A

Project Report

on

AUTONOMOUS DRONE WITH LIVE VIDEO FEED USING GPS

Submitted

in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

Electronics & Communication Engineering

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CERTIFICATE

This is to certify that the project report titled **AUTONOMOUS DRONE WITH LIVE VIDEO FEED USING GPS** being submitted by **N.MOULIKA(17R15A0429), A.SAIRAHUL (16R11A0499), R.BHASKAR (17R15A0424)** in partial fulfillment for the award of the Degree of Bachelor of Technology in **Electronics and Communication Engineering** is a record of bonafide work carried out under my guidance and supervision. The results embodied in this report have not been submitted to any other University for the award of any degree.

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With Regards

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ABSTRACT

A quadcopter can achieve vertical flight in a stable manner and be used to monitor or collect data in a specific region such as Loading a mass. Technological advances have reduced the cost and increase the performance of the low power microcontrollers that allowed the general public to develop their own quadcopter. The goal of this project is to build, modify, and improve an existing quadcopter kit to obtain stable flight, gather and store GPS data, and perform auto commands, such as auto-landing. The project used an Aero quad quadcopter kit that included a frame, motors, electronic speed controllers, Arduino Mega development board, and sensor boards and used with the provided Aero quad software. Batteries, a transmitter, a receiver, a GPS module, and a micro SD card adaptor were interfaced with the kit. The aero quad software was modified to properly interface the components with the quadcopter kit.

Individual components were tested and verified to work properly. Calibration and tuning of the PID controller was done to obtain proper stabilization on each axis using custom PID test benches. Currently, the quadcopter can properly stabilize itself, determine its GPS location, and store and log data. Most of the goals in this project have been achieved, resulting in a stable and maneuverable quadcopter.
KEYWORDS Drone/Quadcopter, Transmitter & Remote, Propellers, Electric Motors, Battery

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The project is to design an autonomous flying drone, specifically a quadcopter. The drone is fitted with a GPS tracking system and programmed to be able to autonomously fly from one location to another using GPS coordinates. Significant consideration is given to safety and ruggedness due to the possibility of collision with a variety of objects. In addition to collisions, the drone is also rugged enough to operate during moderately windy conditions. The goal of the project is to act as a proof of concept for small scale autonomous aerial delivery similar to that nearing deployment by Amazon.

A Drone or Quadcopter is a Vehicles have large potential for performing tasks that are dangerous or very costly for humans. Examples are the inspection of high structures, humanitarian purposes or search-and-rescue missions. One specific type of Drone is becoming increasingly more popular lately: the quadcopter (Fig. 1.1). When visiting large events or parties, professional quadcopters can be seen that are used to capture video for promotional or surveillance purposes. Recreational use is increasing as well: for less than 50 Euros a small remote controlled quadcopter can be bought to fly around in your living room or garden. In these situations the quadcopter is usually in free flight. There is no physical contact between the surroundings and the quad copter and no cooperation between the quadcopters If would have the capabilities to collaborate the number of possibilities grows even further.

For example, a group of Drone would be able to efficiently and autonomously search a missing person in a large area by sharing data between. Or, the combined load capacity of a group of quad copters can be used to deliver medicine in remote areas. This bachelor thesis focuses on the use of a commercially available quadcopter platform, the.Drone, to perform a task that requires physical collaboration and interaction: moving a mass. In this way a clear interaction between the quadcopters and their surroundings is present. As preliminary step towards the view of collaborating aerial robots the choice was made to perform this task in an indoor scenario where position feedback is present. Starting off with position control, additional controller logic can be implemented to counteract the forces imposed by a mass connected to the quadcopter. The choice is made for the Drone, a generalized approach is chosen where possible to encourage reuse of this research's outcome and deliverables. (1) A helicopter is a flying vehicle which uses rapidly spinning rotors to push air downwards, thus creating a thrust force keeping the helicopter aloft. Conventional helicopters have two rotors. These can be arranged as two coplanar rotors both providing upwards thrust, but spinning in opposite directions (in order to balance the torques exerted upon the body of the helicopter).

Fig-1.1 Quadcopter

1.2 HISTORY

1.2.1Oehmichen (1920)

Etienne Oehmichen experimented with rotorcraft designs in the 1920s. (Fig.1.2) among the six designs he tried, his helicopter No.2 had four rotors and eight propellers, all driven by a single engine. The Oehmichen No.2 used a steel-tube frame, with two-bladed rotors at the ends of the four arms. The angle of these blades could be varied by warping. Five of the propellers, spinning in the horizontal plane, stabilized the machine laterally. Another propeller was mounted at the nose for steering. The remaining pair of propellers were for forward propulsion. The aircraft exhibited a considerable degree of stability and controllability for its time, and made more than a thousand test flights during the middle 1920s. By 1923 it was able to remain airborne for several minutes at a time, and on April 14, 1924 it established the first-ever FAI distance record for helicopters of 360 m (390 yd). It demonstrated the ability to complete a circular course and later, it completed the first 1 kilometer (0.62 mi) closed-circuit flight by a rotorcraft.

1.2.2 De Bothezat helicopter (1922)

Dr. George de Bothezat and Ivan Jerome developed this aircraft, (Fig. 1.3) with six bladed rotors at the end of an X-shaped structure. Two small propellers with variable pitch were used for thrust and yaw control. The vehicle used collective pitch control. Built by the US Air Service, it made its first flight in October 1922. About 100 flights were made by the end of 1923. The highest it ever reached was about 5 m (16 ft 5 in). Although demonstrating feasibility, it was underpowered, unresponsive, mechanically complex and susceptible to reliability problems. Pilot workload was too high during hover to attempt lateral motion.

1.2.3. Convertawings Model A Quadrotor (1956)

This unique helicopter was intended to be the prototype for a line of much larger civil and military quadrotor helicopters. The design featured two engines driving four rotors through a system of v belts. (Fig. 1.4) No tail rotor was needed and control was obtained by varying the thrust between rotors.[5] Flown successfully many times in the mid-1950s, this helicopter proved the quadrotor design and it was also the first four-rotor helicopter to demonstrate successful forward flight. Due to a lack of orders for commercial or military versions however, the project was terminated. Convert a wings proposed a Model E that would have a maximum weight of 42,000 lb (19 t) with a payload of 10,900 lb (4.9 t) over 300 miles and at up to 173 mph (278 km/h). 4. Curtiss-Wright VZ-7 (1958) The Curtiss-Wright VZ-7 was a VTOL aircraft designed by the Curtiss-Wright company for the US Army. The VZ-7 was controlled by changing the thrust of each of the four propellers. (Fig.1.5) AR.Drone is a small radio controlled quadcopter with cameras attached to it built by Parrot SA, designed to be controllable with by smartphones or tablet devices. Nixie is a small cameraequipped drone that can be worn as a wrist band.(6) • Had 4 rotors and 8 propellers all driven by one motor

• Over 1000 Successful flights

- First recorded FAI distance record of 360m in 1924 for a helicopter
- Very Stable for the Time • Designed by Etienne Oemichen 2.2

Fig.1.2 rotor craft design

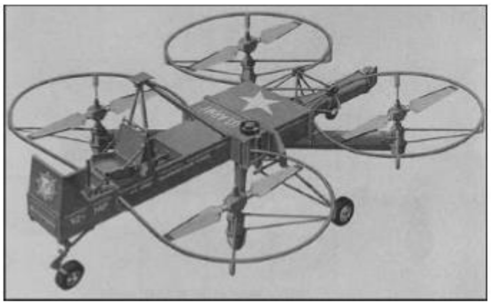

Fig 1.3 Jerome aircraft

1.3Current Developments

In the past 10 years many small quadcopters have entered the market that include the DJI Phantom and Parrot AR Drone. This new breed of quadcopters are cheap, lightweight. In the 20th Century, military research precipitated many widely used technological innovations. Surveillance satellites enabled the GPS-system, and defence researchers developed the information swapping protocols that are fundamental to the Internet. Drone fall into a similar category. Designed initially for reconnaissance purposes, their para-military and commercial development was often out of sight of the public.

1.4 GPS Introduction

The global positioning system is a satellite navigation system that uses a radio receiver to collect signals from orbiting satellites to determine position, speed, and time. This navigation system is more accurate than over forms of navigation, and provides position knowledge to within a few meters. Advanced GPS systems can provide even better accuracies to within a few centimeters. The miniaturization of integrated circuits has allows GPS receivers to be highly economical, and available to everyone. GPS is a broadcast radio system that reaches almost all areas of the planet, so it is highly accessible. The GPS system was developed by the US military in 1973 in order to develop an accurate navigation system for ICBMs. Knowledge of the target is well known, but for the US, knowledge of the launch coordinates was tricky since most of the US nuclear missiles were carried on submarines at sea. To successfully hit the intended target, accurate knowledge of the location where the submarine surface location was needed. Hence, GPS was developed to address this problem.

1.4.1GPS Position Triangulation

GPS navigation is related to the concept of triangulation to determine a position on the ground. Triangulation a process where the location of a radio receiver can be determined by measuring the radial distance of the received signal from different sources. For satellite navigation, we use trilateration which requires four signals to determine the position of a GPS drone receiver. The signal from one satellite allows you to determine that you are on a sphere at a given radius from the satellite. A second signal from another satellite is another sphere, which intersects with the first. So now you somewhere on a circle that intersects both spheres. A third signal narrows the location down to two points on the circle. To determine the proper location from these two points, a fourth signal could be used, but usually one of the two points can be rejected due to being too far from the Earth, or moving at an improbable velocity. However, a fourth measurement is usually used, but for another reason.

1.4.2 Distance from Time

When you have a GPS receiver, the exact distance to the three or four satellite it receives a signal from needs to be determined. Each satellite transmits a coded signal that contain time stamped information regarding its position and time. The radio wave signals are travelling at the speed of light. If the receiver has an accurate clock, it seems like it should be a simple case of distance = time x speed. However, there is a problem with this approach. The first problem is the need for synchronized clocks. Each GPS satellite has four atomic clocks, two cesium and two rubidium, providing time accuracy of one second in 100,000 years. The receivers have much less accurate clocks and have to compensate for the time taken to receive the signal. Radio waves only travel at the speed of light in a perfect vacuum. The Earth’s atmosphere distorts and delays satellite signals. This effect must also be compensated by the receiver. The latest drones have dual Global Navigational Satellite Systems (GNSS) such as GPS and GLONASS.

Drones can fly in both GNSS and non satellite modes. For example DJI drones can fly in PMode (GPS & GLONASS) or ATTI mode, which doesn't use GPS. Highly accurate drone navigation is very important when flying especially in drone applications such as creating 3D maps, surveying landscape and SAR (Search & Rescue) missions. When the quadcopter is first switched on, it searches and detects GNSS satellites. High end GNSS systems use Satellite Constellation technology. Basically, a satellite constellation is a group of satellites working together giving coordinated coverage and synchronized so that they overlap well in coverage. Pass or coverage is the period in which a satellite is visible above the local horizon. The radar technology will signal the following on the remote controller display;

• signal that enough drone GNSS satellites have been detected and the drone is ready to fly.

• display the current position and location of the drone in relation to the pilot.

• record the home point for 'Return To Home' safety feature. Most of the latest drone have 3 types of Return to Home drone technology as follows;

• Pilot initiated return to home by pressing button on Remote Controller or in an app.

• A low battery level, where the UAV will fly automatically back to the home point.

• Loss of contact between the UAV and Remote Controller with the UAV flying back automatically to its home point.

1.4.3 GPS Applications

Most people are accustomed to seeing GPS receivers being used for car driving navigation. But once you can determine your exact location on Earth, it opens the doors for further technological innovations. It is not hard to imagine self-driving cars that use GPS for navigation. Highway driving can also be made safer, if your car has precise knowledge of the position of the cars around it, thereby removing the need for error prone human drivers. The same logic can also be applied to air traffic control. Over the next decades, GPS will reduce the need for radar aircraft tracking systems. Emergency first responders can benefit from GPS navigation, which can provide the shortest and fast route to the scene. Farmers are now using GPS systems in farm equipment to manage and harvest crops more efficiently.

Farm animals, pets and wildlife can be more easily tracked using GPS collars. Visually impaired people, who have traditionally relied on seeing dogs, greatly benefit from having talking GPS modules.

Fig.1.4.GPS Navigation

1.5 FPV Live Video Transmission Drone Technology

FPV means "First Person View". A video camera is mounted on the unmanned aerial vehicle and this camera broadcasts the live video to the pilot on the ground. The ground pilot is flying the aircraft as if they were on-board the aircraft instead of looking at the aircraft from the pilot's actual ground position. FPV allows the unmanned aircraft to fly much higher and further than you can from looking at the aircraft from the ground. First Person View allows for more precise flying especially around obstacles. FPV allows unmanned aerial vehicles to fly very easily indoors, or through forests and around buildings. The exceptionally fast growth and development of the drone racing league would not be possible without FPV live video transmission technology. This FPV technology uses radio signal to transmit and receive the live video. The drone has a multi-band wireless FPV transmitter built in along with an antenna. Depending on the drone, the receiver of the live video signals can be either the remote control unit, a computer, tablet or smartphone device. This live video feed is related to the strength of the signal between the ground control on the drone. The latest DJI Mavic 2 has an FPV live video range of 5 miles (8 km) with a 1080p quality video transmission.Other, slightly older drones such as the DJI Mavic and Phantom 4 Pro, can transmit live video up to 4.3 miles (7 km). The Phantom 4 Pro and Inspire 2 use the latest DJI Lightbridge 2 transmission system. Drones such as the

DJI Mavic use integrated controllers and intelligent algorithms to set a new standard for wireless high definition image transmission by lowering latency and increasing maximum range and reliability.

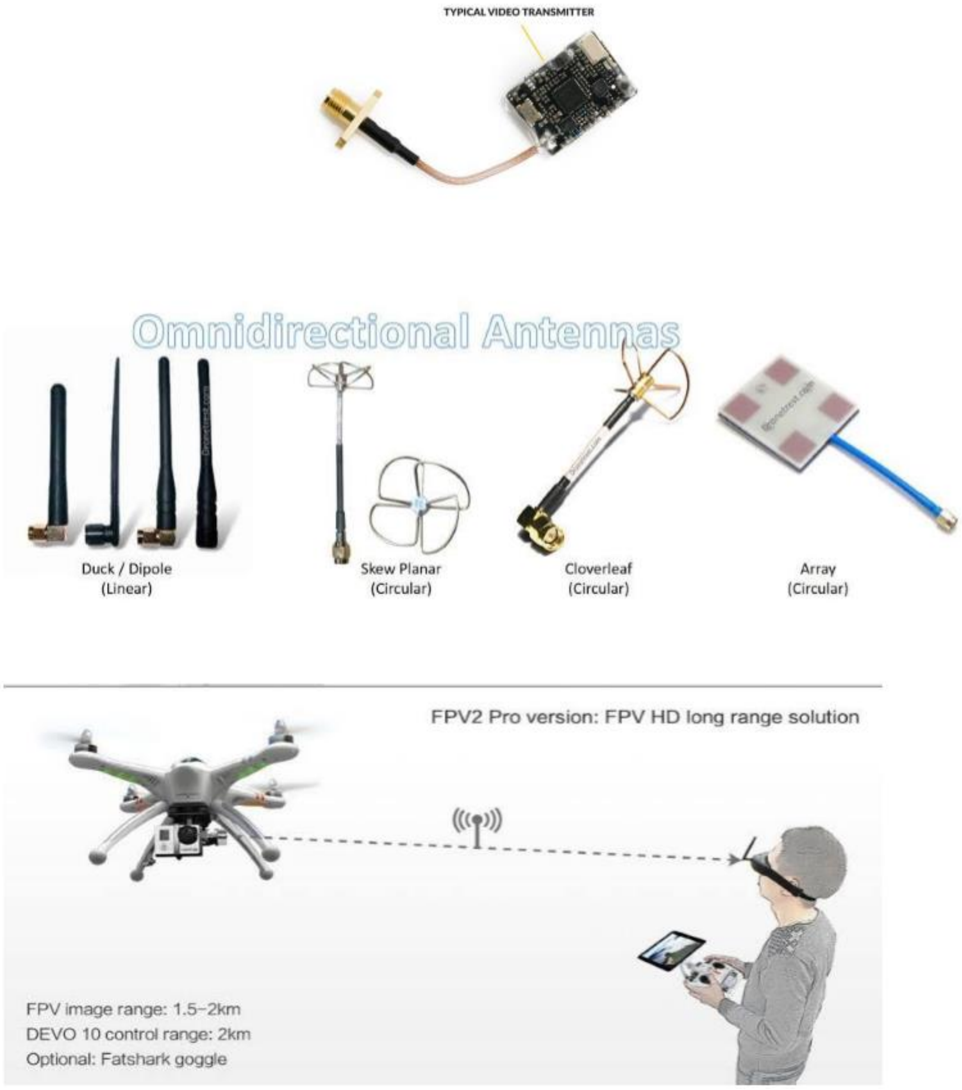

Fig 1.5 AR Drone

CHAPTER 2

LITERATURE SURVEY

2.1 Materials

For someone new to the multirotor hobby, putting together our first quadcopter parts list can be extremely daunting. Trying to figure out what to buy and what parts will work together is tough, especially for people who don't come from a background in radio controlled planes or helicopters. Forums are packed with people who want to build a quadcopter but don't know where to start. It can be frustrating trying to sort through the thousands of posts on forums and blogs and figure out what to do.

Fig.2.1 Materials

We've heard from a lot of readers who are in similar positions and this post is designed to spell out exactly what you need for your first quadcopter build. While we will recommend a complete list of specific parts that we have used and tested for a complete quadcopter build, the main purpose of this post is to provide a general overview of the parts needed to build a quadcopter.

2.2 Working Principle

1. First , we are making a frame of light weight material. 2. Quadcopter is a device with a intense mixture of Electronics, Mechanical and mainly on the principle of Aviation. 3. The Quadcopter has 4 motors whose speed of rotation and the direction of rotation changes according to the users desire to move the device in a particular direction (i.e Takeoff motion, Landing motion, Forward motion, Backward motion, Left motion, Right Motion.) 4. The rotation of Motors changes as per the transmitted signal send from the 6-Channel transmitter. 5. The signal from microcontroller goes to ESC's which in turn control the speed of motor This chapter introduces some of the main concepts and background knowledge related to this project. A generic model of a quadcopter will be introduced, as well as methods of connecting masses to UAVs and an introduction to controller actions.

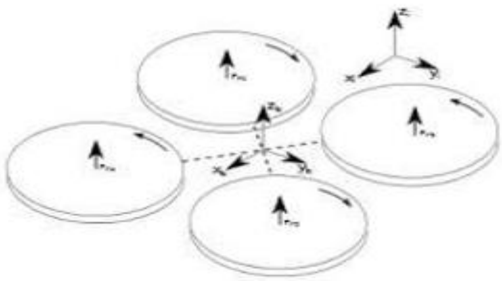

Fig 3.5 Axis Of a Drone

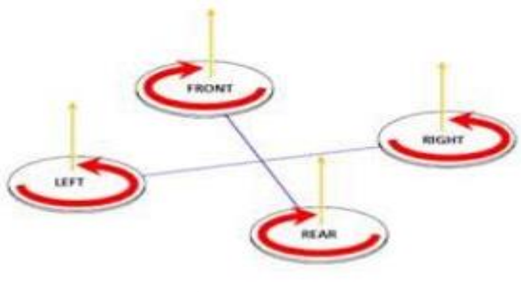

Fig 3.6 Take Off Motion

Fig.2.2working principles

2.3 APM 2.8 FLIGHT BOARD

Ardupilot Mega (APM) is a professional quality IMU autopilot that is based on the Arduino Mega platform. This autopilot can control fixed-wing aircraft, multi-rotor helicopters, as well as traditional helicopters. The APM 2.8 is a complete open source autopilot system and the bestselling technology that won the prestigious Outback Challenge UAV competition. It allows the user to turn any fixed, rotary wing or multirotor vehicle (even cars and boats) into a fully autonomous vehicle; capable of performing programmed GPS missions with waypoints. This revision of the board has an optional onboard compass, which is designed for vehicles (especially multicopters and rovers) where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference. (On fixed wing aircraft it's often easier to mount APM far enough away from the motors and ESCs to avoid magnetic interference, so this is not as critical, but APM 2.8 gives more flexibility in that positioning and is a good choice for them, too). This is designed to be used with the 3DR uBlox GPS with Compass, so that the GPS/Compass unit can be mounted further from noise sources than APM itself. APM 2.8 requires a GPS unit for full autonomy. You can add additional extras to your AMP 2.8 board via the options above.

2.3.1 Why APM...?

-->POWERFUL GROUND CONTROL SOFTWARE The downloadable mission planner software is what you use to configure and control your Ardupilot board, features include:

• Point-and-click waypoint entry, using Google Maps.

• Select mission commands from drop-down menus

• Download mission log files and analyze them

• Configure APM settings for your airframe

• Interface with a PC flight

• simulator to create a full hardware-in-the-loop UAV simulator. See the output from APM's serial terminal The ArduPilot Mega board can control Planes, Copters and Rovers. All you need to do is load the appropriate software onto the board with a few clicks

2.3.2 FEATURES:

• Arduino Compatible!

• Includes 3-axis gyro, accelerometer, along with a high-performance barometer

• Onboard 4 MegaByte Dataflash chip for automatic datalogging

• Optional off-board GPS, uBlox LEA-6H module with Compass.

• One of the first open source autopilot systems to use Invensense's 6 DoF Accelerometer/Gyro MPU-6000. • Barometric pressure sensor upgraded to MS5611-01BA03, from Measurement Specialties

• .Atmel's ATMEGA2560 and ATMEGA32U-2 chips for processing and usb functions respectively.

Fig2.3 APM control board and materials of drone

Fig.2.4 GPS Module

2.4 UBlox NEO-M8N GPS Module with Ceramic Active Antenna

The global positioning system is a satellite navigation system that uses a radio receiver to collect signals from orbiting satellites to determine position, speed, and time Versatile GNSS modules in different variants for easy manufacturing

• Concurrent reception of up to 3 GNSS (GPS, Galileo, GLONASS, BeiDou)

• Industry leading –167 dBm navigation sensitivity

• Security and integrity protection

• Supports all satellite augmentation systems

• Advanced jamming and spoofing detection

• Product variants to meet performance and cost requirements

• Backward compatible with NEO-7 and NEO-6 families

2.4.1 GPS Systems

The US GPS satellites is but only one of several global satellite navigation systems. In 1982, the Soviet Union launched the GLONASS GPS satellites, which Russia continues to operate. Europe is developing the Galileo GPS system, while China is developing its own Compass GPS satellites. There are a few smaller GPS constellations including China’s BeiDou, and India’s IRNSS. Typically, a GPS receiver only receives signals from one of these satellite systems. But there is no reason why one can’t use signals from multiple sources. The distribution of the US GPS satellites is such that at least four satellites are visible from any location. Combining signals from GPS, GLONASS, and Galileo can greatly increase the positional accuracy determination, and eliminate the problem of tall buildings blocking signals. The more satellites that are in view of the receiver, the greater the positional accuracy. There are several drone modes XXXXXX that utilize both the US and Russian GPS satellites, thereby increasing navigation robustness. The ability to utilize multiple GPS sources is a highly advantageous, and is a feature you should look for when buying a more advanced drone.

2.4.2 GPS Issues and Challenges

As good as the GPS systems is, there are several problems inherent in the current system. The GPS satellites have a finite lifetime, and need to be periodically replaced. Space is a hazardous environment leading to satellites being damaged or destroyed by meteors, or solar flares. The biggest concern with GPS is related to privacy and tracking. It is possible to place a GPS tracking device on an individual or a vehicle.

2.4.3 GPS Drone Navigatino Waypoints

The incorporation of GPS receivers in advanced drones allows for GPS drone waypoint navigation. This is an advanced technology that allows a drone to autonomously fly to preprogrammed points. This system can instruct the drone how fast, how high, and where to fly. It can also be programmed to hover for a period of time over each waypoint. Drones are increasingly being used for surveying building construction, road maintenance, and infrastructure inspections. Agricultural applications include crop inspection, and tracking farm animals. Using GPS drone waypoint navigation, an area can be inspected at the predesignated positions. The drone controller is then able to focus his attention on the camera, and conduct the inspection. The advancement of GPS drone navigation has greatly increased their utility and range of applications.

2.5 Gyroscope Stabilization, IMU And Flight Controllers

- Gyros stabilization technology give the drone its smooth flight capabilities.

- The gyroscope works almost instantly to the forces moving against the drone keeping it flying or hovering very smoothly. The gyroscope provides essential navigational information to the central flight controller.

- The inertial measurement unit (IMU) works by detecting the current rate of acceleration using one or more accelerometers. The IMU detects changes in rotational attributes like pitch, roll and yaw using one or more gyroscopes. Some IMU include a magnetometer to assist with calibration against orientation drift.

- The Gyroscope is a component of the IMU and the IMU is an essential component of the drones flight controller. The flight controller is the central brain of the drone.

- The main function of gyroscope technology is to improve the drones flight capabilities. The drone’s hardware, software and algorithms work together to improve all aspects of the flight including hovering perfectly still or taking steep angled turns. A drone with six axis gimbal feeds information to the IMU and flight controller to vastly improve the flight capabilities.

- The gyroscope needs to work almost instantly to the forces moving against the drone (gravity, wind etc) to keep it stabilized. The gyroscope provides essential navigational information to the central flight control systems.

- An inertial measurement unit works by detecting the current rate of acceleration using one or more accelerometers. The IMU detects changes in rotational attributes like pitch, roll and yaw using one or more gyroscopes. Some IMU on drones include a magnetometer, mostly to assist calibration against orientation drift.

- On board processors continually calculate the drones current position. First, it integrates the sensed acceleration, together with an estimate of gravity, to calculate the current velocity. Then it integrates the velocity to calculate the current position.

- To fly in any direction, the flight controller gathers the IMU data on present positioning, then sends new data to the motor electronic speed controllers (ESC). These electronic speed controllers signal to the motors the level of thrust and speed required for the quadcopter to fly or hover. 11

2.6 Drone FPV Live Video, Antenna Gain And Range

FPV live video using radio frequency antenna, transmitter and receiver signaling technology is one of the main reasons why drones have become so popular. This live video transmission, along with high quality cameras, allow drones to be used in many positive ways across numerous sectors. It is a terrific flying experience as you are seeing what the drone camera sees. If you are using top FPV goggles, it feels as if you are in the drone. To fly a drone, you don’t need to understand the technology behind it all, as drones have become so easy to fly. However, understanding the UAV’s live video transmission technology will help you if you want to increase the live video range from your drone or troubleshoot video transmitter and receiver problems. If you want to build and design drones, then understanding drone live video using radio frequencies, transmitters and receiver signalling technology is essential. This post will assist you in learning about live video transmission, radio frequencies, omnidirectional and directional antennas and how to increase the FPV range from any drone.

Fig 2.5live video transmission

In radio communication, an omnidirectional antenna is a class of antenna which radiates radio wave power uniformly in all directions in one plane, with the radiated power decreasing with elevation angle above or below the plane, dropping to zero on the antenna's axis. This radiation pattern is often described as sphere or doughnut shaped. How far away, you receive video signal depends on the transmitter and receiver your are using. The video quality will become grainy or you will lose video as the receiver and transmitter move away from each other. Using the above omnidirectional transmitter and corresponding antenna will give a live video signal up to about 1.5 mile (2.4 km) range.

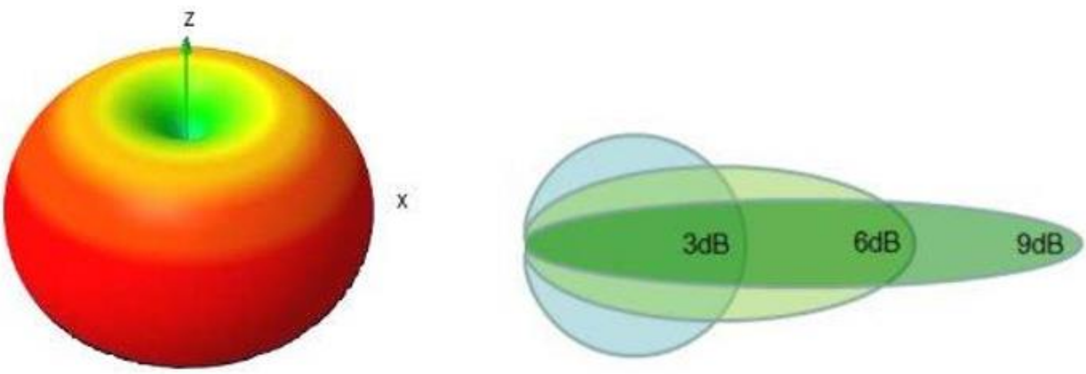

Fig 2.6 plot diagram

CHAPTER 3

PROPOSED ALGORITHM

3.1 BLOCK DIAGRAM AUTONOMOUS DRONE WITH LIVE VIDEO FEED USING GPS

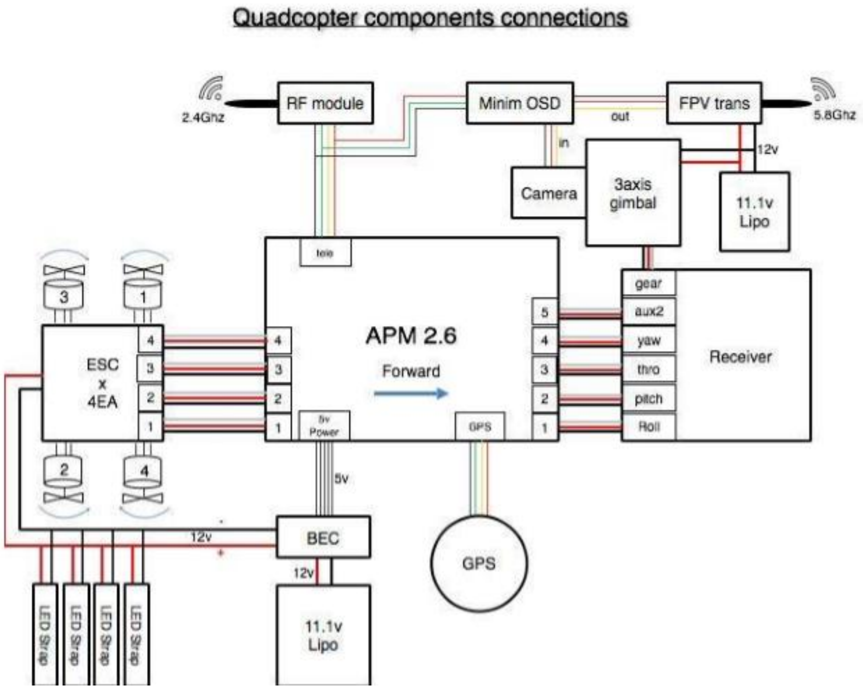

Fig 3.1.Block diagram

The below schematic shows the various connections between the motors, flight controller and ESC. Alternatively the 14.6 volts supplied by the three cell LiPo battery is sent directly to the four motors. It is impossible to see here, but by switching any of the three wires going to each motor (signal, ground and power) the rotation could be reversed. This made it simple to pair motors 1 and 3 to be clockwise as well as 2 and 4 to be counter clockwise. Magnetometer values were used to determine North, South, East, West orientation whereas the accelerometers were used to test for being level. This was done by comparing the magnetometer values in real CW CW CCW CCW time to a compass as the quadcopter was turned in a circle. The magnetometer values in all three axes were recorded for each of the cardinal directions. To simplify movement the drone will only attempt to move in a single cardinal direction at a time so knowing combinations of them for this testing is unnecessary. Accelerometer values were tested in a similar way but instead of spinning the drone it was instead tilted in the eight main ways it could be while in flight. Those tilting directions are forward, right, forward-right, left, forwardleft, back, back-right and back-left. For each of these different scenarios the three axes accelerometers change in value in a specific way that can be easily tested for.

3.2 SAFETY TIPS

1. Choose the right environment. First, try flying a drone in an open, preferably outdoor area instead of indoors. Make sure the day you've selected is relatively wind free and the location has few trees – because no one wants an emergency drone landing 15 feet up in a tree.

2. Be aware of your surroundings. Take note of where other people, objects, trees or roads are to assure a safe flight path and landing. Don't fly near an airport or over a large group of people. Be aware of powerful antennas and power lines as well.

3. Get permission. If you are on someone else's property or in a public space, ask for permission to avoid invasion of privacy or other consequences.

4. Learn the modes and controls. Different flying modes and settings can affect your flight and ability to control the drone. Before flying, learn which setting is best for you in your selected environment. For example, AR Drone has an outdoor flight mode, left-handed mode or joypad mode.

5. Check the battery. Make sure your battery is fully charged to avoid an emergency landing. You should also consider the season. If you're flying in the cold winter, your battery will drain more quickly than it would in the summer.

6. Be in control. The emergency land button should be one of the first things you learn before flying the drone. It ensures the drone lands safely if you make a critical error while flying. However, you should only use the emergency land function in true emergencies because the motors will cut out and your drone will drop (which could cause serious harm to those below). Also, keep a direct line of sight on your drone and watch its altitude.

7.Do not overcharge the battery. When the battery is fully charged, disconnect it from the charger. Do not put the device back in the charger once charging has finished. You risk causing overheating. Do not cover your product or its charger while the battery is charging. Recharge the battery at a temperature of between 0°C and 40°C.

3.3 SOFTWARE- MISSION PLANNER

Fig.3.2 Mission planer

Mission Planner is a full-featured ground station application for the ArduPilot open source autopilot project. This page contains information on the background of Mission Planner and the organization of this site. Mission Planner is a ground control station for Plane, Copter and Rover. It is compatible with Windows only. Mission Planner can be used as a configuration utility or as a dynamic control supplement for your autonomous vehicle. Here are just a few things you can do with Mission Planner:

• Load the firmware (the software) into the autopilot board (i.e. Pixhawk series) that controls your vehicle. • Setup, configure, and tune your vehicle for optimum performance.

• Plan, save and load autonomous missions into you autopilot with simple point-and-click way-point entry on Google or other maps.

• Download and analyze mission logs created by your autopilot.

• Interface with a PC flight simulator to create a full hardware-in-the-loop UAV simulator.

• With appropriate telemetry hardware you can: o Monitor your vehicle's status while in operation. o Record telemetry logs which contain much more information the the on-board autopilot logs. o View and analyze the telemetry logs. o Operate your vehicle in FPV (first person view)

3.4 LAYOUT CONNECTIONS

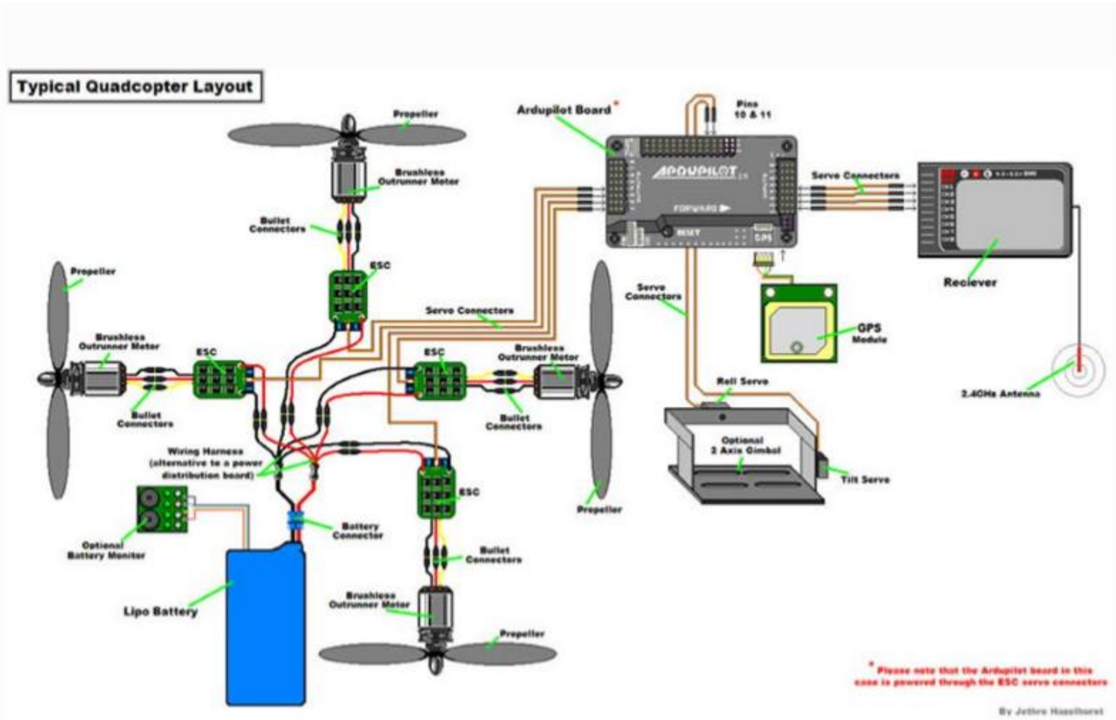

Fig3.3 layout connections

CHAPTER 4

RESULTS

Fig.4.1 Designed Drone

4.1 APPLICTIONS OF DRONE

4.1. 1 This awesome shot of Ultron for Marvel's *Avengers*:

Apparently the Hollywood movie industry has been making good use of those commercial licenses for drone sues it was granted, because Marvel posted on their official Twitter news feed that this awesome shot of Ultron was made using a drone. Being in the drone business, we're so excited that UAVs are being used for projects such as *The Avengers*. Here's hoping that next time they employ a Flyver App!

4.1.2 Spotting Wildfires Before They Start

Wildfires can be a very dangerous problem once they get started, so it's important to do everything in our power to prevent them. The trouble is that it's pretty hard to spot a forest fire before it's grown into a size that's hard to put out. Infrared cameras have always been a possibility, but the trouble is that until now they haven't been feasible, since manned aircraft are expensive to fly and their velocity is too great for someone to be able to get a good image of an area. However, as NASA has discovered, with the adoption of UAVs monitoring for wildfires can be made much simpler and more efficient. Using two drones, one of which is equipped with an infrared camera, Michael Logan, who is head of NASA's Langley unmanned aerial vehicle lab, has created a system that should make spotting wild fires in their early stages much easier. The advantage of drones is that they can fly at lower altitudes and at much slower speeds, allowing them to get a clear image of fire-prone areas.

4.1.3 Tracking Disease Spread Patterns in Africa

Over on Cell.com , there's a very interesting paper detailing how drones are being used to detect patterns in the spreading of a new malaria strain. With plenty of deforestation going on, the habits of the mosquitoes changes along with their habitat, which means their victims also change. To track how changes in the map of the area affect infection patterns, scientists have been successfully employing drones. The role of the drone is to frequently map out the area so that any recent changes can be taken into account. Being aware of these changes, the doctors can compare them to patient records to see how they affect disease spread patterns. The relevance of a drone in this case is that it can be programmed to perform these tasks automatically and in this rid health care workers of the duty and danger of having to personally map everything.

4.1.4. Using a Drone in Emergency Situations

Using drones in emergencies is one of the first applications which one can come up with. It can save more lives than probably any other application. Apparently the fire rescue team of Northport Alabama knows this and has been training to use drones for several months. This week, however, was the first in which a drone was utilised during a real rescue mission. There was a tanker fire and the drone was utilised as a means to identify the substance in the tanker as quickly as possible. Apparently, this is one of the most useful ways a drone can help in an emergency situations as it allows fire rescuers to quickly identify dangerous chemicals without ever having to go near the fire site.

4.1.5 Chasing Down Criminals

Chasing after criminals is a dangerous job. You never know what they might have on them and where they might lead you. Last week four policemend from North Dakota managed to catch four underage people who were pulled over for drunk driving and then made their way into a corn field. Considering the event happened during the night. Finding them on foot would have been almost impossible. Luckily the cops has a drone at their disposal, which they used in order to catch the cornfield runners in a matter of minutes. While this isn’t a precedent in chasing down criminals using drones, it’s nice to see them being utilised in the USA, considering it’s the biggest drone market in the world right now.

CHAPTER 5

FUTURE WORK AND CONCLUSION

5.1 FUTURE WORK

We briefly discuss a few points of future work.

• **Fusion with IMU**: Safety Net is a completely orthogonal solution, but it is possible to combine GPS with IMU for even better accuracy. We leave this to future work.

• **GPS Sampling Rate**: Sampling rate of our GPS modules

was only 5 Hz, but all of our techniques are fundamentally applicable to high rate GPS receivers.

• **Latency**: The processing power on drones continues to evolve – various drones offer diverse computing capabilities. Our future work would need to carefully profile the latency to characterize the kinds of drones that could execute SafetyNet in real-time.

• **Vehicles**: Orientation estimation of self driving cars can also benefit from SafetyNet, adding an extra layer of reliability.

5.2 CONCLUSION

Grand visions abound for applications of drones. While Amazon, Google, and others have made great strides towards package delivery, etc., drones remain an unacceptable hazard to persons and property. By comprehensively addressing IMU failure through GNSS – a failover completely orthogonal to inertial methods, SafetyNet progresses the state of the art in drone safety.

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