AUTONOMOUS UAV

[1]Janhavi Joshi, [2]Rajeshwari CS, [3]Rakshith Kumar G, [4]Sneha S, [5]Sneha Nayak

[1] Asst. Professor, Electronics and Communication, AMC Engineering College, Karnataka, India
[2] Student, Electronics and Communication, AMC Engineering College, Karnataka, India
[3] Student, Electronics and Communication, AMC Engineering College, Karnataka, India
[4]Student, Electronics and Communication, AMC Engineering College, Karnataka, India
[5]student, Electronics and Communication, AMC Engineering College, Karnataka, India

ABSTRACT

Unmanned aerial vehicle, also known as a drone, is a type of electronic gadget. Currently, drones are widely used in many aspects of life. Their main advantages are their appropriate size and the tasks they can complete. A UAV's hardware is composed of a frame, a propulsion system, and a flight control system (FCS), in that order. The size and propulsion system of the UAV can be designed to accommodate the required payload and flying duration. GCS software, on the other hand, concentrates on the operator side and offers manual path planning and flight control of one or more vehicles. A communication protocol is needed to transmit these GCSs to the autopilots. The most used protocol, MAVLink, allows for communication with both ArduPilot and PX4. The most well-known GCS tools, including MAVProxy, Mission Planner and QGroundControl, employ this protocol. The autopilot and other flight control-related gear make up the flight control system, which is merely an embedded system. The computing unit (for example, a microcontroller) is the following element. Typically used to construct the autopilot logic for dependable and fault-tolerant flight control. The computer unit should ideally be constrained by real-time requirements. Its answer must be deterministic and occur within predetermined time limits. Generally speaking, the FCS is in charge of calculating low-level control commands, estimating the vehicle states (such as altitude, attitude, and velocity) based on sensor data, logging crucial data for post-flight analysis, and interacting with higher-level components via wired connections or other communication channels. A FCS is necessary for teleoperation in the navigation mode. This paper concludes by discussing the technological potential of these systems, how they will fit into contemporary society, as well as the risks and technical constraints they may provide.

Keyword: *autonomous ,UAV, quadcopter, Pixhawk ,flight data, qgroundcontrol, mavlink*

---

1. INTRODUCTION:

The Unmanned Aerial Vehicles (UAVs) category of aircraft includes drones. These drones are used to record and analyse aerial footage and photos of the environment while monitoring it. The problems of humanly piloted UAVs, such as control errors, may be eliminated with autonomous UAVs. UAVs use sensors to identify obstructions and choose their course with minimal to no human input. The main area of development for UAVs in terms of size, power needs, and code restrictions is autonomy. Mission replanning, which implies a new planning for the previous mission plan owing to specific incidences, such as a vehicle or sensor failure or the introduction of a new task, during the real-time execution of the mission, is one of the most difficult difficulties in this sector. A few recent studies have created methods for automating mission replanning based on repairing the prior plan or completing a complete mission replanning in a constrained runtime.

2. PROBLEM DEFINITION:

An unmanned aerial vehicle (UAV) is a quadcopter. Unmanned aerial vehicles (UAVs) are commonly understood to be any flying machine that does not have an onboard pilot. These gadgets are also known as remotely piloted vehicles (RPVs), which are driven remotely by a ground control operator, and drones, which are designed for autonomous flight. This characteristic frequently leads to expensive maintenance and implementation costs, particularly when it comes to applications in the industrial arena. However, the autonomy here is intended as a straightforward path planning through several given points, unlike some applications that implement an autonomous flight mode.

3. HARDWARE AND SOFTWARE REQUIRED:

3.1 HARDWARE REQUIREMENTS:

3.1.1 F450 FRAME:

Fig -1: F450 Frame

Hobbyists primarily use the Q450 Quadcopter Frame as their Multirotor Frame. This is the third iteration of the Q450 Quadcopter Frame, which features stronger material than versions 1 and 2. As a result, heavy landings no longer result in arm breakage at the motor mounts. Because it is made of glass fibre, the Q450 Quadcopter Frame is strong and long-lasting. They have arms made of extremely resilient Polyamide-Nylon that are stronger moulded arms with a great deal of thickness, preventing arm breaking at the motor mounts in the event of a hard landing. Because of the support ridges on the arms, flight forward is more stable and swifter. They are robust, lightweight, and feature a practical design that includes a PCB (Printed Circuit Board) that allows you to connect.

3.1.2 ELECTRONIC SPEED CONTROL(ESC):

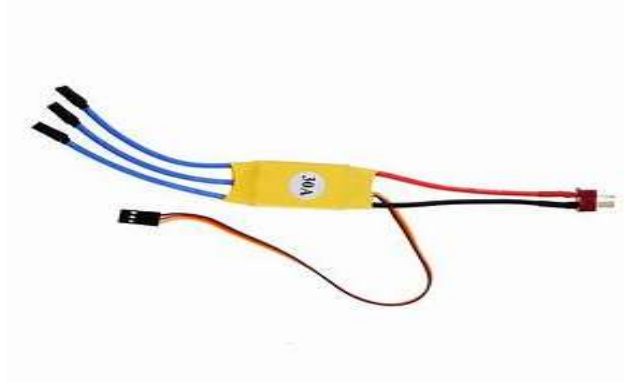

Fig -2: Electronic speed control

For quadcopters and multi-rotor aircraft, a standard BLDC 30 amp ESC Electronic Speed Controller with Connector is available. In comparison to other ESCs, it offers faster and better motor speed control, improving flight performance.Motors that require up to 30A of current can be driven by an electronic speed controller. It utilises LiPo batteries with 2-3S. The flight controller and other onboard modules are powered by regulated 5V (maximum demand of 2A) from the onboard BEC. With a 2-3S LiPo battery, we can use this to control our brushless motors (just make sure the motor doesn't draw more than 30A).

3.1.3 BRUSHLESS MOTORS:

Fig -3: Brushless Motor

Brushless motors are used in drones. It produces higher thrust while using less battery power. The motors' early iterations were not very effective. Additionally, the brushless motors are more stable and make less noise. All the qualities necessary for successful drone design are present in brushless motors: high efficiency, broad speed ranges, and overall high speed-torque capabilities. They also need less maintenance and are generally more cheap. The smaller drones often use brushed motors, but larger drones and UAVs typically have brushless motors because they can support the weight of the heavier electronics. Electronic speed controllers (ESCs) are also necessary for brushless drone motor operation.

3.1.4 PROPELLERS:

Fig -4: propellers

A drone's propellers are a necessary component. To keep the height during the flight, they push the air downward. Additionally, propellers aid in movement in all directions. The high-quality propellers 1045(10X4.5) ABS DJI Black were created especially for multi-copters. These high-strength, lightweight propellers have a 15° angle design at the end to prevent whirlpools when the multicopter is in flight. Both multi-copters and drones can benefit from them. The aerofoil stability and air-powered efficiency are both enhanced by the propellers.

3.1.5 BATTERY:

Fig -5: Battery

Lithium polymer (LiPo) batteries are the most common type of battery used to power commercial drones. These batteries' high energy density, power-to-weight ratio, and safety record are major advantages. But lithium ion (Li-ion) batteries are gaining popularity. The Lithium Polymer Battery Pack (Lipo) 4200mah 2S 35C (7.4V) batteries are renowned for their efficiency, dependability, and affordability. We don't find it surprising that individuals in the know prefer lithium polymer packs as their preferred option. Batteries give their full rated capacity at a cost that is affordable to all. Heavy-duty discharge leads are included with the 4200mah 2S 35C (7.4V) Lithium Polymer Battery Pack (Lipo) batteries to reduce resistance and support high current loads.

3.1.6 GPS MODULE:

Fig -6: GPS module

GPS drones have a GPS module that enables them to determine their position in relation to a system of orbiting satellites. The drone can carry out tasks including position hold, autonomous flight, return to base, and waypoint navigation by connecting to signals from these satellites .This GPS Module is required if you are using a drone to wander and navigate a distance. GPS drones have a GPS module that enables them to determine their position in relation to a system of orbiting satellites. The drone can carry out tasks including position hold, autonomous flight, return to base, and waypoint navigation by connecting to signals from these satellites.

3.1.7 915Mhz 100mW Radio Telemetry :

Fig-7: 915Mhz 100mW Radio Telemetry

The Unmanned Telemetry Kit enables you to quickly add a two-way telemetry connection between your drone and ground station and is compatible with Ardupilot or Pixhawk-based systems. As it uses the same firmware onboard, this 915Mhz 100mW Radio Telemetry Kit is 100% compatible with the 3DR Telemetry Kit. We are able to use the same firmware that 3D Robotics uses on our own version at Unmanned Tech because it is entirely open-source.The Unmanned Telemetry Kit enables you to quickly add a two-way telemetry connection between your drone and ground station and is compatible with Ardupilot or Pixhawk-based systems.

3.1.8 SAFETY SWITCH:

Fig-8: Safety switch

The switch manages the vehicle's "Safety" mode. In this state, servo outputs' PWM is disabled, motors cannot operate, and a pre-arm error condition is generated to prevent unintentional arming. A two-position JST-SH connector on the Pixhawk Passive Buzzer's one side connects to the Pixhawk directly. Once connected, you'll be able to hear various sounds associated with various modes. This also contains the PX4 safety switch, which enables you to instantly arm or disarm your board.

3.1.9 PIXHAWK FLIGHT CONTROLLER:

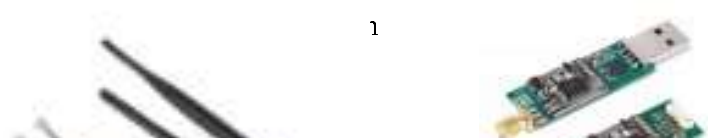

Fig-9: Pixhawk flight controller

Pixhawk is user-innovated hardware that consolidates the various parts required to operate open source software in a drone into a single box. The Raspberry Pi or Arduino of drones are good comparisons for Pixhawk. Today's commercial drone business is driven by Pixhawk .Eight RC channels and four serial interfaces are supported. For programming, analyzing logs, and even certain apps for smartphones and tablets, there are numerous user interfaces accessible. It instantly recognizes and sets up all of its peripherals .The Pixhawk system offers a programming environment similar to Unix/Linux and whole new autopilot features. A bespoke PX4 driver layer and sophisticated mission and flight behavior scripting ensure precise timing for all operations.

3.2 SOFTWARE REQUIREMENTS

3.2.1 MISSION PLANNER:

Fig -10: Mission planner

Mission Planner V1.3.79 is the open-source autopilot project's mission planner is a ground station application with all the bells and whistles. A ground control station for planes, helicopters, and rovers is called Mission Planner. Only

Windows is compatible with it. For your autonomous vehicle, Mission Planner can be used as an additional dynamic control method or as a configuration tool.

3.2.2 QGROUNDCONTROL:

Fig-11: Qgroundcontrol

QGroundControl offers total flight control and mission planning. Its main objective is developer and professional user convenience. Since all of the code is open-source, you can modify and improve it as you see fit. Running on Windows, OS X, Linux, iOS, and Android is QGroundControl. supports a variety of autopilots, including PX4 Pro, ArduPilot, and any vehicle using the MAVLink protocol,VTOL, fixed-wing, and multi-rotor vehicles are all supported by PX4 Pro and ArduPilot.

4. METHODOLOGY:

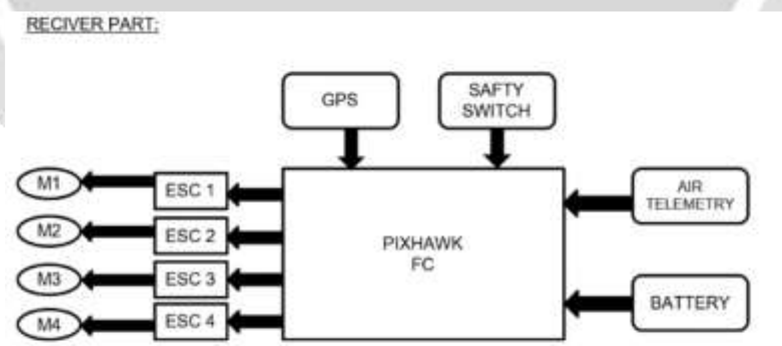

Fig-12: Block diagram of receiver part

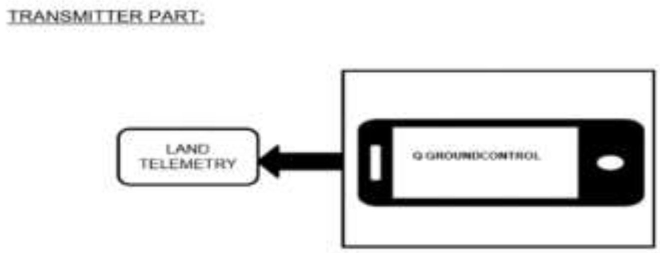

Fig-13: Block diagram of transmitter part

- Assemble the Frames then organize the motors and ECSs on to the frame.
- After mounting the ECSs we need to connect the ECSs to the motors.
- Then connect the ESCs to the Pixhawk output respectively.
- Then Connect inputs of Pixhawk to the remote receiver.
- Download the mission planner software then load the firmware to the Pixhawk.
- Setting up necessary parameters for accel calibration, compass calibration .
- Using QGroundControl app for the flight control and mission planning for making MAVLink enabled drone .Once the QGroundControl app is downloaded we need to connect ground telemetry to the mobile.
- Then we need to update the required plan in to the app. the parameters get downloaded.
- once we update required plan it will show the location of the drone.
- Then will give required wave points and set the altitude and flight speed.
- once everything is done we need to upload the mission. And check for required satellite (i.e minimum 11). Then give command as take off.

5. RESULTS:

Below Fig.14 & Fig.15 are the results captured.

Fig-14: Setup of Quadcopter

Fig-15: Autonomous UAV

6. CONCLUSION:

This paper presents the development and construction of an autonomous drone system are discussed in this study. Both the theory behind the operation of the autonomous system and the theory underlying quadcopter technology are presented. The thesis goes on to provide a thorough explanation of every piece of hardware and software that goes into creating our drone system, as well as how everything works together. It then goes into our suggested approach for achieving autonomous control of a quadcopter system, along with all the challenges and setbacks we ran into. This also offers a strategy for integrating new drone mission planning techniques into an open-source ground control system (GCS), namely QGroundControl.

7. FUTURE ENHANCEMENTS:

Future work on this project will involve using the LiDAR laser scanner unit's data for object avoidance, using Hector SLAM's map to direct the quadcopter as it moves from one location to another, and adding point-to-point local path planning. It will be fascinating to watch what this technology brings in the years to come given current developments in computer technology and the rise of drone systems.

8. REFERENCES:

[1] G. A. Venkatesh, P. Sumanth and K. R. Jansi, "Fully Autonomous UAV," 2017 International Conference on Technical Advancements in Computers and Communications (ICTACC), Melmaurvathur, India, 2017, pp. 41-44, doi: 10.1109/ICTACC.2017.20.

[2] Jha AR. Theory, design, and applications of unmanned aerial vehicles. New York: CRC Press; 2016.

[3] Motlagh NH, Bagaa M, Taleb T. UAV-based IoT platform: a crowd surveillance use case. IEEE Commun Mag. 2017;55(2):128–34.

[4] Shiri, H.; Park, J.; Bennis, M. Remote UAV Online Path Planning via Neural Network-Based Opportunistic Control. IEEE Wirel. Commun. Lett. 2020.

[5] Anwar, A.; Raychowdhury, A. Autonomous Navigation via Deep Reinforcement Learning for Resource Constraint Edge Nodes Using Transfer Learning. IEEE Access 2020.

[6] Islam, S.; Razi, A. A Path Planning Algorithm for Collective Monitoring Using Autonomous Drones. In Proceedings of the 2019 53rd Annual Conference on Information Sciences and Systems (CISS), Baltimore, MD, USA, 20–22 March 2019.