SKYPILOT - AUTONOMOUS DRONE

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Abstract - Unmanned Aerial Vehicles (UAVs) or autonomous drones are aerial machines that operate without a human pilot on board. They are equipped with advanced technologies such as GPS, sensors, and cameras that enable them to navigate, collect data, and perform various tasks. These tasks include military operations, surveillance and tracking, environmental monitoring, and delivery services. The use of drones in security operations has numerous applications. They can be utilized to report emergencies, monitor accidents and crimes, survey specific areas, track movements in busy environments, and more. The adaptability of drones in security operations makes them a valuable tool in various industries. The project aims to monitor areas that are difficult to navigate for security personnel in corporate institutions. The drone will hover and record the area, transmitting the footage to a ground station. The ground station will then record and analyze the events as they occur. Due to its ability to fly at different altitudes, the drone can be used in areas with rugged terrain or over water bodies. The drone operates autonomously without the use of a remote controller.

Index Terms - Monitoring, Surveillance, Unmanned Aerial Vehicles.

I. INTRODUCTION

Drone technology has revolutionized the way we see and interact with the world. These versatile devices are capable of flying through the air and capturing stunning footage with their wireless cameras. They have become an essential tool in various fields, from military operations to scientific research. However, as with any new technology, drones have raised concerns about privacy and safety.

Despite these concerns, the benefits of drone technology are numerous. They can be used for national security, as long-range weapons in military conflicts, for public safety, environmental research, and scientific research. Drones have also made their way into small household work, making tasks such as cleaning and monitoring more efficient.

As the technology continues to advance, drones are becoming more accessible to the public. However, it is important to remember to follow government rules and regulations regarding their use.

Drones have become an integral part of our society, offering endless possibilities for various industries. While there are concerns about their use, the potential benefits make it clear that this technology is here to stay.

II. PRINCIPLE OF QC OPERATION

Autonomous QC has the potential to revolutionize the transportation industry, leading to faster delivery times, reduced fuel costs, and decreased labor costs. This technology will help companies improve their supply chain management, resulting in higher levels of customer satisfaction and increased revenue growth. By reducing production costs, consumer surplus can be increased, and the producer's profits can be raised The design of the QC is based on four rotor assemblies equally spaced around a central hub. Each rotor produces the same amount of thrust when given the same power input. The angular momentum of the rotors generates a torque that can be balanced by the opposing rotor, eliminating the need for additional equipment such as control moment gyroscopes. This design allows for precise and efficient movement, making it an ideal solution for home delivery services.

Implementing autonomous QC for home delivery will help to overcome the problems associated with traffic congestion and the time-consuming process of traditional delivery methods. By increasing operational efficiencies and productivity, companies can create a competitive advantage in the marketplace. Ultimately, the use of autonomous QC technology will benefit both companies and consumers alike.

III. FUNCTIONALITY OF SKYPILOT – AUTONOMOUS DRONE

The Block Diagram of SKYPILOT is shown in the Fig. 1. Firstly, Transmitter sends information from the drone to the ground station. Then telemetry Receiver receives the information on the ground. The drone's GPS system sends location information to the Flight Controller, it uses this information to coordinate the drone's movements and speed. Electronic Speed Controllers (ESC) receive commands from the Flight Controller to control the drone's motors. A radio receiver is also included as a backup for manual control in case of emergencies.

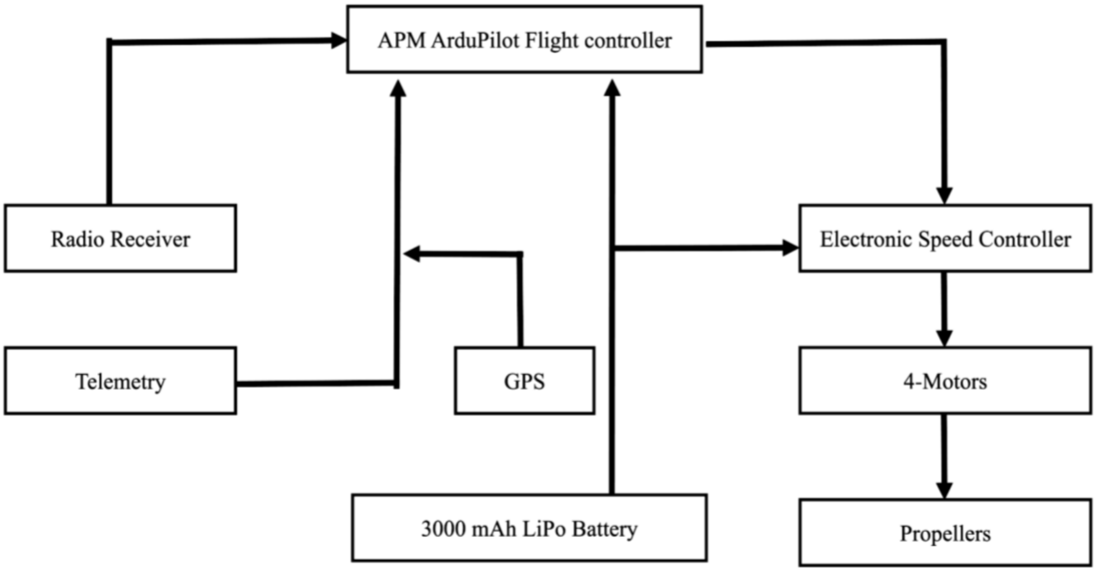

Fig. 1: Block Diagram of SKYPILOT – Autonomous Drone.

The functionality of all these components enables the drone to fly autonomously and perform tasks without the need for human intervention.

IV. SOFTWAREV USED

(1) Machine Planner

The Machine Planner software used in ArduPilot is a powerful tool that enables users to create and edit autonomous flight plans for their drones. It is a part of the ArduPilot open-source software suite, which is widely used in the unmanned aerial vehicle (UAV) industry.

The Machine Planner software allows users to specify a variety of parameters for their drone's flight plan, such as the desired altitude, speed, and direction of travel. It also provides a graphical interface that allows users to define waypoints, which are specific locations in space that the drone should fly to or around. The users can also set up complex flight patterns, such as circles or spirals, and specify the duration and timing of various actions, such as taking pictures or changing the drone's speed. The software for autonomous drone flight planning includes advanced features such as coordinating multiple drones during flight. After creating a flight plan, it can be uploaded to the drone's flight controller via telemetry. The drone will then follow the plan autonomously, executing each action and waypoint in a sequence until the mission is finished.

The software, known as Machine Planner, is customizable and can be modified to cater to the unique requirements of different industries and applications. The ArduPilot development community frequently updates and enhances the software to ensure it remains a dependable and efficient tool for autonomous drone flight planning.

(2) QGroundControl

QGroundControl is a free and open-source software application used for drone and unmanned vehicle control. It is compatible with various drones and autopilots, including Pixhawk and APM, and can be installed on multiple platforms like Windows, Mac, and Linux.

The software has a user-friendly interface and a range of features, including mission planning tools to create flight plans, set waypoints, and adjust mission parameters. It also provides real-time telemetry data and video feed from drones, allowing users to monitor their performance and detect issues in real-time.

QGroundControl supports MAV Link, a communication protocol used by many drones and autopilots, enabling it to communicate with a wide range of devices and systems.

V. IMPLEMENTATION OF SKYPILOT- AUTONOMOUS DRONE

SKYPILOT – Autonomous Drone is used for Aerial Security, Surveying, Monitoring, Delivery Purpose etc., The implementations and connections of the components are shown in Fig. 2.

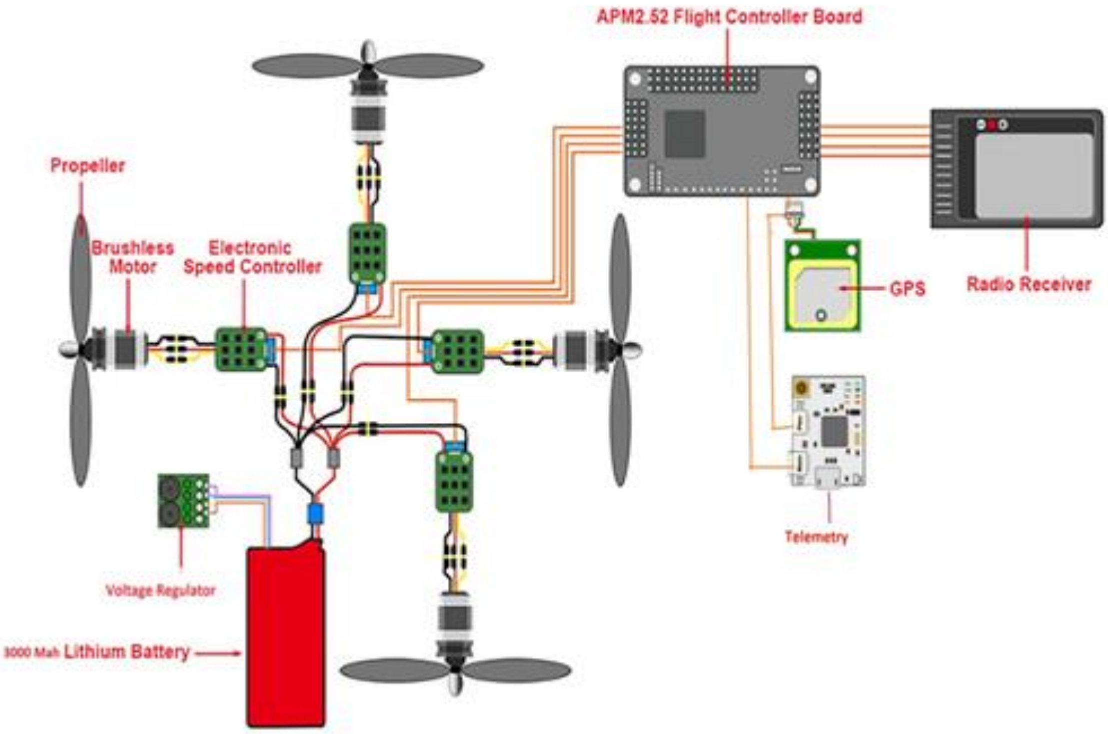

Fig. 2: Implementation of SKYPILOT.

The Hardware use for the making this drone works are APM ArduPilot Flight Controller, GPS(4Neo8N), Telemetry (915mhz – 500mw), Landing Gear, Battery (LIPO -3000mah), ESC (20Amp), Motor (MT2213 93kv) and Propellers.

VI. RESULTS TAKEN FOR VARIOUS CLIMATIC CONDITIONS

(1) Night Time Condition

Tested for the purpose to find Accuracy of the G.P.S in the night time. Founded that GPS (4Neo8N) Installed in the SKYPILOT works perfectly in the night time. It can be observed in the below Fig.3.

Fig. 3: Testing of SKYPILOT During Night Time.

(2) Moderate Wind Condition

Tested for the purpose to find stability of SKYPILOT in Moderate wind. Founded the SKYPILOT can maintain its Stability up to 38-42 mph. Beyond that It loses it stability.it can be observed in the below Fig. 4.

Fig. 4: Testing of SKYPILOT in Moderate Wind.

(3) Light Rain Condition

Tested for the purpose of Quality of Electronic equipment of SKYPILOT. Founded that SKYPILOT can survive precipitation rate is between 2.5 mm (0.098 in) – 7.6 mm (0.30 in) per hour. it can be observed in the below Fig.5.

Fig. 5: Testing of SKYPILOT in Light Rain.

(4) Hot Climatic Condition

Tested for the purpose to find out the any Issues in SKYPILOT. Founded that up to 40°C – No Issues in Flight Controller and in Motor but from 40°C- 45°C noticed that battery heating issues. it can be observed in the below Fig. 6.

Fig. 6: Testing of SKYPILOT in HOT Climatic Condition.

S. No	Tested Condition	Outcomes
1	Night Time	GPS works perfectly
2	Moderate Wind	Stable up to 38-42 mph
3	Light Rain	Survive precipitation rate is between 2.5mm (0.098 in) – 7.6mm (0.30 in) per hour
4	Hot Climatic	Up to 40°C – No Issues in Flight Controller and in Motor but from 40°C- 45°C noticed that battery heating issues

Table. 1: Test Conducted for Various Altitudes of 35, 40 & 110 and Its Outcomes

The design and implementation of an autonomous drone system that utilizes ArduPilot flight controller, GPS, and telemetry for navigation and flight control. The system was tested in various flight scenarios and environments to evaluate its performance and capabilities.

The results of our experiments demonstrate that the autonomous drone system can successfully perform a range of tasks, including aerial surveying, inspection, and surveillance, with a high degree of precision and accuracy. The system was able to maintain stable flight and navigate to pre-programmed waypoints, while also responding to real-time commands from the ground station.

Also evaluated the system's performance in adverse weather conditions and in the presence of obstacles, such as trees and buildings. The system demonstrated robustness and resilience, with the ability to adjust its flight path and speed to avoid obstacles and maintain safe operation.

The telemetry system proved to be a reliable and effective means of communicating with the drone, allowing operators to monitor its status and adjust its behavior as needed. The GPS system provided accurate positioning information, which was critical for navigation and flight control.

Overall, our experiments demonstrate the effectiveness and potential of an autonomous drone system that utilizes ArduPilot flight controller, GPS, and telemetry. Believed that this system has significant practical applications in various industries, including agriculture, construction, and surveillance. Future work will focus on improving the system's performance and functionality, including the integration of advanced sensors and algorithms for enhanced navigation and obstacle avoidance.

VII. CONCLUSION AND FUTURE SCOPE

Autonomous drones equipped with autopilot, GPS, and telemetry technologies have revolutionized the way we conduct various activities. These drones have proven to be very effective in applications such as aerial surveying, delivery, and inspection, among others. The use of these technologies has made it possible for drones to operate safely, accurately, and efficiently, even in complex environments.

In the future, we can expect to see even more advancements in the field of autonomous drones. As the demand for drone services continues to grow, there will be an increased need for drones that can operate for longer periods and cover greater distances. We can also expect to see improvements in the accuracy and reliability of drone navigation systems, which will enable drones to operate more effectively in adverse weather conditions.

Another area of future development is the integration of drones with artificial intelligence and machine learning. This will enable drones to learn from their environment and make decisions based on that knowledge. For instance, drones equipped with machine learning algorithms can detect and classify objects in real-time, making them useful for search and rescue operations.

Autonomous drones with autopilot, GPS, and telemetry technologies are a game-changer in the world of unmanned aerial vehicles. With further advancements in technology, we can expect to see even more innovative applications of drones, making them an indispensable tool in many industries.

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