LiDAR MICRO DRONE WITH PROXIMITY SENSING

A Project report submitted in partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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(UGC AUTONOMOUS)

(Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade)Sangivalasa, Bheemili mandal, Visakhapatnam dist.(A.P)2021-2022.

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CERTIFICATE

This is to certify that the project report entitled **"LiDAR MICRO DRONE WITH PROXIMITY SENSING"** submitted by **Venkata Gowthami Priya Boddu(318126512009), Shyam Deepak Kammila(318126512049) and Gudisa Pavan(319126512L04)** in partial fulfillment of the requirements for the award of the Degree of **Bachelor of Technology** in **Electronics & Communication Engineering** of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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ABSTRACT

Drones are now widely used in a variety of industries in the present era of fast-moving technology. Drones are used for anything from photography and cinematography to thermal examinations. The expense of drones is the most significant concern. Drones are often expensive to buy, and there is a significant risk of harm while flying them, which is why they are still a very uncommon item. Large drones can produce a lot of noise and require a lot of open space to fly. They can't fly indoors, in dense forests, or in locations with a lot of trees. The little drone is made up of four propeller-driven drone motors, an Arduino Pro Mini F3 EVO controller, a lidar sensor, and a buzzer. Infrared is used by the LiDAR sensor. The LiDAR sensor detects obstacles in front of it using infrared technology. If an obstacle is detected, the lidar signal is decoded by the controller, which then activates a buzzer and a light to signal the proximity of the object. The user is constantly notified to the vicinity of the drone by altering the led and buzzer frequency in response to the proximity, allowing the drone to be flown appropriately to avoid collision. To take off and fly, the little drone has four motors. To achieve desired flying movement, the flight controller interprets and uses the RC controller commands through the RF receiver. The drone uses an Arduino Pro micro to sense the vicinity of other objects using LiDAR and to control the led and buzzer in response. As a result, we have a small, lightweight micro drone that can take off from anywhere, fly indoors, in forests, or in gardens, and detect obstacles using LiDAR proximity sensing.

Keywords: LiDAR(Light Detection And Ranging),Drone, Proximity Sensor, Arduino Pro Mini F3 Evo controller, Obstacle detection.

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CHAPTER 1

INTRODUCTION

INTRODUCTION:

Drones are today widely being used in a number of fields. Applications of drones ranges from filming and videography to thermal inspections. The major issue associated with drones is the cost. Drones are generally costly purchase and there is a huge risk of damage while flying drone that is why drones are still not a very common gadget. Also large drones make a lot of noise and need a lot of clear space to fly. They cannot be flown indoors or in dense forests or areas with many trees. So here we build a micro drone with an obstacle detection feature using LIDAR. This drone helps you understand drone flying as well as how obstacle sensing can be done using drones. Also its small size and lower cost makes it less risky to fly it in dense forest of tricky places.

This Micro drone provides the following advantages:
- Small size and Low Cost
- LIDAR based obstacle sensing
- LED and Buzzer indications as per obstacle distance
- Can Takeoff from ones hand/trees or tight places
- Less Noise and very lightweight design

The mini drone consists of 4 drone motors with propellers with Arduino Pro Mini F3 EVO controller and a lidar sensor and buzzer. The lidar sensor uses IR for detecting any obstacles in front of it. If any obstacle is detected the lidar signal are decoded by controller to operate a buzzer and led for indication of obstacle proximity alert. The user is constantly alerted with about the proximity by modifying the led and buzzer frequency as per proximity so drone can be controlled accordingly to avoid collision.

The small drone uses 4 motors to lift off and control the flight. The RC controller

commands are interpreted and used by flight controller through the rf receiver to achieve desired flight movement. The drone makes use of a Arduino Pro mini to sense the proximity using LIDAR and the operate the led and buzzer accordingly.
Thus we get a lightweight micro drone that can take off from anywhere, fly indoors or in forests or gardens and sense obstacles using LiDAR proximity .

CHAPTER 2

DRONE ASSEMBLING

A **drone**, in technological terms, is an unmanned aircraft. Essentially, a **drone** is a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS.

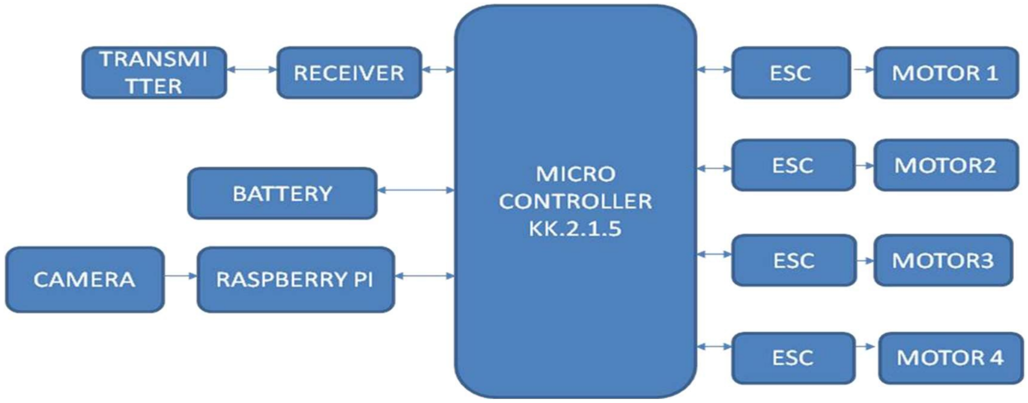

Fig 2.1:Block Diagram Of ICMAS

DRONE COMPONENTS:

Standard Propellers:

The propellers are usually located at the front of the drone/quadcopter. There are very many variations in terms of size and material used in the manufacture of propellers. Most of them are made of plastic especially for the smaller drones but the more expensive ones are made of carbon fiber. Propellers are still being developed and technological research is still ongoing to create more efficient propellers for both small and big drones. Propellers are responsible for the direction and motion of the drone. It is therefore important to ensure that each of the propellers is in good condition before taking your drone out for flight. A faulty propeller means impaired flight for the drone and hence an accident. You can also carry an extra set of propellers just in case you notice some damage that was not there before.

Pusher Propellers:

Pusher propellers are the ones responsible for the forward and backward thrust of the drone during flight. As the name suggest, the pusher propellers will determine the direction the drone takes either forward or backward. They are normally located at the back of the drone. They work by cancelling out the motor torques of the drone during stationary flight leading to forward or backward thrust. Just like the standard propellers, the pusher propellers can also be made of plastic or carbon fiber depending on the quality. The more expensive ones are usually made of carbon fiber. There are different sizes depending on the size of the drone. Some drones provide for pusher prop guards that will help protect your propellers in the event of an unplanned crash. Always ensure you inspect your pusher propellers before flight as this will determinethe efficiency Of the flight.

Brushless Motors:

All drones being manufactured lately use the brushless motors that are considered to be more efficient in terms of performance and operation as opposed to the brushed motors. The design of the motor is as important as the drone itself. This is because an efficient motor means you will be able to save on costs of purchase and maintenance costs. In addition to that, you will also save on battery life which contributes to longer flight time when flying your drone. Currently, the drone motor design market is pretty exciting as companies try to outdo each other in coming up with the most efficient and best developed motors. The latest in the market is the DJI Inspire 1 which was launched recently. This offers more efficient performance and saves on battery life. It is also relatively quiet and does not produce a lot of unnecessary noises.

Landing Gear:

Some drones come with helicopter-style landing gears that help in landing the drone. Drones which require high ground clearance during landing will require a modified landing gear to allow it to land safely on the ground. In addition to that, delivery drones that carry parcels or items may need to have a spacious landing gear due to the space required to hold the items as it touches the ground. However, not all drones require a landing gear. Some smaller drones will work perfectly fine without a landing gear and will land safely on their bellies once they touch the ground. Most drones that fly longer and cover longer distances have fixed landing gears. In some cases, the landing gear may turn out to be an impediment to the 360 degrees view of the environment especially for a camera drone. Landing gears also increase the safety of the drone.

Electronic Speed Controllers:

An electronic sped controller (ESC) is an electric circuit whose main responsibility is to monitor and vary the speed of the drone during flight. It is also responsible for the direction of flight and variations in brakes of the drone. The ESC is also responsible for the conversion of DC battery power to AC power to propel the brushless motors. Modern drones depend entirely on the ESC for all their flight needs and for performance. More and more companies are coming up with better performing ESC that reduce power needs and increase performance, the latest one being the DJI Inspire 1 ESC. The ESC is mainly located inside the mainframe of the drone. It is unlikely that you will need to do anything or make any change on the ESC but in case you need to make any changes, you can locate it inside the mainframe of the drone.

Flight Controller:

The flight controller is basically the motherboard of the drone. It is responsible for all the commands that are issued to the drone by the pilot. It interprets input from the receiver, the GPS Module, the battery monitor and the onboard sensors. The flight controller is also responsible for the regulation of the motor speeds through the ESC and for the steering of the drone. Any commands such as triggering of the camera, controlling the autopilot mode and other autonomous functions are controlled by the flight controller. Users will most likely not be required to make any alterations to the flight controller as this may often affect the performance of the drone.

The Receiver:

The receiver is the unit responsible for the reception of the radio signals sent to the drone through the controller. The minimum number of channels that are needed to control a drone are usually 4. However, it is recommended that a provision of 5 channels be made available. There are very many different types of receivers in the market and all of them can be used when making a drone.

The Transmitter:

The transmitter is the unit responsible for the transmission of the radio signals from the controller to the drone to issue commands of flight and directions. Just like the receiver, the transmitter needs to have 4 channels for a drone but 5 is usually recommended. Different types of receivers are available in the market for drone manufacturers to choose from. The receiver and the transmitter must use a single radio signal in order to communicate to the drone during flight. Each radio signal has a standard code that helps in differentiating the signal from other radio signals in the air.

GPS Module:

The GPS module is responsible for the provision of the drone longitude, latitude and elevation points. It is a very important component of the drone. Without the GPS module, drones would not be as important as they are today. The modules helps drone navigate longer distances and capture details of specific locations on land. The GPS module also help in returning the drone safely “home” even without navigation using the FPV. In most modern drones, the GPS module helps in returning the drone safe to the controller in case it loses connection to the controller. This helps in keeping the drone safe.

Battery:

The battery is the part of the drone that makes all actions and reactions possible. Without the battery, the drone would have no power and would therefore not be able to fly. Different drones have different battery requirements. Smaller drones may need smaller batteries due to the limited power needs. Bigger drones, on the other hand, may require a bigger battery with a larger capacity to allow it to power all the functions of the drone. There is a battery monitor on the drone that helps in providing battery information to the pilot to monitor the performance of the battery.

Camera:

Some drones come with an inbuilt camera while others have a detachable camera. The camera helps in taking photos and images from above which forms an important use of drones. There are different camera types and qualities in the market and a variety to choose from.

These are basically the main component of a drone. If you ever need to make a drone, you will need to have all of these in order to have a working drone.

COMPONENTS USED IN PROJECT:

- Arduino Pro Mini
- F3 EVO Controller
- LIDAR Module
- Buzzer
- LED
- Drone Motors
- Propellers
- Battery
- Buttons & Switches
- Electrical & Wirings
- Drone Body
- Connectors
- Screws and Fittings

Arduino Pro Mini:

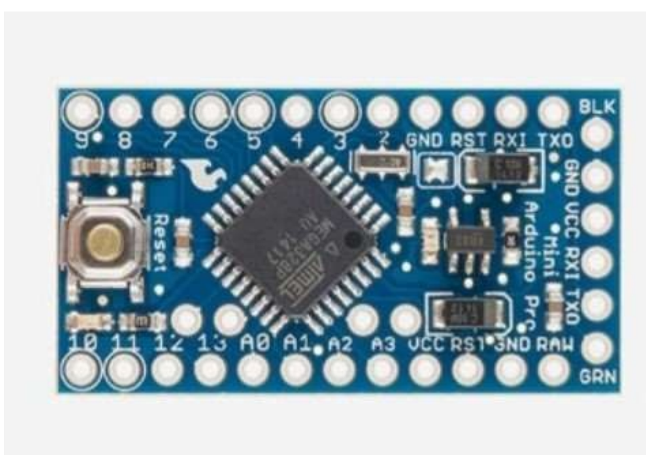

Fig 2.2) Arduino Pro Mini

The Arduino Pro Mini is a microcontroller board based on the ATmega328.

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable or Sparkfun breakout board to provide USB power and communication to the board. The Arduino Pro Mini is intended for semi-permanent installation in objects or exhibitions. The board comes without pre-mounted headers, allowing the use of various types of connectors or direct soldering of wires. The pin layout is compatible with the Arduino Mini. There are two version of the Pro Mini. One runs at 3.3V and 8 MHz, the other at 5V and 16 MHz. The Arduino Pro Mini was designed and is manufactured by SparkFun Electronics. Number of pins: 18+2.The Arduino Pro Micro has 18 easily accessible pins, that's theoretically enough for a board with up to 81 keys (9*9).However, there are 2 more pins, used by the onboard LEDs, which can be quite easily turned into usable pins.

Just follow my Pro Micro upgrade guide and solder your wire to the pad of the removed resistors of the RX/TX LEDs. This way you can wire up a board with up to 100 keys (using the 18+2 pins in a matrix of 10 rows and 10 columns).The additional pins are B0 and D5 as described in the ATmega16U4/32U4 data sheet.The Atmega32u4 has even more GPIO pins (26), which could be available by soldering directly to the microcontroller, but that's not really for beginners.

Pinout & pin names:

If you use the Pro Micro outside the Arduino IDE (e.g. with QMK), you'll have to translate the pin names marked on its PCB to the AVR ones. E.g. pin 3 on the Pro Micro is called D0 on the Atmega32u4.

Arduino makes it confusing by not mapping its pin numbers to AVR ports, but this is for a reason. Some pins on the AVR can also be used for special purposes such as serial, timer input, PWM output, etc. and they are therefore sometimes labelled by those functions on the Pro Micro.Arduino pins to AVR ports. This is a table to translate the Arduino pin names marked on the silk screen into ARV ports, ordered more or less alphabetically:

Arduino AVR

TX0 D3.RX1 D2,2 D1,3 D0,4 D4,5 C6,6 D7,7 E6,8 B4,9 B5,10 B6,14 B3,15 B1,16 B2,A0 F7,A1 F6,A2 F5,A3 F4,LED pin (left of crystal) B0,LED pin (right of crystal) D5

AVR ports to Arduino pin names. The same data as above, this time in order of the AVR codes to make translating from AVR to Arduino easier:

AVR Arduino

B0 LED pin (left of crystal),B1 15,B2 16,B3 14,B4 8,B5 9,B6 10,C6 5,D0 3,D1 2,D2 RX1,D3 TX0,D4 4,D5 LED pin (right of crystal),D7 6,E6 7,F4 A3,F5 A2,F6 A1,F7 A0

Voltage:

The Pro Micro has a built-in voltage regulator (it was designed to run on batteries).

There are two variants of the Pro Micro: One which feeds the AVR 3.3V, and one which is made to feed it 5V - the 5V version being the most common.

If you do feed it with +5.0V from USB, however, there is a penalty - the voltage regulator will deliver only +4.9V.

The AVR should run well on 4.9V, but you could also bypass the voltage regulator by bridging J1 with solder.

• RAW = +5V from the USB port (or power IN if you use battery).

• VCC = +4.9V (or 3.3V) from the voltage regulator, or +5V if bypassed.

On 3.3V, the AVR is limited to 8 MHz and the firmware needs to be made for it but since most firmwares are made for the Teensy 2.0 which runs always on 5V, if you have the 3.3V of the Pro Micro you should bridge J1 to run that firmware.

BUZZER:

Fig 2.3) BUZZER

This is Small PCB Mountable 5V Passive Buzzer. It is great to add Audio Alert to your electronic designs. It operates on 5V supply, uses a coil element to generate an audible tone.A buzzer or beeper is an audio signaling device,which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click.

LED:

Fig 2.4)LED

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device. Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light.[7] Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced LEDs available in visible, ultraviolet (UV), and infrared wavelengths, with high, low, or intermediate light output, for instance white LEDs suitable for room and outdoor area lighting. LEDs have also given rise to new types of displays and sensors, while their high switching rates are useful in advanced communications technology with applications as diverse as aviation lighting, fairy lights, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper, horticultural grow lights, and medical devices.

LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. In exchange for these generally favorable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and lesser maximum operating temperature and storage temperature. In contrast to LEDs, incandescent lamps can be made to intrinsically run at virtually any supply voltage, can utilize either AC or DC current interchangeably, and will provide steady illumination when powered by AC or pulsing DC even at a frequency as low as 50 Hz. LEDs usually need electronic support components to function, while an incandescent bulb can and usually does operate directly from an unregulated DC or AC power source.

PRINCIPLE OF DRONE:

2.3.1 Vertical Motion

Drones use rotors for propulsion and control. Think of a rotor as a fan, because they work pretty much the same. Spinning blades push air down.

Of course, all forces come in pairs, which means that as the rotor pushes down on the air, the air pushes up on the rotor. This is the basic idea behind lift, which comes down to controlling the upward and downward force. 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.

To hover, the net thrust of the four rotors pushing the drone up must be equal to the gravitational force pulling it down.

To climb just increase the thrust (speed) of the four rotors so that there is a non-zero upward force that is greater than the weight. After that, you could decrease the thrust a little bit—but there are now three forces on the drone: weight, thrust, and air drag. So, you will still need for the thrusters to be greater than for just a hover.

Descending requires doing the exact opposite: Simply decrease the rotor thrust (speed) so the net force is downward.

Let's say you have a hovering drone pointed north and you want to rotate it to face east. How do you accomplish this by changing the power to the four rotors? Before answering, I will draw a diagram of the rotors (viewed from above) labeled 1 through 4. This the primary principle of a Drone.

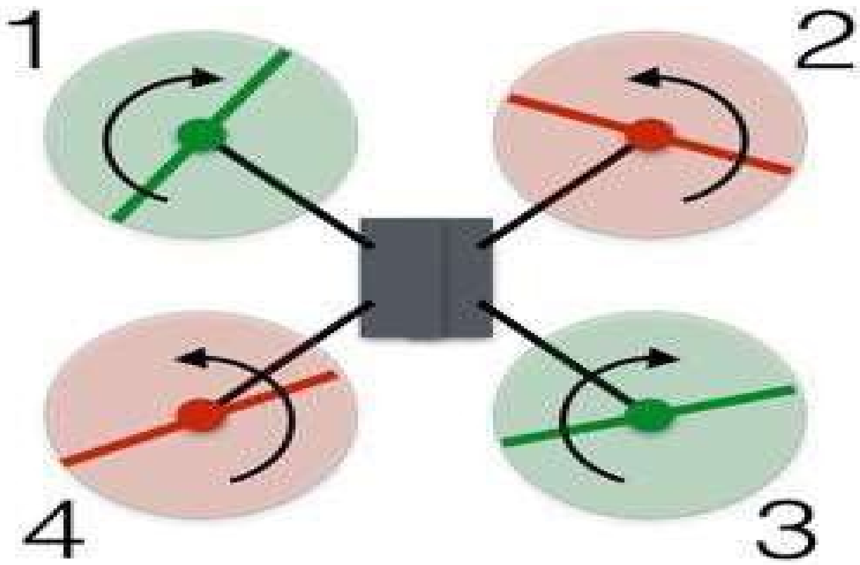

Fig2.5)Drone Principle

In this configuration, the red rotors are rotating counterclockwise and the green ones are rotating clockwise. With the two sets of rotors rotating in opposite directions, the total angular momentum is zero. Angular momentum is a lot like linear momentum, and you calculate it by multiplying the angular velocity by the moment of inertia. It is similar to the mass, except it deals with rotation. The angular momentum depends on how fast the rotors spin.

If there is no torque on the system (the system here being the drone), then the total angular momentum must remain constant (zero in this case). Just to make things easier to understand, I will say the red counterclockwise rotors have a positive angular momentum and the green clockwise rotors have a negative angular momentum. I'll assign each rotor a value of +2, +2, -2, -2, which adds up to zero Let's say to rotate the drone to the right. Decrease the angular velocity of rotor 1 such that now it has an angular momentum of -1 instead of -2. If nothing else happened, the total angular momentum of the drone would now be +1. Of course, that can't happen. So the drone rotates clockwise so that the body of the drone has an angular momentum of 1.Decreasing the spin of rotor 1 did indeed cause the drone to rotate, but it also decreased the thrust from rotor 1. Now the net upward force does not equal the gravitational force, and the drone descends. Worse, the thrust forces aren't balanced, so the drone turn downward.

To rotate the drone without creating all those other problems, decrease the spin of rotor 1 and 3 and increase 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. But 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.

Forwards and Sideways:

The same holds true for side-to-side motion. Basically a quadcopter drone is like a car where every side is the front. This means that explaining how to move forward also explains how to move back or to either side.

In order to fly forward, a forward component of thrust from the rotors. Here is a side view (with forces) of a drone moving at a constant speed.

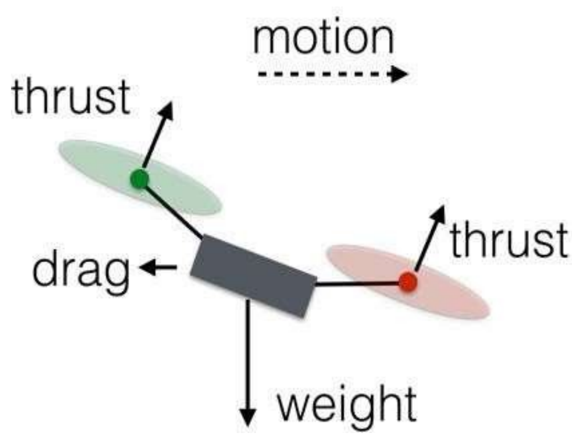

Fig 2.6) forces acting on a Drone

By increasing the rotation rate of rotors 3 and 4 (the rear ones) and decrease the rate of rotors 1 and 2. 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 rotors 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 that has a component to balance the weight along with a forward motion.

APPLICATIONS OF DRONES:

Drones can assist farmers by measuring and recording the height of crops. They use a remote sensing technology called Lidar that illuminates the crop with a laser and calculates distance by measuring what is reflected back.

Drones with biological sensors can fly to unsafe areas to take air quality readings and check for the presence of specific micro-organisms or atmospheric elements.

During wildfires, drones can survey the extent of the affected areas and determine how quickly the fires are spreading. Images taken can provide details of the damage in specific areas.Drones are used by television sport networks to capture sporting event footage, such as taped and live flyover footage, that would otherwise be difficult to acquire. The use of drones must comply with regulations from the FAA, the sports leagues, the venue and local law enforcement.

They can also be used in search and rescue, disaster response, asset protection, wildlife monitoring, firefighting, communications relay, healthcare and agriculture.

Indoor Drones

Animal Repelling

Children’s fun Toys

Advantages:

• Small size and Low Cost

• LIDAR based obstacle sensing

• LED and Buzzer indications as per obstacle distance

• Can Takeoff from ones hand/trees or tight places

• Less Noise and very lightweight design

Disadvantages:

• It has a limited battery Lie

• It has a limited operating range

• Doesn’t auto avoid obstacless

CLASSIFICATION OF DRONES:

The best classification of ‘Drones’ can be made on the basis of aerial platforms. Based on the type of aerial platform used, there are 4 major types of drones.

- Multi Rotor Drones
- Fixed wing Drones
- Single Rotor Helicopter
- Fixed Wing Hybrid VTOL

Multi-rotor drones can be further classified based on the number of rotors on the platform. They are **Tricopter** (3 rotors), **Quadcopter** (4 rotors), **Hexacopter** (6 rotors) and **Octocopter** (8 rotors). Out of these, Quadcopters are the most popular and widely used variant.

MULTI ROTOR DRONES:

Multi Rotor drones are the most common types of drones which are used by professionals and hobbyists alike. They are used for most common applications like aerial photography, aerial video surveillance etc. Different types of products are available in this segment in the market – say multi-rotor drones for professional uses like aerial photography (whose price may range from 500USD to 3K USD) and there are lots of variants for hobby purposes like amateur drone racing, or leisure flying (price range from 50USD to 400USD). Out of all the 4 drone types (based on aerial platform), multi-rotor drones are the easiest to manufacture and they are the cheapest option available.

FIXED WING DRONE:

Fixed Wing drones are entirely different in design and build to multi-rotor type drones. They use a 'wing' like the normal airplanes out there. Unlike multi-rotor drones, fixed wing type models never utilize energy to stay afloat on air (fixed wing types can't stand still on the air) fighting gravity. Instead, they move forward on their set course or as set by the guide control (possibly a remote unit operated by a human) as long as their energy source permits.

Fig 2.7) Fixed Wing Drone

Single Rotor Drones:

Single rotor drones look very similar in design & structure to actual helicopters. Unlike a multi rotor drone, a single rotor model has just one big sized rotor plus a small sized one on the tail of the drone to control its heading. Single rotor drones are much efficient than multi rotor versions. They have higher flying times and can even be powered by gas engines. In aerodynamics, the lower the count of rotors the lesser will be the spin of the object. And that's the big reason why quadcopters are more stable than octocopters. In that sense, single rotor drones are much efficient than multi-rotor drones.

Fig 2.8)Single Rotor drone

Hybrid VTOL:

These are hybrid versions combining the benefits of Fixed wing models (higher flying time) with that of rotor based models (hover). This concept has been tested from around 1960's without much success. However, with the advent of new generation sensors (gyros and accelerometers), this concept has got some new life and direction.

Hybrid VTOL's are a play of automation and manual gliding. A vertical lift is used to lift the drone up into the air from the ground. Gyros and accelerometers work in automated mode (autopilot concept) to keep the drone stabilized in the air. Remote based (or even programmed) manual control is used to guide the drone on the desired course.

Fig 2.9) Hybrid VTOL

HOW TO MAKE A DRONE ?:

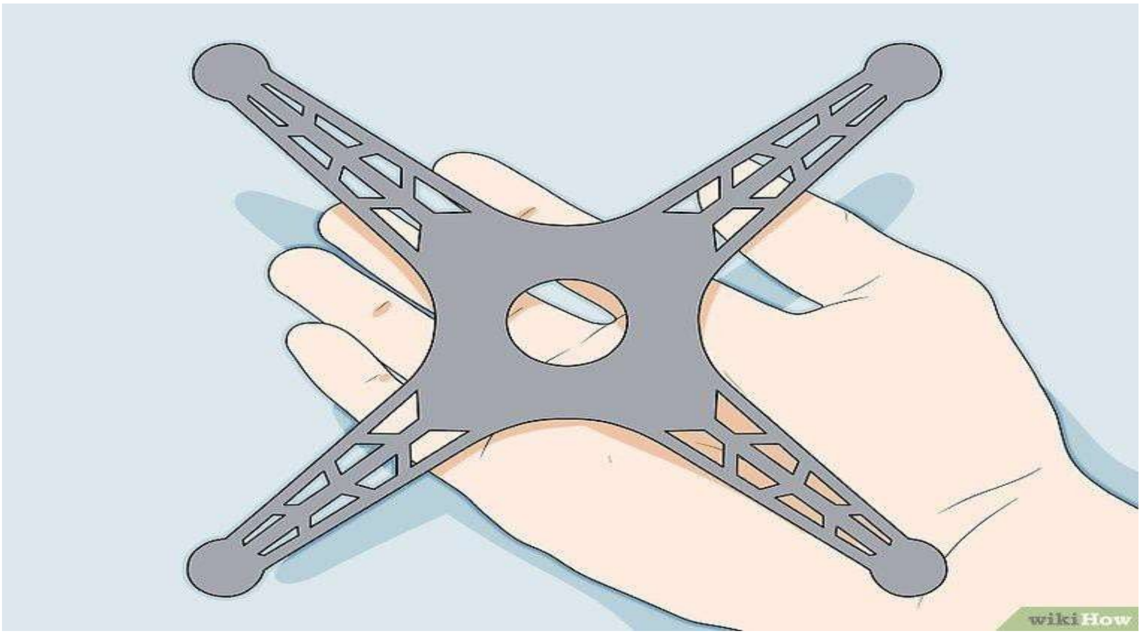

Fig 2.9.a)Building the base of the Drone

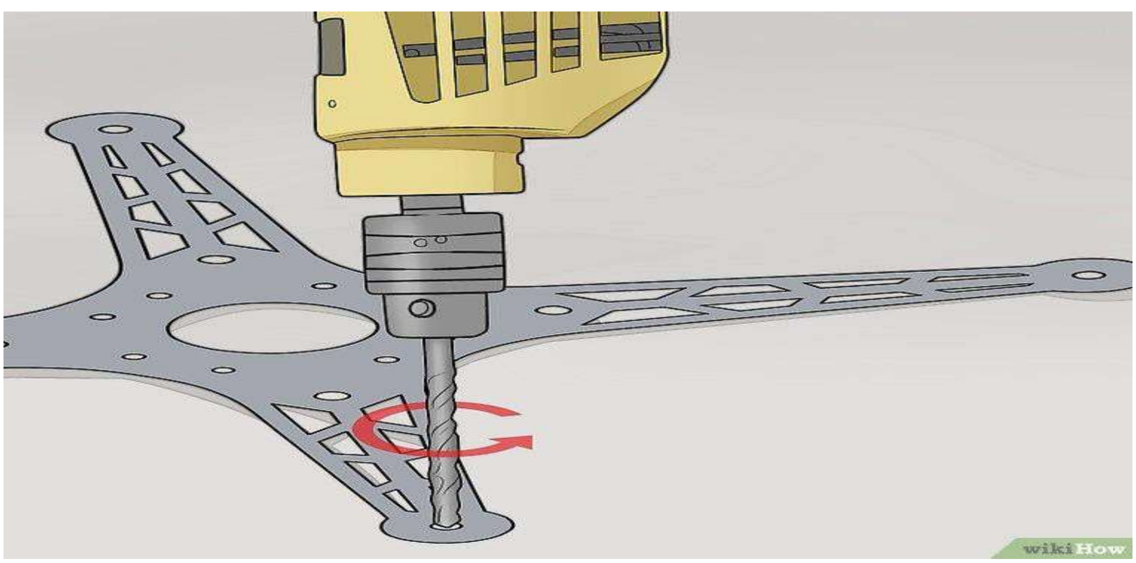

Fig 2.9.b) Drill holes in the frame to support the motors

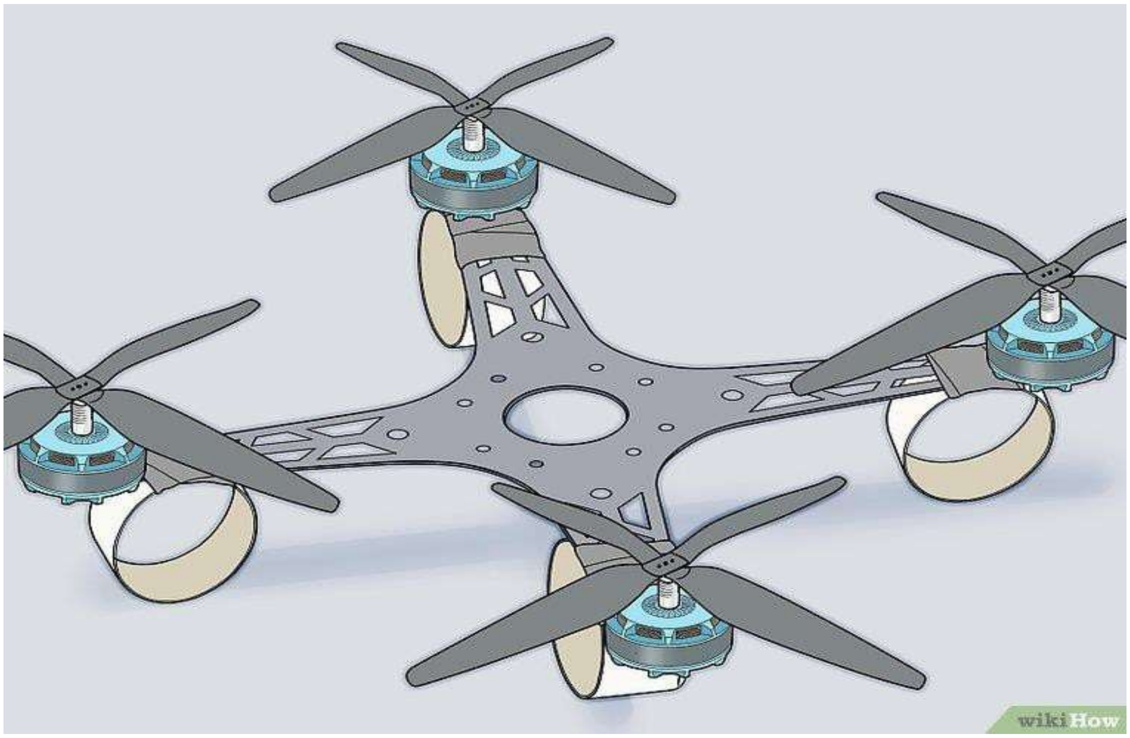

Fig 2.9.c) Mount the motors on the frame

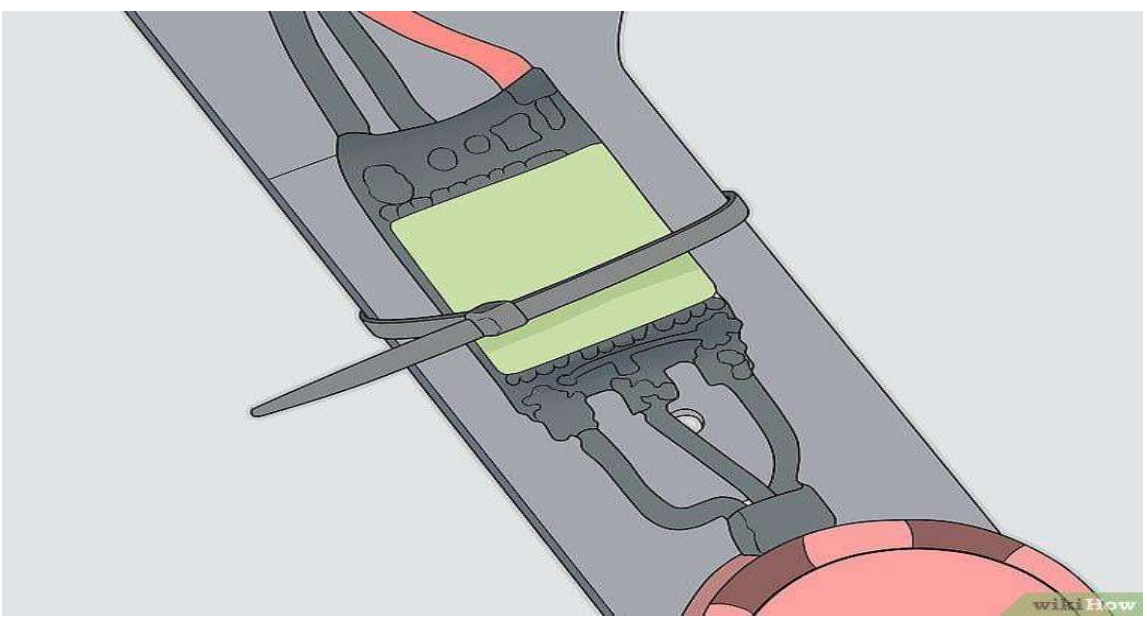

fig 2.9.d):Zip ties to secure the speed controllers to the bottom of the frame

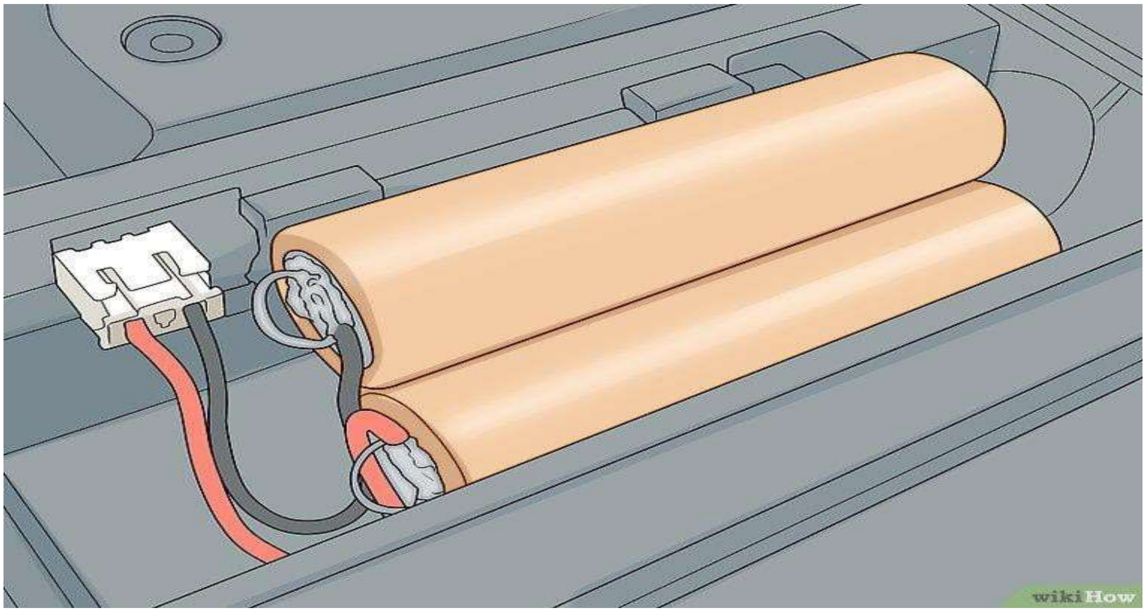

Fig 2.9.e) Secure the battery to the frame.

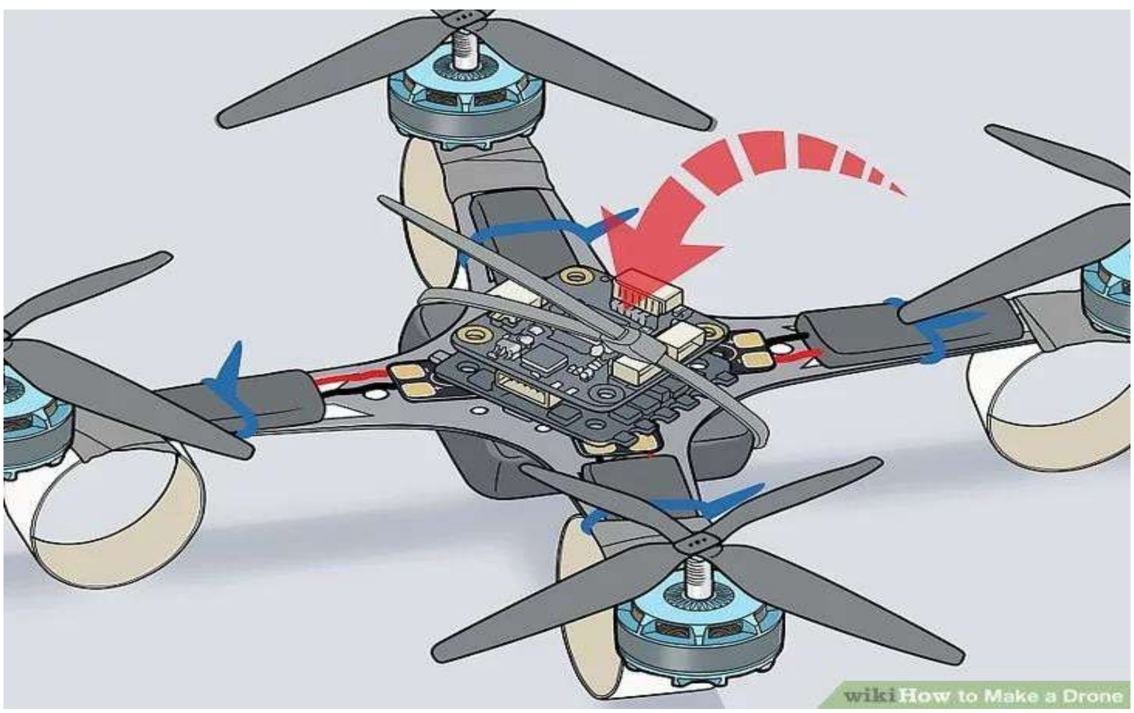

Fig2.9.f) Attach the flight controller to the drone frame with zip ties and connect it.

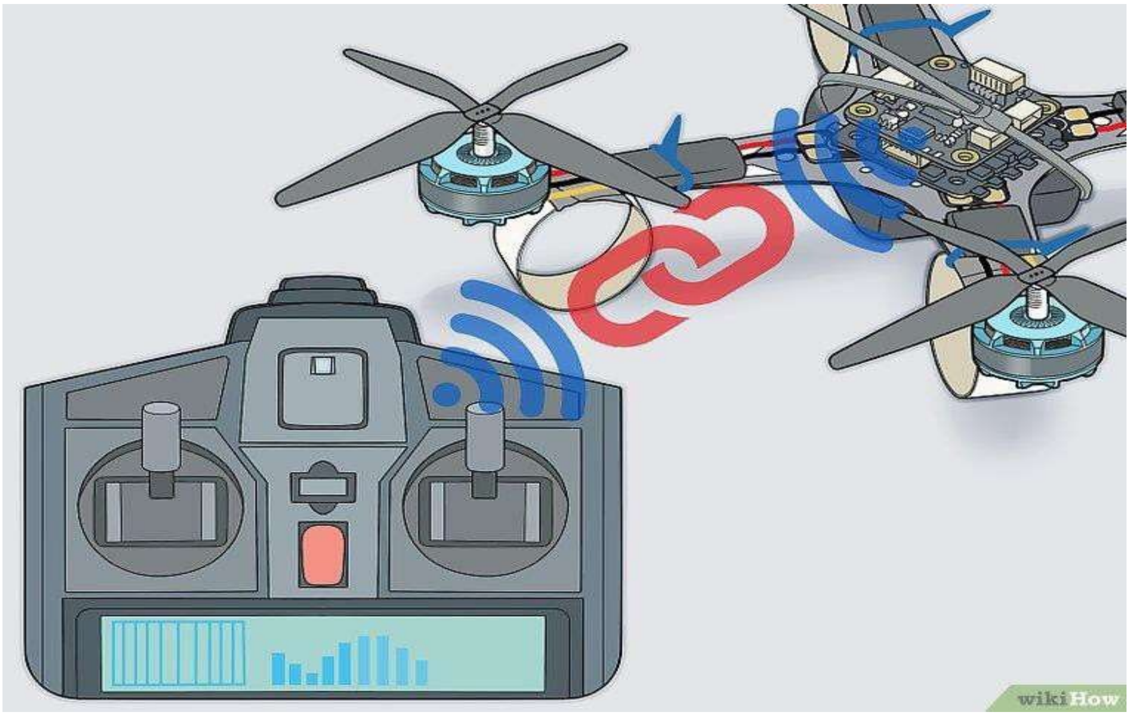

Fig 2.9.g)Connecting remote control to Drone

CHAPTER 3

DRONE CONTROLLING

FLIGHT CONTROLLERS:

The controllers that are used with quadcopters are just as important as the quality and capabilities as the quadcopters themselves. Without a quality fly controller to a quadcopter, the entire thing is practically useless. Applications exist for this purpose, but some applications are simply not as good as the controllers.

F3 EVO Controller:

The F3 Racing EVO flight controller has features that makes it the board of choice for your next multirotor (drone) racer build. It has been designed to give awesome flight performance in a stackable race ready package. It has the latest sensors, race timing and logging technology backed by excellent connectivity options, all this at a very affordable price. Featuring a race timing transponder system the F3 EVO Pro has been designed with the serious racer in mind. Analyze your race and flight telemetry/blackbox logs using the built-in micro SD card socket. The F3 EVO gives you all the features you need for the heart of your multirotor whether you are an FPV racer, aerobatic flyer or do aerial photography, it's the perfect choice.

The F3 Racing Evo runs the open-source Cleanflight flight control (FC) software which has an ever growing community of friendly developers and users. Being open-source means that you too can contribute to the system. The hardware was designed by the lead developer of Cleanflight to be more capable than the previous generation of STM32F1 based boards. The F3 EVO uses a similar layout to the F3 Acro and Deluxe boards, the stack pins, ESC/Servo outputs and connectors are in the same location for maximum mounting compatibility with existing products.

In conclusion, the F3 EVO uses advanced processor, sensor and software technologies to make your multirotor (drone) fly like it's on rails. The Cleanflight software enables the precision flying you require for fast FPV racing. uses the ARM Cortex-M4 72Mhz CPU with Math co-processor (FPU) for efficient flight calculations that gets more done in less time. The gyroscope and accelerometer sensors are connected to the fast SPI bus, this enables the software to get more data even quicker to help stabilize your craft even better.

Special features: Customer self-update function, adjustable signal to motors, polarity protection, added stability through 6050 MPU updates

The **Hobbypower KK2.15** is a next generation flight controller board that hosts multi- rotor drone types. All you have to do is install the board into your drone, select the type of craft that it is, check the propeller direction and motor layout, calibrate the ESCs and the radio, and you're good to go.
This specific board has been updated from the first of its line for a more sensitive 6050 MPU system and an additional auto-levelling function.

DJI NAZA-M V2:

Special features: GPS, automatic course deviation compensation, altitude stabilization algorithm, IOC, error identification and warning, IMU advanced calibration, RTL

Best for: Hexacopter and Octocopter users

The **DJI Naza M V2** flight controller has revamped the first of its kind and added more features. It has support that is specifically designed for hexacopters and octocopters to ensure that a safe landing is possible should an unexpected motor fail occur.
The upgraded version includes GPS, RTL, and better position holding capabilities for improved flight performance. The automatic course deviation compensation reduces any effect of a magnetic disturbance and overall interference in regard to the compass, as well.

NEW PIXHAWK PX4 2.4.6:

Special features: External multi-colored LED, dual full angle LED, NuttX RTOX real time operation system, automatic and manual mode, Micro SD

Best for: Aerial photography drones

The **New Pixhawk PX4 2.4.6** flight controller board has 32 bit chip technology and integrated sensor technology. This allows for the need of an 8-bit APM or CPU to be eliminated. It includes an external multi-colored LED and a main controller efficiency that allows for alternate backup control.

Both automatic and manual modes are available and provide a redundant power supply failover and input. The Micro SD allows for images and a storage device overall.

LHI PRO RACING F3 FLIGHT CONTROLLER:

Special features: RGB LED strip support, Autotune, In-Flight PID Tuning, blackbox flight data logging, OneShot ESC, additional PID controllers

Best for: Racing mini FPV quadcopters

The **LHI Pro Racing F3 Flight Controller** is perfect for mini quads that are both made for racing and have FPV capabilities. It allows for easier maintenance with future developments with the software, features an RGB LED strip support, blackbox flight data logging, and allows for multiple different flight controllers.

You can use a CC3D, CJMCU, and a Sparky as your choice. It supports more than 8 RC channels, which makes it perfect for racing.

HOBBYKING RACE 32 MICRO:

Special features: Blackbox flight log recorder, built-in inverter, battery monitoring buzzer port, protective case, cross-platform GUI

Best for: Fixed wing quads of all types and quads designed for racing.

The **HobbyKing Race32 Micro** is designed to have a critical weight reduction that is vital where racing drones are concerned. This allows for less weight and faster speeds as a result.

The ARM-Cortex M4 Core uses a floating point hardware unit that allows for more efficient loop times and flight calculations that will be twice as fast when compared to STM2 F1 boards, the previous generation. It also includes an output dedicated for programmable LEDs, as well.

ABUSEMARK NAZE32 FLIGHT CONTROLLER:

Special features: Onboard Micro USB, bright LEDs, MultiWii-based configuration system, standalone camera stabilizer

Best for: Aerial photography drones

The **AbuseMarkNaze 32 Flight Controller** has a 3-axis MEMS gyro and an accelerometer, the MPU6050, 3-axis magnetometer, the HMC5883L. It incorporates motor outputs that are fully flexible and allows for multiple airframe types for quads, hexas, tris, bis, Y4s, octos, and camera gimbals in general. You can get up to 8 RC channels through standard receivers.

The 16Mbit onboard SPI flash onboard Micro USB allows for an easier setup and total configuration. The software is MultiWii-based.

TAULABS SPARKY 2.0 FLIGHT CONTROLLER:

Special features: Can be connected for better connectivity through an RCVR, Flexi, 12C Auce, Main, or USB, dual analog input for current monitoring and overall voltage, runs an external magnetometer, OSD, GPS, FrySky Telemetry support for Sensor Hub and/orS. Port receivers, 3-axis gyro

Best for: High-speed drones, including racing but more for drones that are generally fast regardless if they are for racing or not. Also good for drones that use Waypoint, have a more complicated scripting, such as the PicoC coding, and those that are used mainly for flight logging

The **TauLabs Sparky 2.0 Flight Controller** features an additionally powerful processor that has had improvements from the prior generation. It includes a STM32F4 processor that runs at 165MHz, and also brings increased flash and memory to the table, as well.

There is a full sensor suite, 3-axis gyro, and a brushless, external gimbal that aids in the necessity of POI tracking and control from the transmitter over to the gimbal itself.

USES OF FLIGHT CONTROLLER:

The flight controller receives the signals from the operator's transmitter. This allows the commands and instructions of the user to reach the quadcopter midair. The flight controller is also useful for functioning alongside sensors that are placed on board for a smooth flight. These would include devices like an accelerometer, gyroscopes and the likes.

The controller has yet another function. A quadcopter is a multirotor that comes packed with four different motors. Each motor has a specific speed. So, the flight controller is capable of computing the speed of each of the four motors, and then it sends a signal to the Electronic Speed Controllers or ESCs.

SENSORS IN A FLIGHT CONTROLLER:

THE ACCELEROMETER:

First and foremost, almost all flight controllers have an accelerometer. This is essentially a device that measures the linear acceleration of the copter in a 3-axis system. This sensor gives an output that allows the user to make an idea of the position of the drone.

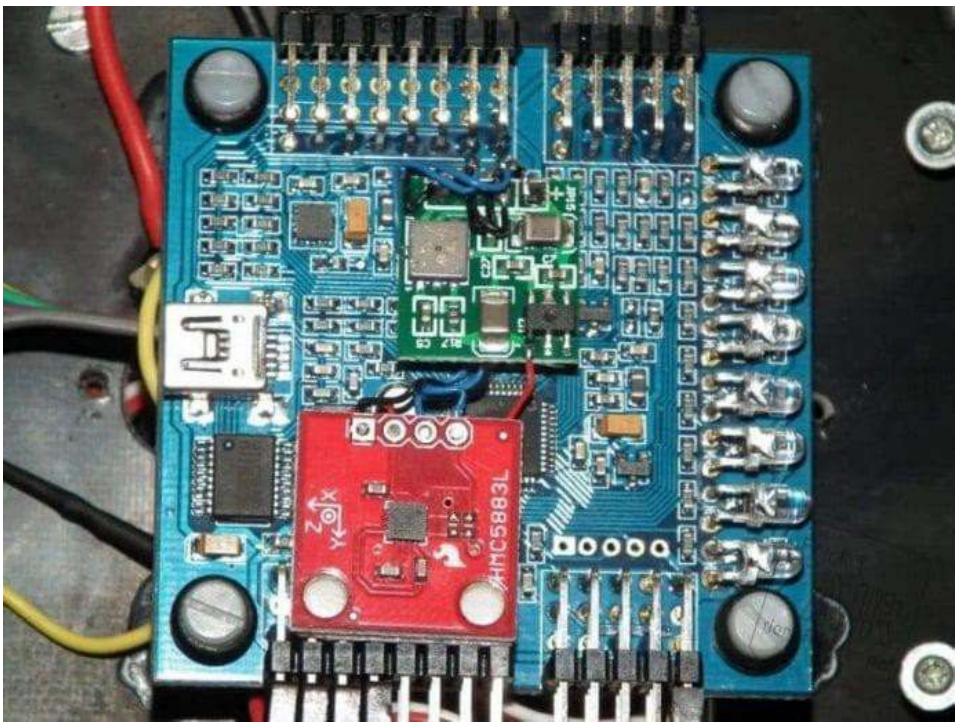

Fig 3.1:Accelerometer

The simple fact that an accelerometer is able to detect and respond to gravity means that it stays stable in the air, ensuring a smooth flight. The correct way to mount an accelerometer on to a flight controller board is by aligning the linear axis of the device with the primary axis of the UAV.

THE GYROSCOPE:

Just like the accelerometer, the gyroscope is useful for measuring the rate of angular change. Once again, this can be measured up to 3 axes. However, you need to do some iteration in order to get the angle. The rotational axis of the sensor should align with the UAV axis.

INERTA MEASUREMENT UNIT (IMU):

This part of the quadcopter flight controller consists of both the gyroscope and the accelerometer. There are some systems that combine the use of a magnetometer and the likes.

Fig 3.2:Inertia Measurement Unit

As the name suggests, this sensor is basically an electronic compass placed on the controller board. This is especially required to align the drone's direction as compared to the magnetic field of the earth.

THE BAROMETER:

A barometer, as we know, is a device for measuring pressure. A pressure sensor on the drone can give us an accurate value of the height of the device from the sea level. The most accurate information about the height is given by the combination of the pressure sensor and the GPS altitude.

THE DISTANCE SENSOR:

A distance sensor is being incorporated in the most modern quadcopter flight controllers. This basically improves on the height value given by the pressure sensor or the barometer.

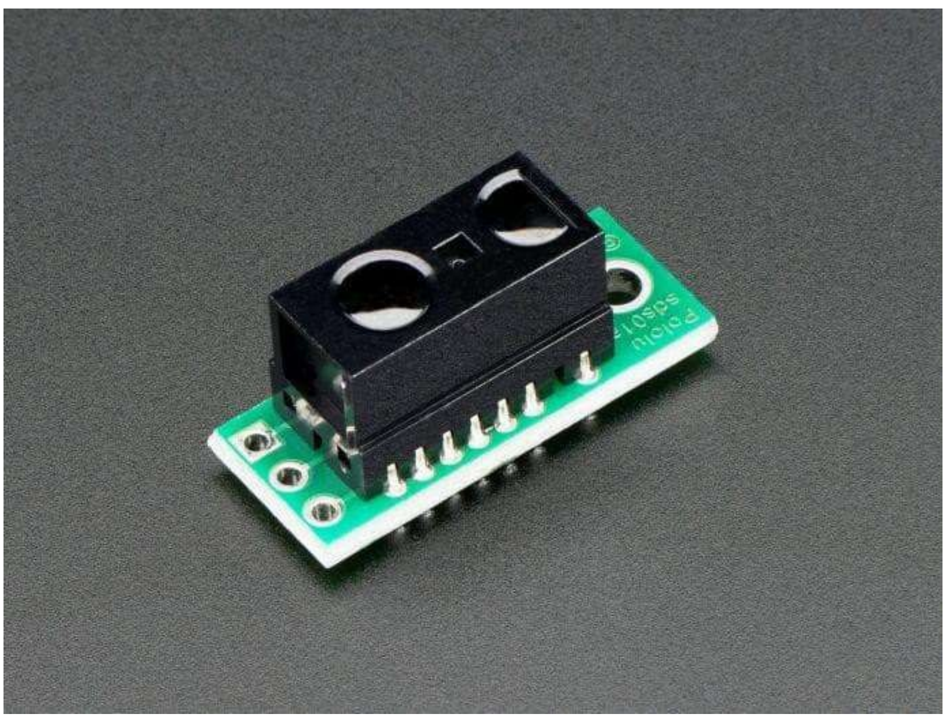

Fig3.3:Distance Sensor

A distance sensor can be ultrasonic, laser or LIDAR technology.

LiDAR Module:

Fig3.4:Distance Sensor

The TFMini-S Micro LiDAR Module is a ToF (Time of Flight) LiDAR sensor capable of measuring the distance to an object as close as 10 centimeters (+/- 6cm up to 6m) and as far as 12 meters (+/-1% starting at 6m)! As with all LiDAR sensors, your effective detection distance will vary depending on lighting conditions and the reflectivity of your target object, but what makes this sensor special is its size. Measuring only 42x15x16mm, the TFMini-S allows you to integrate LiDAR into applications traditionally reserved for smaller sensors.
TFMini-S is a single-point ranging LiDAR based on TFmini upgrade. The blind zone is shortened to 10cm, the outdoor performance and accuracy of different reflectivity are improved, it can achieve stable, accuracy, sensitive and high frequency range detection.

Lidar uses ultraviolet, visible, or near infrared light to image objects. It can target a wide range of materials, including non-metallic objects, rocks, rain, chemical compounds, aerosols, clouds and even single molecules. A narrow laser beam can map physical features with very high resolutions; for example, an aircraft can map terrain at 30-centimetre (12 in) resolution or better.

A lidar determines the distance of an object or a surface with the formula :

$d = c.t/2$

where c is speed of light,d is the distance between the detector and the object or surface being detected, and t is the time spent for the laser light to travel to the object or surface being detected, then travel back to the detector.

FEATURES FOR GOOD FLIGHT CONTROL:

Gyro stabilization – this allows the pilot to keep the quadcopter stable in midair and well under control.

Self-leveling – this is a rather useful feature that allows the quadcopter to stay level in the air by letting go of the pitch.

Orientation mode – a quadcopter having an orientation mode gives the pilot the chance to control the orientation of the drone.

Altitude hold – this feature allows the quadcopter to hover and remain stable at a certain distance from the ground level and the pilot does not have to keep adjusting the throttle.

Position hold – similar to the altitude hold, this feature allows the quadcopter to stay at a fixed position or location.

Return home – this is a special feature that is present in a lot of copters which allows the device to return to its initial position of takeoff even when the flyer loses control.

Waypoint navigation – this is another exciting feature in a copter. By virtue of this quality, the device can follow a few points marked out on a map as part of the flight plan.

GPS – this feature has been gaining a lot of importance lately. It not only allows the device to maintain its position but also keeps a record of the flying data for convenience.

KK 2.1.5 FLIGHT CONTROLLER:

The KK2.1.5 is next big evolution of the first generation KK flight control boards. The KK2.1.5 was engineered from the ground up to bring multi-rotor flight to everyone, not just the experts. The LCD screen and built in software makes install and setup easier than ever. A host of multi-rotor craft types are pre-installed, simply select your craft type, check motor layout/propeller direction, calibrate your ESCs and radio and you're ready to go! All of which is done with easy to follow on screen prompts.

The original KK gyro system has been updated to an incredibly sensitive 6050 MPU system making this the most stable KK board ever and allowing for the addition of an auto-level function. At the heart of the KK2.1.5 is an Atmel Mega644PA 8-bit AVR RISC-based microcontroller with 64k of memory. An additional polarity protected header has been added for voltage detection, so no need for on-board soldering.

The KK2.1.5 added polarity protection to the voltage sense header and a fuse protected buzzer outputs, in case something is accidentally plugged in incorrectly. The voltage sense line has been updated for better accuracy. The board is clearly labeled and the voltage sense line color has been changed to red for easy identification, making installation and connections a snap. identification, making installation and connections a snap.

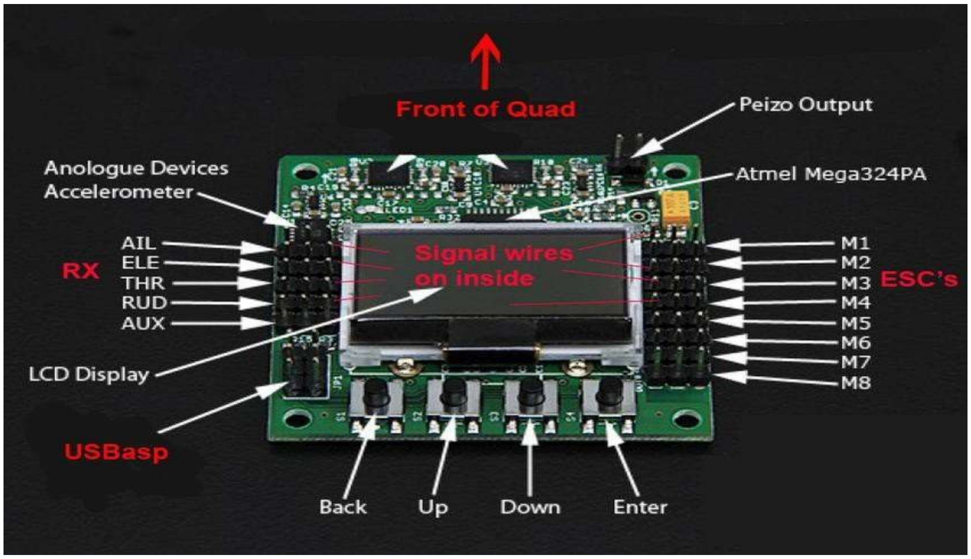

Fig 3.5:KK 2.1.5 Circuit diagram

KK 2.1.5 FLIGHT CONTROLLER MANUAL:

PI Editor Enables you to adjust the control loop feedback parameters for Roll, Pitch and Yaw. The proportional term (P) produces an output value that is proportional to the current error value.

A high proportional gain results in a large change in the output for a given change in the error. If the
proportional gain is too high, the multicopter will overshoot and start to oscillate. Since the control loop compensates for errors 400 times a second too high a P gain will result in a high frequency oscillation. If the proportional gain is too low, the control action will be too slow to react on the multi copter and it will be difficult to control.

The contribution from the integral term (I) is proportional to both the magnitude of the error and the duration of the error.

The integral in a PI controller is the sum of the instantaneous error over time and gives the accumulated offset that should have been corrected previously.

If the integral term is too high, the multicopter will start to oscillate. Since the I term is related to the duration of the error over time, too high an I gain will result in a low frequency oscillation.

Too low an I gain will result in a less “locked in” feeling. PI gain adjustment process Go to the "Receiver Test" menu and use the transmitter trims to set the Roll, Pitch and Yaw values to zero.

Switch off Self Level:

Set the I gain to zero for Roll, Pitch and Yaw.

Hover the multicopter and move in one axis (Roll, Pitch or Yaw) and quickly centre the TX control stick.

Increase the P gain until the multicopter starts to oscillate when the stick is quickly centred.

Decrease the P gain slightly to remove the oscillation.

Repeat for all three axis (note, if you have “Link Roll Pitch” set to “Yes” in the Mode Settings menu then adjusting the PI gains and limits for Roll will also adjust the Pitch settings).

Increase the Roll and Pitch I gain until it flies straight forward/sideways without pitching up or down. It should feel more “locked in”.

Increase the Yaw I gain until Yaw feels “locked in”. You will see most impact on a tricopter. Leave as default for quadcopter.

Note, if you have I gains set and you operate your multicopter on the ground, you will find that motors will start to increase in speed while others decrease. This is the I term working to compensate for long term errors, but on the ground, or in your hand (without props on of course) it doesn’t allow the I term to move the multicopter to compensate for the error.

PI limits:

The PI limits are the percentage of motor power that can be used to apply the correction. These should be left at default. For example, a limit of 20 (20% motor power to apply the correction) will allow 80% of motor power to be used for commanding a change in direction from the receiver.

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: -o Receiver connection(s). Mode Settings, Receiver is correct.

If Mode Settings Channel Map is “Yes”, check Receiver Channel Map.

Receiver Sliders:

Displays a graphical representation of the receiver signal inputs.

This is useful to see which transmitter channel is mapped to which input, either in Receiver Channel Map or in your transmitter.

If you have a standard receiver, it will display the 5 inputs.

If you have a CPPM, Satellite or SBus receiver, it will display 7 inputs.

The servo pulse values, on the right hand side, are approximate and should only be used as a guide.

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”.

Stick Scaling:

These settings enable you to adjust the sensitivity of the transmitter stick. A higher number gives more sensitive response. It is used in preference to increasing the rates in your transmitter. The default values are low for beginners that may not appreciate how sensitive the transmitter sticks can be in controlling a multicopter.

If you want to flip and roll, you will need to increase the Roll and Pitch values.

Increase the Yaw value to yaw to your liking.

Throttle is best left at 90. If you increase it too much, full throttle on the transmitter will run the motors at maximum and leave no headroom for the PI control loop to adjust the motors to keep it steady.

Self-level Settings:

Self Level Settings are independent from normal PI settings.

P Gain – The power of the self-levelling. Higher number is stronger. Too high will cause oscillations. To low and it’s slow to self level.

P limit – Limits the max power of self levelling. Higher number is higher limit.

ACC Trim Roll – compensates for self level drift when the KK2.1.X had the ACC calibrated when it wasn’t exactly level.

ACC Trim Pitch – compensates for self level drift when the KK2.1.X had the ACC calibrated when it wasn’t exactly level.

It’s better to calibrate the ACC with the KK2.1.X level rather than use the trims. Make sure the KK2.1.X is mounted level in the multicopter.

Sensor Test

Displays the raw gyroscope and accelerometer sensor values.

Must show "OK" when stationary.

If it says “Not OK” when stationary, the sensor chip is faulty.

Move the KK2.1.X around to see that the numbers change. In this case, it is fine if the sensors start reading “Not OK”.

ACC Calibration

Calibrates the accelerometers

Set the multicopter level.

Invoke the acc calibration routine.

Do not move the multicopter during calibration.

You will not be able to Arm the KK2.1.X until the calibration routing has been successful.

If the calibration failed and you did not move the multicopter during calibration then you have a faulty sensor chip

Mixer Editor:

This menu lets you adjust where and how much signal the motors gets from the sticks and sensors.

This enables you to make any configuration possible, with up to 8 motors or servos.

To change between the output channels 1-8, press CHANGE when the upper right number is highlighted.

Throttle – Amount of throttle command. Usually 100% if the output channel is connected to an ESC.

Aileron – Amount of aileron/roll command. Use positive value for motors on the right side of the roll axis, and negative for the left side of the roll axis. The value is given by the motor's distance from the roll axis. More is further away.

Elevator – Amount of elevator/pitch command. Use positive value for motors on the front side of the pitch axis, and negative for the back side of the pitch axis. The value is given by the motor's distance from the pitch axis. More is further away.

Rudder – Amount of rudder/yaw command. Usually 100%. Use a positive value for a CW spinning propeller, and negative for a CCW spinning propeller. This is a very important setting for reversing the servo direction on tricopters. If your tricopter starts to pirouette on take off, select the channel that the servo is connected to (usually output 4 or 7) and change the Rudder value from +100 to -100.

Offset – Applies a constant offset to the channel. Keep this zero when it is an ESC channel, and around 50% when connected to a servo. Fine tune servo position by adjusting this value.

Type – Set it to the type (servo or ESC) connected to the channel.

For ESC: Output PWM rate is always high. Normally outputs zero when disarmed or throttle is at idle. Applies the "Minimum Throttle" value from the "Misc. Settings 1" sub- menu when armed and throttle is above zero or when Spin on Arm is “Yes”.
For Servo: Output PWM rate can be high or low. Outputs the offset value when disarmed.
Rate – High rate (400Hz) for ESC or digital servos, or low rate (50Hz) for analogue servos.

Show Motor Layout:

Displays a graphical representation of the motors and servos
Can be used to check the Motor direction and which outputs to connect the ESCs and Servos to. Note that this does not set the motor direction. That is set by the wires connected between your motor and ESC. If you need to reverse your motor, reverse two of the three motor wires.
Enables you to see which Motor Layout you have selected and any changes you make in the Mixer Editor.

Load Motor Layout:

Enables you to load a preconfigured multicopter setup.
Select from a list of preconfigured multicopter types.
“Tricopter Servo M7” uses M7 for the servo which is almost jitter free.
You will not be able to Arm the KK2.1.X until you have selected a Motor Layout.
When loading the firmware, after a Factory Reset or Resetting a Profile, you will need to select a Motor Layout.

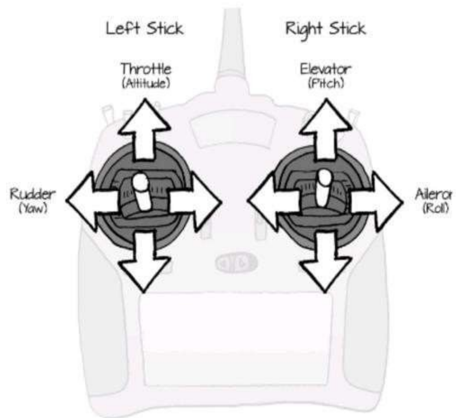

Fig 3.6:Transmitter for KK2.1.5 flight controller

Fig 3.7:Receiver for KK2.1.5 flight controller

Transmitter gives the following commands to the receiver throttle(altitude), rudder(yaw), elevator(pitch), aileron(roll). These are the basic movements of the quad copter. Apart from that quad copter movements it also has an AUX knob which increases the self-level system of the drone. FS-CT6B receiver has 6 channels . Each channel is assigned to give signals received by transmitter to the KK flight controller board which can make calculations with respect to the gyro meter readings and can further send that signal to the ESCs which control motors accordingly.

ARDUINO BASED DRONE WITH MPU 6050: For this, you will need the following:

Arduino UNO

MPU-6050 Module

Prototype Board

Female and Male Headers

330-ohm Resistor and an LED

Thin Gauge Wires

HC-05 Bluetooth Module

The Bluetooth module is required only if you want to be able to have an insight into the parameters and tune the quad through an app, as opposed to taking the laptop with you out on the field when testing.

Arduino comes with:

14 digital input/output pins (6 of them can be used as outputs for PWM)

6 analog inputs

a 16 MHz quartz crystal

a USB connector

a power jack

an ICSP header

a reset button

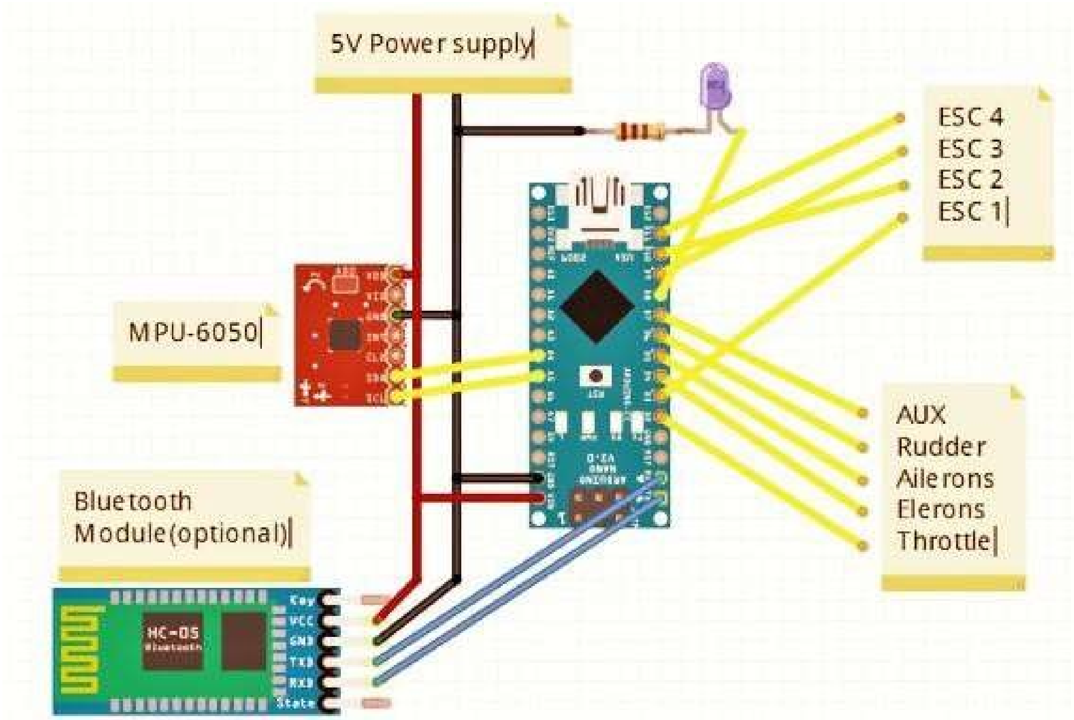

Fig 3.8:Drone with Arduino and MPU6050

CHAPTER 4

THE CODE

```
#define sensor A6 // Sharp IR GP2Y0A41SK0F (4-30cm, analog)
#define buzzer 4 // Onboard Buzzer
#define LEDPin 13 // Onboard LED

int distance;
float volts;
long critcal_distance;
long buzzer_distance;

void setup()
{
 Serial.begin(9600); // start the serial port
 pinMode(LEDPin, OUTPUT);
 pinMode (buzzer, OUTPUT);
}

void loop()
{
// 5V
volts = analogRead(sensor)*0.0048828125; // value from sensor * (5/1024)
 distance = 13*pow(volts, -1);// worked out from datasheet graph
 check_obstacle();                          // Run the fucntion
}

void check_obstacle()
{
if (distance <= 30)// If Object distance is less then or equal to 30cm
 {
 critcal_distance = map(distance, 2, 60, 254, 0);
```

```
Serial.print("critcal_distance =");
Serial.println(critcal_distance); // Adjust the delay for Buzzer ON/OFF
 if (distance > 25 && distance <= 30) {buzzer_distance = 370;}
 else if (distance > 20 && distance <= 25){buzzer_distance = 300;}
 else if (distance > 15 && distance <= 20) {buzzer_distance = 170;}
 else if (distance > 10 && distance <= 15){buzzer_distance = 110;}
 else if (distance > 5 && distance <= 10){buzzer_distance = 75;}
 else if (distance > 2 && distance <= 5){buzzer_distance = 35; }

 // Beep the Buzzer
digitalWrite(buzzer, HIGH);
delay(buzzer_distance);
digitalWrite(buzzer, LOW);
delay(buzzer_distance);

 digitalWrite(LEDPin, HIGH);
 delay(buzzer_distance);
 digitalWrite(LEDPin, LOW);
 delay(buzzer_distance);
 delay(100);
 }
else
 {
 // Buzzer OFF
 analogWrite(buzzer, 0);
 }
}
```

Fig 4.1:Flying drone

Fig 4.2:Flying Drone

CONCLUSION:

Drones can be used to optimize a farm based on a large range of image data about the condition of crops, fields and livestock as well as applying pesticides

In our project we use drones for real time adaptive monitoring to check the condition of the crops from time to time with the use of drones. This methodology can provide good crop yield, decrease farmers burden of checking the crop field daily. It might also predict beforehand if the crop is going to be damaged. Furthermore, it can provide security to the agriculture fields from animals as well as from thievery.

FUTURE SCOPE:

The Future Scope of this drone capable of sensing the obstacles can be modified to drone getting automatically redirected without any manual controlling.

As of now, its small size and lower cost makes it less risky to fly it in dense forest of tricky places.There can be many applications where the drone with obstacle detection is needed. One of the applications is, it can provide security to the agriculture fields from animals as well as from thievery.

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