iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** III **Month of publication:** March 2026

DOI: https://doi.org/10.22214/ijraset.2026.79003

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

Design and Development of an Autonomous Navigation Drone with Camera-Based Monitoring Using GPS Waypoint Control

Parth Patil, Zoya Bagsiraj, Kanishka Pillay, Rudra Sharma
AISSMS Polytecnic, India

Abstract: Unmanned Aerial Vehicles (UAVs) have gained widespread attention due to their ability to perform automated aerial operations efficiently across various applications. This paper presents the design and development of a cost-effective autonomous navigation drone capable of executing waypoint-based missions using GPS-assisted flight control. The proposed system is built on an F450 quadcopter frame integrated with a Radiolink Pix6 flight controller and TS100 GPS module for accurate positioning and autonomous navigation. The drone utilizes brushless DC motors, electronic speed controllers (ESCs), and a LiPo battery power system to achieve stable flight performance and efficient power management.

A Skydroid T10 transmitter is used for mission configuration and manual override, while autonomous flight modes enable the drone to follow predefined paths with minimal human intervention. An onboard camera system is incorporated to support aerial monitoring, surveillance, and data collection applications. The system demonstrates reliable flight stabilization, multi-waypoint navigation capability, and practical usability for real-world operations such as environmental monitoring, inspection, and surveillance tasks.

The developed platform highlights the feasibility of integrating commercially available components to create an affordable and scalable autonomous UAV system suitable for academic research and practical deployment. Future improvements may include obstacle avoidance, computer vision integration, and artificial intelligence–based autonomous decision-making to enhance operational capability.

I. INTRODUCTION

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have become an important technology in modern robotics due to their ability to perform aerial operations efficiently and safely. Advances in embedded systems, GPS navigation, and wireless communication have enabled drones to evolve from manually controlled systems into autonomous platforms capable of executing predefined missions with minimal human intervention.

Autonomous drones use flight controllers, GPS modules, and control algorithms to follow waypoint-based navigation paths while maintaining flight stability and positioning accuracy. Compared to conventional remote-controlled drones, autonomous systems improve mission precision, reduce operator workload, and allow repeatable operations across large areas.

This research focuses on the design and development of an automatic navigation quadcopter using an F450 frame integrated with a Radiolink Pix6 flight controller and TS100 GPS module. The system includes brushless motors, electronic speed controllers (ESCs), a LiPo battery power system, and a Skydroid T10 transmitter for configuration and manual control. An onboard camera is incorporated to enable aerial monitoring and real-time data collection.

The objective of this project is to develop a cost-effective autonomous drone capable of stable flight and multi-waypoint navigation for applications such as surveillance, mapping, environmental monitoring, and inspection. The proposed system demonstrates how commercially available components can be integrated to create a reliable and scalable autonomous UAV platform suitable for research and practical applications.

II. LITERATURE SURVEY

Autonomous Unmanned Aerial Vehicles (UAVs) have become an important research area due to their wide applications in surveillance, agriculture, mapping, and environmental monitoring. Earlier drone systems were manually controlled, which limited operational accuracy and efficiency. With the development of modern flight controllers and embedded sensors, drones are now capable of stable and autonomous flight.

Researchers have introduced GPS-based navigation systems that allow drones to follow predefined waypoints automatically. These systems combine Global Positioning System (GPS) data with inertial sensors such as gyroscopes and accelerometers to maintain position stability and accurate navigation. Waypoint navigation and return-to-home features have significantly improved mission automation and safety.

Recent studies have also focused on integrating onboard cameras for aerial monitoring and real-time data collection. Camera-equipped drones are widely used for surveillance, inspection, and disaster assessment tasks. Low-cost quadcopter platforms like the F450 frame are commonly used in academic projects due to their modular structure and easy integration with commercial components.

Although autonomous UAV technology has advanced considerably, challenges such as battery limitations, environmental disturbances, and obstacle avoidance still exist. This project builds upon existing research by developing a cost-effective autonomous navigation drone capable of stable flight and multi-waypoint operation using GPS-based control.

III. PROBLEM STATEMENT

Traditional drones mainly depend on manual remote control, which requires continuous pilot attention and limits operational efficiency, accuracy, and repeatability. Human-controlled flight increases the chances of navigation errors, unstable flight, and inefficient coverage of large areas, especially in applications such as surveillance, environmental monitoring, and inspection tasks. Additionally, manual operation becomes challenging in hazardous or hard-to-reach environments where human intervention may not be safe.

Although advanced autonomous drones exist, many commercial systems are expensive and not easily accessible for academic learning and small-scale research projects. There is a need for a cost-effective and reliable autonomous drone platform that can perform automatic navigation using commercially available components while maintaining stable flight performance.

The problem addressed in this research is the design and development of an affordable autonomous navigation drone capable of executing multi-waypoint missions using GPS-based control. The system aims to reduce human dependency, improve navigation accuracy, and provide a scalable platform suitable for real-world monitoring and data collection applications.

IV. METHODOLOGY

Hardware assembly included mounting motors, ESCs, and flight controller on the F450 frame. ArduPilot firmware was installed using Mission Planner. Calibration procedures included accelerometer, compass, radio, and ESC calibration. Waypoints were programmed using GPS coordinates, and the camera was mounted for aerial monitoring during autonomous missions.

V. SYSTEM COMPONENTS

1) ReadyToSky 920kv Brushless Motors (2 CW + 2 CCW)

Brushless DC motors are responsible for generating thrust required for drone lift and movement. Two clockwise (CW) and two counterclockwise (CCW) motors are used to maintain flight balance and torque stability. These motors offer high efficiency, longer lifespan, and reduced heat generation compared to brushed motors. They enable smooth and reliable flight performance.

2) 30A Electronic Speed Controllers (ESC) ×4 –

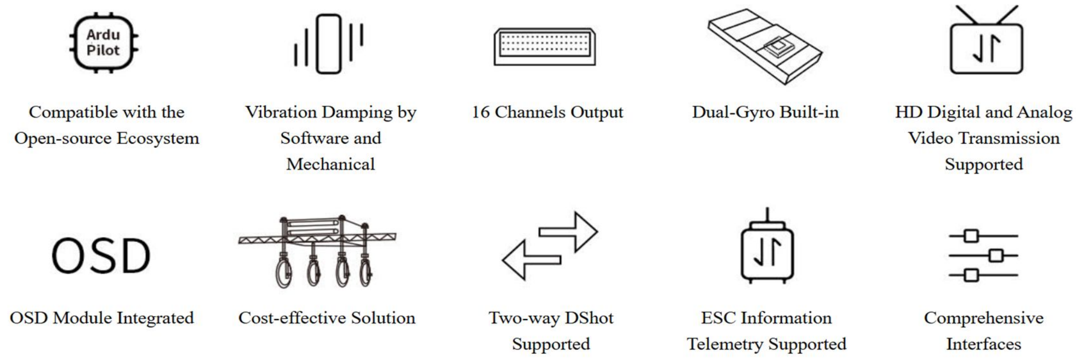
Electronic Speed Controllers regulate the speed of each brushless motor based on signals received from the flight controller. The 30A ESC converts battery power into controlled electrical signals for motor operation. ESC calibration ensures synchronized motor response and stable flight control. Proper ESC functioning is essential for accurate maneuvering and throttle response.

3) 1045 Propellers

The 1045 propellers convert motor rotation into upward thrust required for lift-off. Two clockwise and two counterclockwise propellers balance rotational forces and prevent spinning of the drone body. Proper propeller selection improves flight efficiency and stability. The aerodynamic design helps achieve smoother and controlled flight.

4) Radiolink PIX6 Flight Controller

The Radiolink Pix6 flight controller acts as the brain of the drone by processing sensor data and controlling flight operations. It receives inputs from GPS, transmitter, and onboard sensors to stabilize and navigate the drone. The controller executes autonomous flight modes such as waypoint navigation and position hold. It ensures safe and precise drone operation.



5) Radiolink TS100 GPS Module

The Radiolink TS100 GPS module provides real-time positioning information including latitude, longitude, altitude, and speed of the drone. It enables autonomous navigation features such as waypoint flight, position hold, and return-to-home functionality. The GPS module communicates with the flight controller to maintain accurate location tracking during flight operations. Its high positioning accuracy improves navigation stability and ensures reliable autonomous mission execution

6) Skydroid T10 Transmitter

The Skydroid T10 transmitter allows the user to control and configure the drone wirelessly. It is used for manual flight control, mission planning, and emergency override operations. The transmitter communicates with the flight controller through a radio link. It ensures reliable long-range communication between the pilot and drone.

7) 3S 5200mAh LiPo Battery

The 3S 5200mAh Lithium Polymer battery supplies power to all drone components. It provides high energy density and lightweight characteristics suitable for aerial applications. The battery supports longer flight duration and stable voltage output. Proper battery monitoring is required to prevent over-discharge and ensure safe operation.

8) Onboard Camera – Captures aerial images and videos.

The onboard camera is used for aerial imaging, surveillance, and real-time monitoring applications. It enables data collection and visual observation during autonomous missions. The camera enhances the drone's usability in inspection, mapping, and security applications. It can also support future computer vision and AI-based operations.

9) Connecting wires

-


VI. FLOW CHART

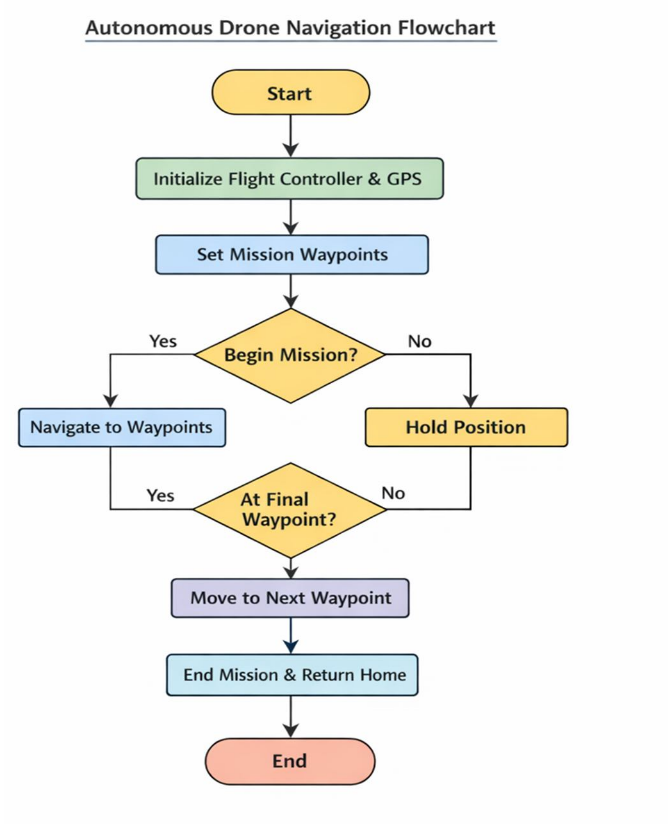
The flowchart represents the operational sequence of the autonomous navigation drone during mission execution. The process begins with system initialization, where the flight controller and GPS module are powered on and calibrated to ensure proper communication and accurate positioning.

After initialization, mission waypoints are configured using the ground control system or transmitter. These waypoints define the predefined path that the drone must follow during autonomous flight. Once the mission parameters are set, the system checks whether the mission command is initiated by the user.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

If the mission begins, the drone autonomously navigates toward the programmed waypoints using GPS-based positioning and onboard stabilization algorithms. If the mission is not started, the drone remains in position-hold mode, maintaining a stable hover while waiting for further instructions.

During flight, the system continuously checks whether the drone has reached the final waypoint. If not, it proceeds to the next waypoint automatically. After completing all waypoints, the drone executes the end mission command and performs a Return-to-Home operation for safe landing. The process then terminates, marking the completion of the autonomous mission.



VII. RESULTS AND DISCUSSION

The developed autonomous navigation drone was successfully assembled and tested for stable flight and waypoint-based navigation. The quadcopter demonstrated reliable take-off, hovering, and landing performance under controlled environmental conditions. Integration of the Radiolink Pix6 flight controller with the TS100 GPS module enabled accurate position holding and autonomous navigation functionality.

During testing, the drone followed predefined waypoints effectively with minimal deviation, confirming proper GPS communication and flight controller calibration. The brushless motors and ESCs provided smooth thrust control, ensuring balanced flight stability. The onboard camera system successfully captured aerial visuals, demonstrating the drone’s capability for monitoring and surveillance applications. Overall, the system achieved stable performance suitable for practical autonomous operations.

VIII. FUTURE SCOPE

The proposed autonomous drone system can be further enhanced by incorporating advanced technologies to improve performance and intelligence. Obstacle avoidance sensors such as ultrasonic or LiDAR modules can be added to increase flight safety. Integration of computer vision algorithms can enable object detection, tracking, and automated decision-making.

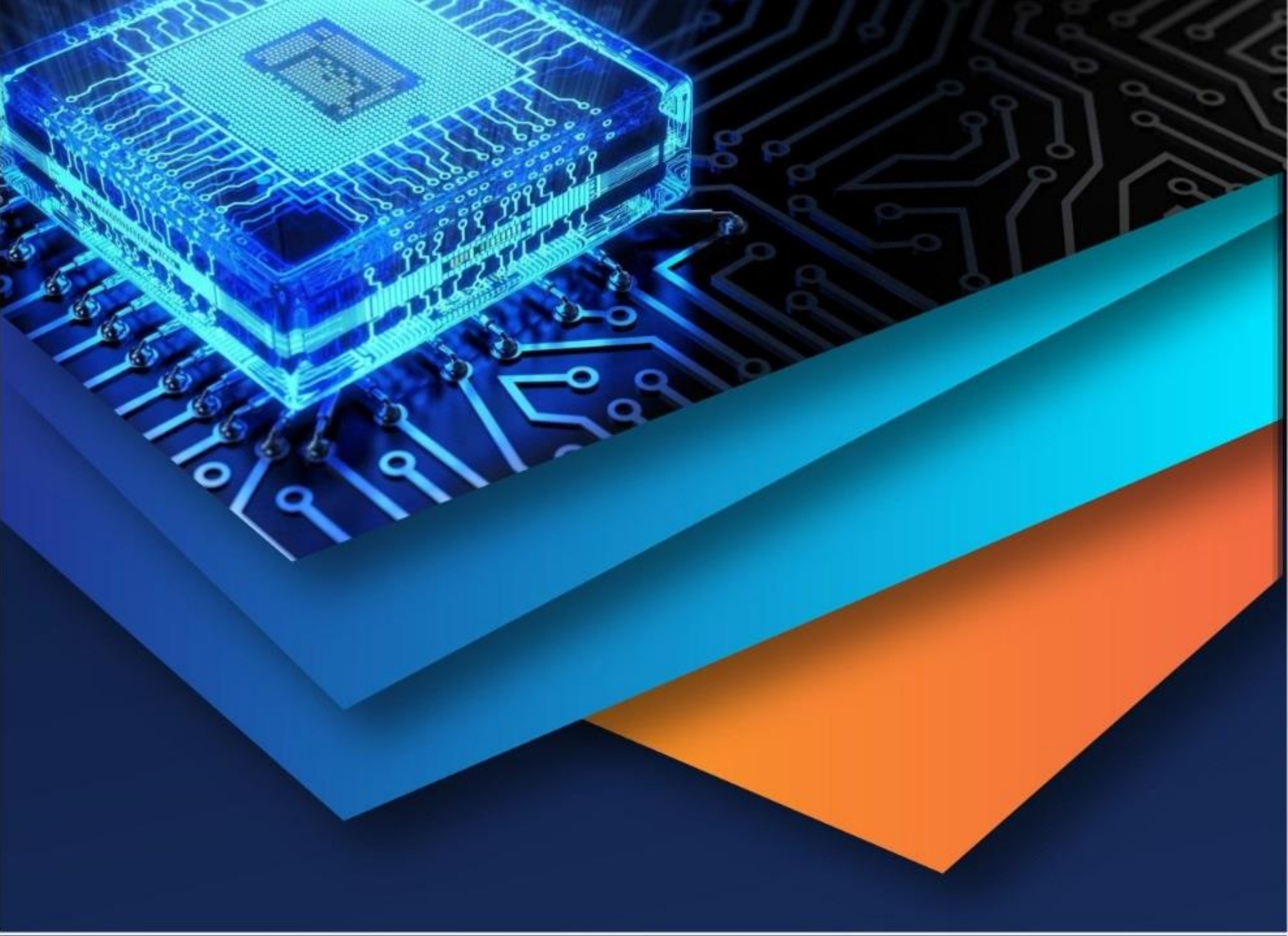
Artificial Intelligence (AI) and machine learning techniques may be implemented for smart navigation and adaptive flight control. Improvements in battery technology can increase flight duration and operational range. Additionally, real-time data transmission and cloud connectivity can allow remote monitoring and data analysis for large-scale applications such as smart agriculture and disaster management.

IX. CONCLUSION

This research presented the design and development of a cost-effective autonomous navigation drone using commercially available components. The system successfully integrates an F450 quadcopter frame, Radiolink Pix6 flight controller, GPS module, brushless motors, ESCs, and a camera module to achieve stable and automated flight operations. The drone demonstrated reliable flight stability, accurate waypoint navigation, and effective aerial monitoring capability. The project validates that autonomous UAV systems can be developed using affordable hardware while maintaining functional reliability. The developed platform provides a strong foundation for future research involving intelligent navigation, computer vision, and advanced automation technologies.

REFERENCES

[1] Austin, R., Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley Publications, 2010.
[2] Beard, R. W., & McLain, T. W., Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012.
[3] Bouabdallah, S., Murrieri, P., & Siegwart, R., “Design and Control of an Indoor Micro Quadrotor,” IEEE International Conference on Robotics and Automation, 2004.
[4] PX4 Autopilot Documentation, Available: https://px4.io
[5] Radiolink Official Documentation and User Manuals, Available: https://www.radiolink.com
[6] UAV Coach, “Drone Flight Controller Basics and Autonomous Navigation,” Online Technical Resource.



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY