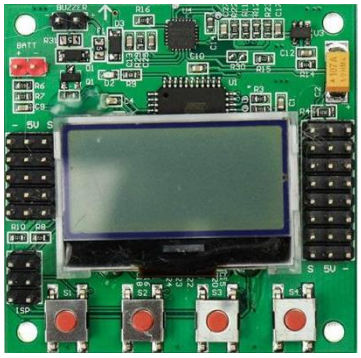

Figure 15 : KK 2.1 Multi Rotor Flight Controller

KK2.1.5 is a flight controller; the flight controller is also called the brain of the drone because with this all the operation of the drone is controlled. KK2.1.5 has ATMEL mega 664PA IC inbuilt inside it. It is 8-bit AVR RISC based micro-controller with 64k of memory. It has inbuilt accelerometer and gyroscope, 6050 MPU and auto level function. It has eight motor output at right side of board, we connect ESC here. It has 5 control inputs; these inputs are connected through receiver. It also has one LCD display in the middle, it will work as user interface for the drone. Its operating voltage is 1.8V to 5.5V and its input voltage is 4.8-6.0 V.

KK2.1.5 is used to stabilize the quad copter during flight and to do this, it receives the signal from gyroscope (roll, pitch and yaw) and send these signals to processor (ATMEL mega 664PA) and then it passes control signal to ESCs and the combination of these signals instructs the ESCs to make fine adjustments to the motors rotational speeds which in-turn stabilizes the craft. Kk2.1.5 also uses signal from receiver and passes these all signals together to the processor (ATMELmega664PA) via the aileron, elevator, throttle, and rudder user demand inputs. Once processed, this

information is sent to the ESCs which in turn adjust the rotational speed of each motor to control flight orientation (yaw, right, left, up, down, backward, forward).

Specification:

- Size: 50.5mm x 50.5mm x 12mm
- Weight: 21 gram (Inc. Piezo buzzer)
- IC: Atmega644 PA
- Gyro/Acc: 6050MPU
- Auto-level: Yes
- Input Voltage: 4.8-6.0V
- AVR interface: standard 6 pin.
- Signal from Receiver: 1520us (5 channels)
- Signal to ESC: 1520us
- Firmware Version 1.6

2.14 Radio Transmitter And Receiver

Fly-Sky CT6B 2.4Ghz 6 Channel Transmitter and Receiver (FS-R6B) Remote is the popular 6 Channel Radio CT6B manufactured by Fly-Sky. 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 quad-copters and multi-copters that require 6 channel operation.

This radio has 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 12V Power Supply. It comes with a trainer port to help beginners learn flying.

This remote is 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.

Figure 16 : Transmitter

Figure 17 : Receiver

Specification and Features:

- 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
- Weight: 696 gm
- Dimensions: 180 x 220 x 70 mm (L x W x H)

- Color: black
- Certificate: CE FCC
- RF POWER: Less than 0.8W
- APPLICATION: Multi-rotors, RC Planes, RC Boats, RC Helicopters, etc.
- CHANNELS: 6 channels TX RX
- MATERIAL & COLOR: NA& Black and Blue
- Super active and passive anti-jamming capabilities.
- Very low power consumption.
- High receiving sensitivity.
- 8 model memory, digital control.
- Programmable by PC with included software.
- Full range 2.4GHz 6-channel radio.
- 4 Types (Airplane, Heli90, Heli120, Heli140).
- Integrated Contrast Adjustment, Throttle cut.
- Computer USB Socket.
- Use a linear spread of fine paragraph by excess antenna.
- It covers the entire band width of he antenna bandwidth range.
- High quality and stability.

Calibration of Remote:

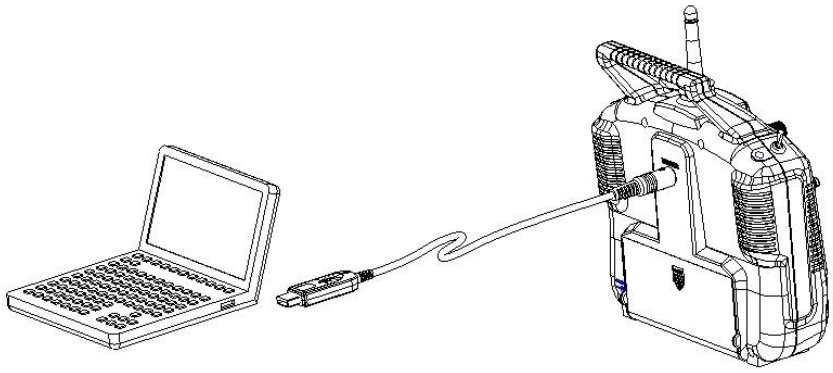

Figure 18 : Setup

1. Connect the transmitter Programming line to PC and click the left button to application.

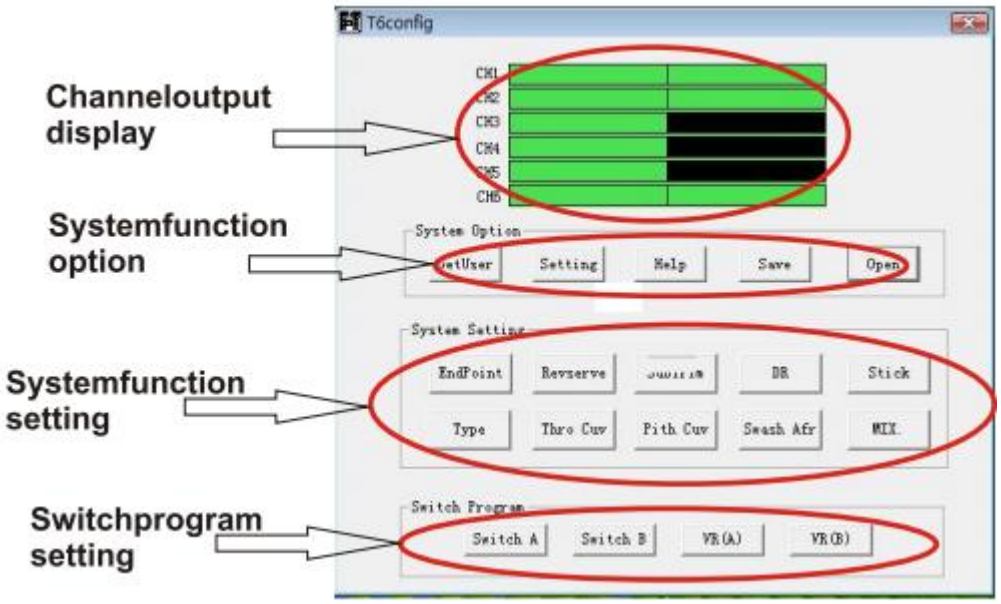

Figure 19 : Calibration

2. Left click the 'Setting' button the screen on the right will appear this system is use for the programming line USB port selection, It improves the communication of transmission and pc. If select wrongly the channel output display will not have any data changes and all other setting are invalid. Press OK button after finished Selection.

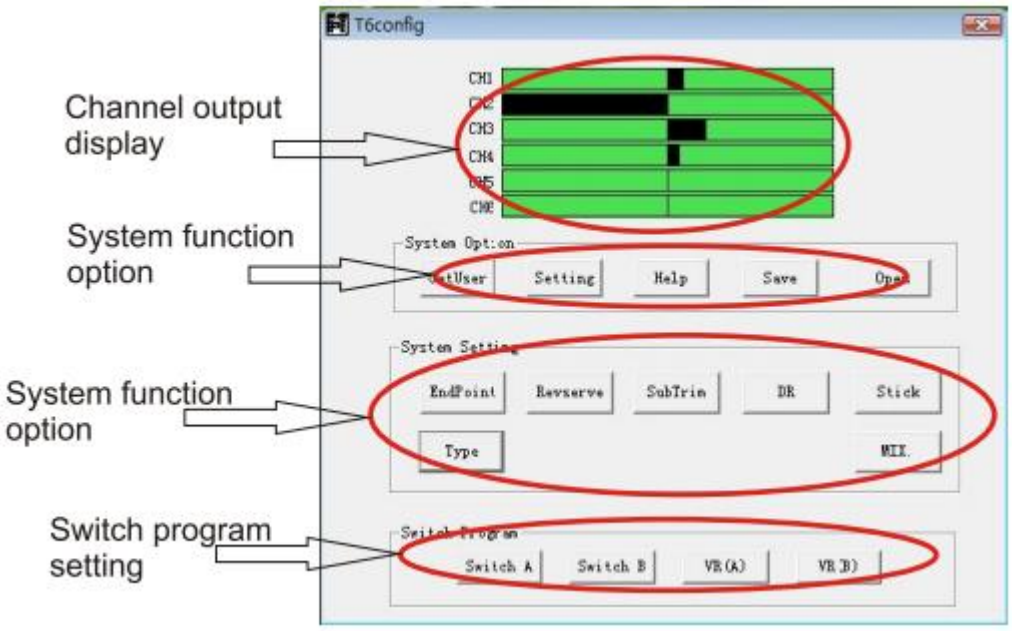

Figure 20 : Complete Of Calibration

3. Left click the save button on the interfacing the screen on the right will appear this function is for save all your setting and finish control adjustment.

4. And finally connect the transmitter line with pc switch on the transmitter and pc software.

CHAPTER 3: PARAMETERS CALCULATION

3.1 Calculation

1. **For BLDC Motor RPM:**

   - RPM = KV * V
   - Brushless motor comes with Ky-rating. It means motor will spin at given RPM (revolutions per minute) if we give V voltage to motor without any load.

     Where,

     RPM=revolutions per minute

     V= voltage to motor without any load

2. **For Propellers**

   - Power (watts) = Kp * D^4 * P * RPM^3
   - We are using (10*4.5) dimension propellers which mean its diameter is 10 and pitch is 4.5 inches.

     Where,

     KP = for mid-sized propellers KP value is 1.2

     D = Diameter of propellers

     P = Pitch

3. **LiPo battery has two characteristics parameter:**

   - Capacity - It tells how much energy is stored in a battery.
   - Discharge Rate – It is also called C-rate and expressed in C-unit. It represents the rate at which the battery can discharge. The maximum current (I_{max}) that can draw from a battery is product of discharge rate and capacity.

I_{max} = Battery Capacity * Discharge Rate

We are using a battery which has discharge rate of 30C.

So, I_{max} = 2200mAh * 30C = 66 Amps

It means A 2200mAh 30C 3S LiPo can give up to 66 Amps of maximum current.

CHAPTER 4: BLOCK DIAGRAM & CIRCUIT DIAGRAM OF MULTI-PURPOSE DRONE

4.1 Block Diagram of Multi-Purpose Drone

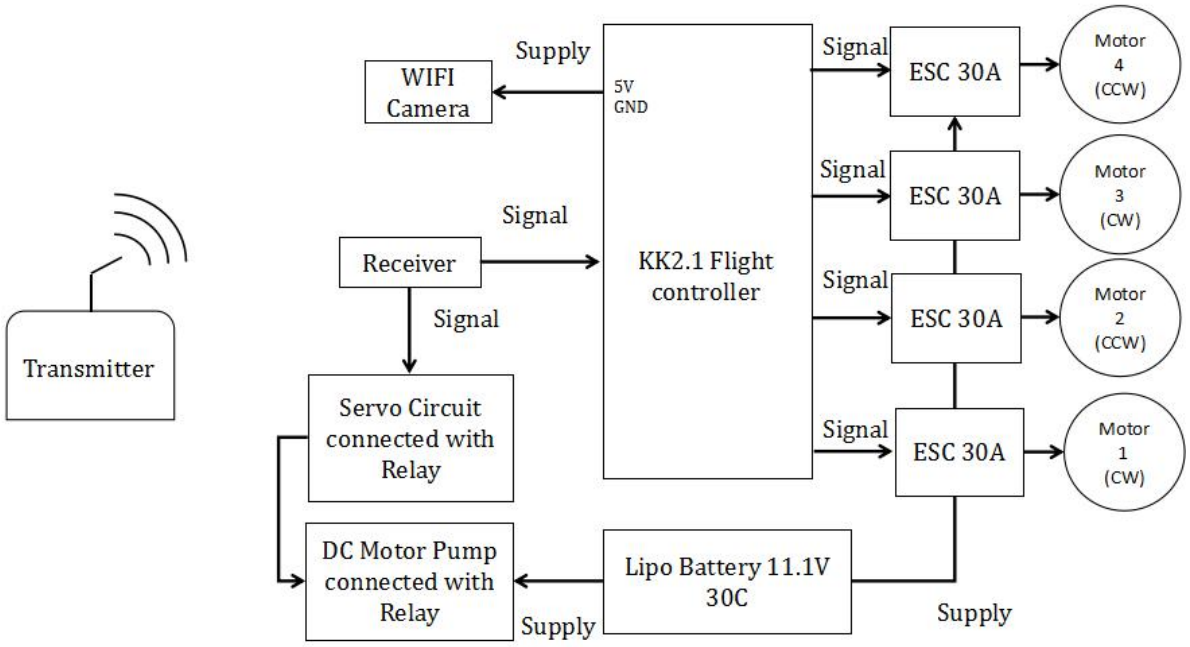

Figure 21 : Block Diagram Of Multi Purpose Drone

In this block diagram we show how the working of multipurpose drone will be there.

Battery is connected to is **ESC 30A** and it is connected to **BLDC MOTOR.** The **2 motor will rotating in clock wise and 2 motor will rotating in counter-clockwise**. This system is used to balancing of drone , without using this this system you cannot fly the drone. The **Receiver** is connected to **KK2.1 Flight Controller** to control the drone with the help of **Remote Controller (Transmitter). KK2.1 Board** will give supply to **Camera (ESP-32CAM).** Camera will give us live video using Wi-Fi(mobile hotspot). The Receiver have 6 Channel. Four or five channel will connected to KK2.1 Board and get single to make fly up , down , right and left and rotate 360. Another 2 channel , one of the channel will connected to servo circuit which will connected to relay to **ON** and **OFF** the relay. Relay will connected to DC Motor Pump for the agriculture purpose. Battery will also supply to the DC Motor Pump and complete the circuit with relay. Servo Circuit is removed from servo motor to give signal to to relay and **ON** and **OFF** the motor pump with the help of remote controller.

4.2 Circuit Diagram of Multi-Purpose Drone

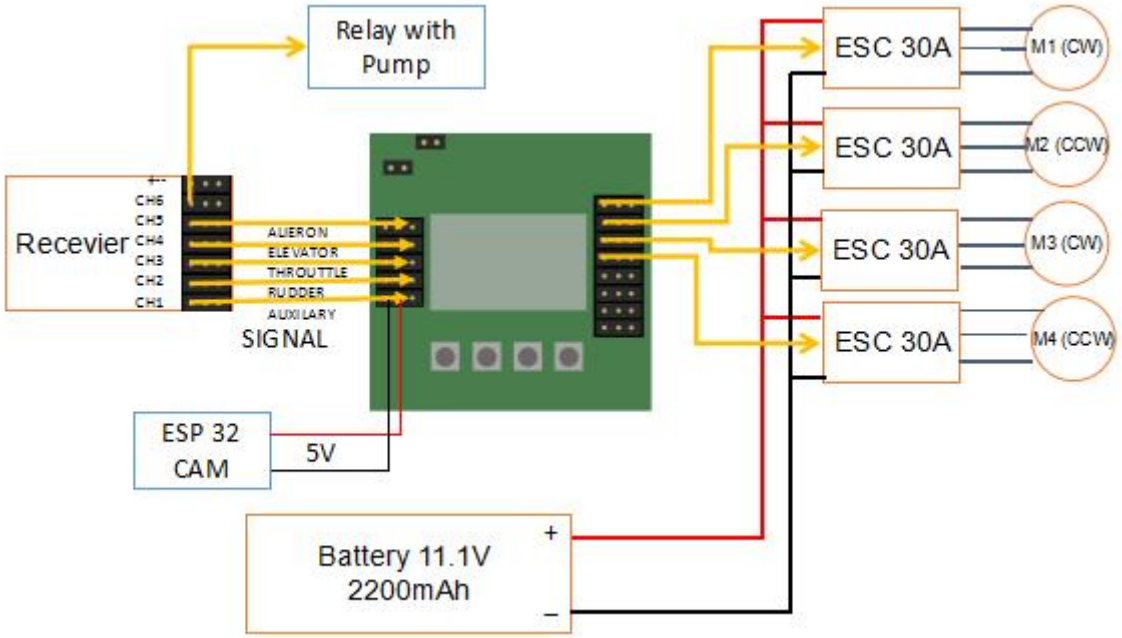

Figure 22 : Circuit Diagram Of Drone

In this Circuit Diagram we show how the connection of multipurpose drone will be there.

Battery is connected to is **ESC 30A** on printed circuit board of F450 frame. **ESC 30A** is connected to **BLDC MOTOR** changing two wire out of three will change the direction of motor**.** The **2 motor will rotating in clock wise and 2 motor will rotating in counter-clockwise**. This system is used to balancing of drone , without using this this system you cannot fly the drone. The **Receiver** is connected to **KK2.1 Flight Controller** (ALIERON , ELEVATOR , THROUTTLE and RUDDER) to control the drone with the help of **Remote Controller (Transmitter). KK2.1 Board** will give supply to **Camera (ESP-32CAM).** Camera will give us live video using Wi-Fi(mobile hotspot). The Receiver have 6 Channel. Four or Five channel will connected to KK2.1 Board and get single to make fly up , down , right and left and rotate 360. Another 2 or 1 channel , one of the channel will connected to servo circuit which will connected to relay to **ON** and **OFF** the relay. Relay will connected to DC Motor Pump for the agriculture purpose. Battery will also supply to the DC Motor Pump and complete the circuit with relay. Servo Circuit is removed from servo motor(So , basically Motor is remove from circuit and relay is connected to it) to give signal to to relay and **ON** and **OFF** the motor pump with the help of remote controller.

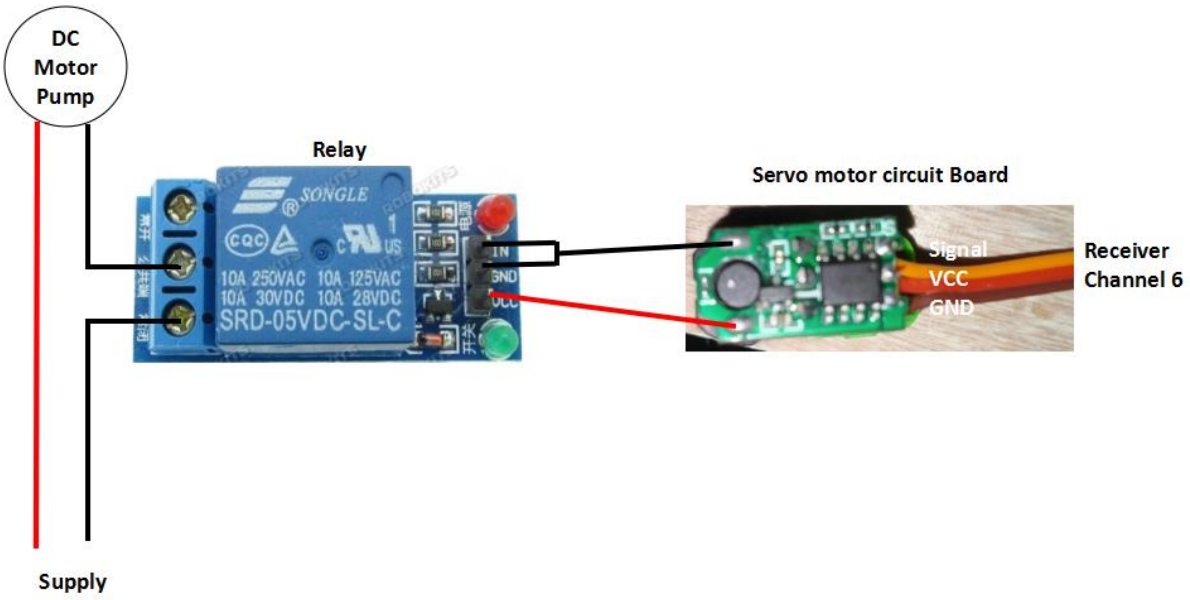

Figure 23 : DC Motor Pump control using relay Servo Motor Circuit Board

The Servo circuit board wire (Signal,VCC ,GND) will connect to channel 6 when switch become **OFF** supply of motor get trip and motor became **STOP** when Switch of transmitter become **ON** motor get started and give water to plant.

CHAPTER 5: HARDWARE AND ITS WORKING

Image 1 : Model of Drone

5.1 KK2.1.5 Setup

For setting up KK2.1.5 board, first keep the transmitter on and ensure that the receiver is bound to transmitter. There are four buttons at the bottom of the KK2.1.5 board S1, S2, S3 and S4. Using these buttons, we will interact with LCD display.

Step-1 First go to menu by pressing S4 then go to load motor layout then select quad copter X mode and setup quad Copter at X – mode. Check all the motor directions here.

Image 2 : Load motor Layout

Step-2 Next is ACC calibration, for which we have to place quad copter on the plane level surface and select the Acc Calibration that is to calibrate accelerometer. Click on S4, this is auto calibration.

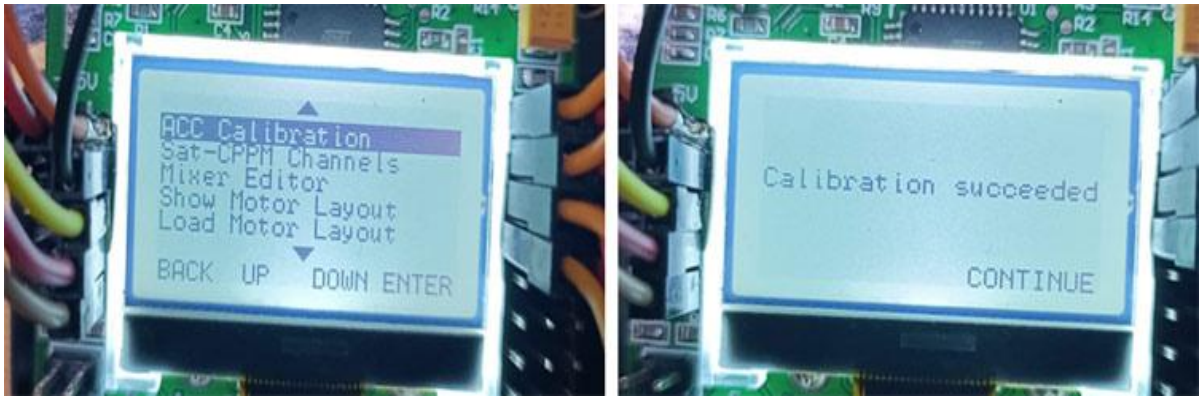

Image 3 : ACC Calibration

As soon as Acc calibration over, we can pull out the power and provide the power again. It will be showing safe on LCD display which means, it has changed from error to safe.

Image 4 : Safe

Step-3 Now, go to the PI editor. Here, we have to set P (gain / limit) and I (gain / limit) of aileron (Roll), elevator (Pitch) and rudder (Yaw). P gain is proportionality gain that represents sensitivity and responsibility. Higher P means sharper control and lower P means softer one.

Image 5 : PI Editor and Aileron Setting

I is integral gain that represents how well it holds the altitude. Once PI setting has been done go to the mode setting.

Image 6 : Elevator and Rudder Setting

Step-4 In the mode setting, set the self level to AUX.

Image 7 : Mode Setting

Step-5 Now go to miscellaneous settings, here we will set Alarm 1/10 volts.

Image 8 : Miscellaneous Setting

To set alarm 1/10 volts, we need to do following calculations.

3-Cell LiPo battery of 11.1 volts use a value 3.60 volt per cell to denote an empty batter then set the value (in 1/10's) to (3.6 * 3 * 10 = 108) and when the supply voltage drops to 10.8 volts the alarm will sound.

Step-6 Now, we have to the calibration of ESCs. First turn the transmitter with throttle to minimum then move throttle to maximum and keep pressing S1 and S4 switches and then connect the battery to the quad copter, now we will get two beep sound and we will put the throttle down which leads to single beep sound. With this, the calibration process gets over .

Step-7 To arm the quad copters, keep the throttle at left hand side, once the quad copter is armed, we can fly quad copter.

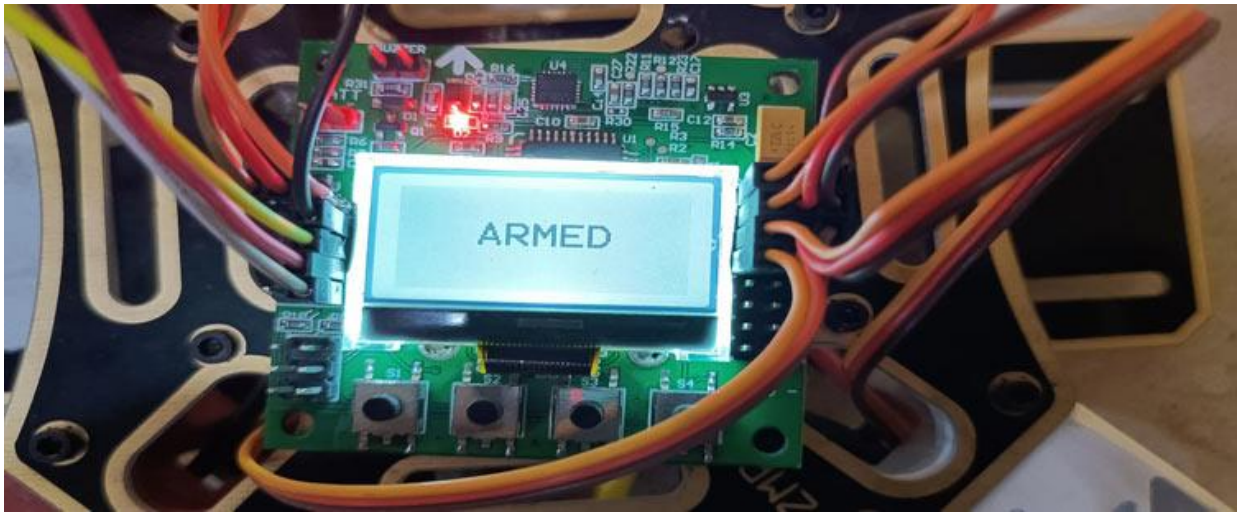

Image 9 : ARMED

Now quad copter is ready to fly. Keep the throttle at right side.

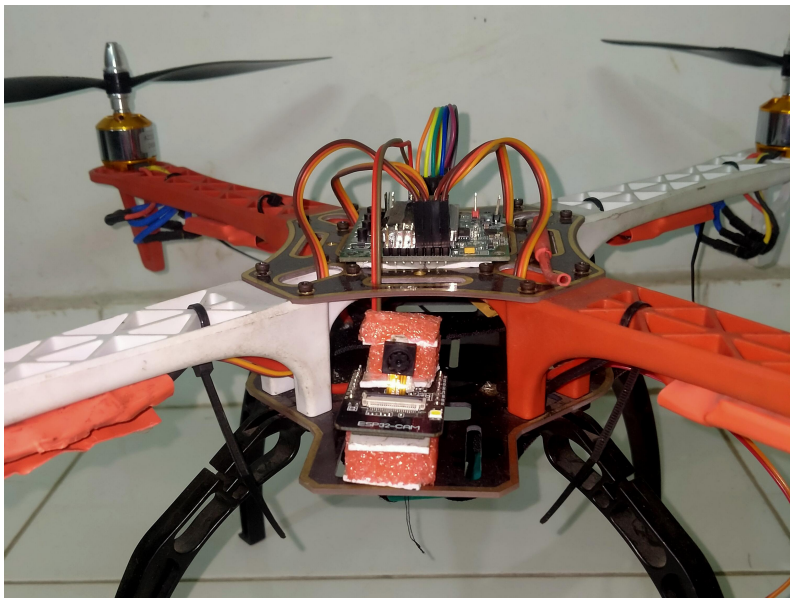

Image 10 : Camera Module On Drone

WI-FI camera (ESP32 CAM) connect to mobile hotspot or WI-FI to see the live video on your mobile or laptop screen using IP address which is give by this module while programming.

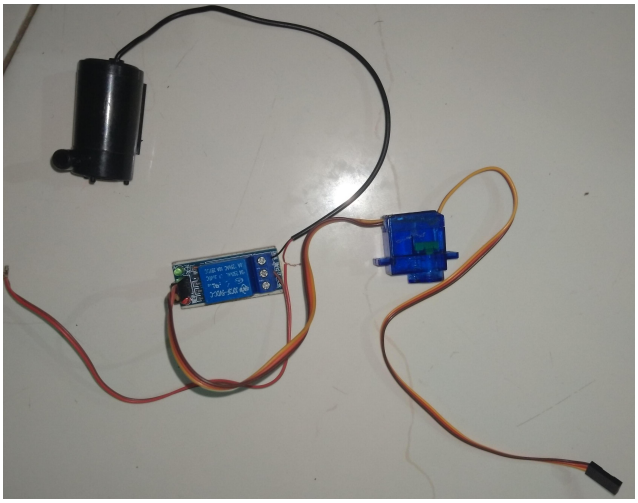

Image 11 : Trip Mechanism For DC Motor Pump using Servo Circuit Board

The Servo circuit board wire (Signal,VCC ,GND) will connect to channel 6 when switch become **OFF** supply of motor get trip and motor became **STOP** when Switch of transmitter become **ON** motor get started and give water to plant.

FUTURE SCOPE

1. Pick and Place

CONCLUSION

In this Project we make a multi tasking prototype drone which will help to complete task easily. In this project we have attach Camera for photography and video shooting and DC motor pump to do pesticides in farming.

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