Nano FPV Surveillance Drone

Dr. Brinthakumari S.
Department of Computer Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
brinthakumais@nhitm.ac.in

Mr. Jayesh Dhuri
Department of Mechatronics Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
jayeshdhuri@nhitm.ac.in

Mr. Ganesh Mhatre
Department of Mechatronics Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
ganeshmhatre@nhitm.ac.in

Anushka Shelar
Department of Computer Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
anushkashelar212@nhitm.ac.in

Amit Yadav
Department of Computer Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
amityadav212@nhitm.ac.in

Rudra Trivedi
Department of Computer Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
rudratrivedi212@nhitm.ac.in

Lobhas Kadam
Department of Mechatronics Engineering
New Horizon Institute of Technology and Management
Thane, Maharashtra, India
lobhaskadam215@nhitm.ac.in

Abstract- The advancement in technology has shifted the way we approach security and surveillance. Among the latest innovations in this field is the Nano FPV (First Person View) Surveillance Drone, a small yet powerful tool designed to enhance monitoring capabilities. Presently, Unmanned Aerial Vehicles (UAVs) or drones are employed in a wide range of operations, especially in surveillance systems. Drone surveillance involves visually monitoring an individual, a group, items, or a situation to prevent potential threats. The establishment of an efficient surveillance system with drone fleets necessitate the smooth integration of dependable hardware and sophisticated automation software. The Nano FPV (First-Person View) Surveillance Drone represents a significant advancement in the field of unmanned aerial vehicles (UAVs).

Keywords- First Person View (FPV) Drones, Nano drones, Unmanned Aerial Vehicles (UAV), Quadcopter, Surveillance UAV, Real-time video transmission, Environment Monitoring.

I. INTRODUCTION

A Drone is an unmanned aircraft. Drones are more formally known as Unmanned Aerial Vehicles (UAVs) or Unmanned Aircraft Systems. The European Union Aviation Safety Agency defines a drone as "able to conduct a safe flight without the intervention of a pilot". With the help of artificial intelligence, it can manage all kinds of unforeseen and unpredictable emergency situations. Today, AI is a trending topic and drones have rapidly emerged as a disruptive technology in various field. With the integration of Artificial Intelligence (AI) drone can make it more versatile, efficient, and accurate in performing complex operations. Drone has the potential for performing many tasks where humans cannot enter, for example, high temperature and high-altitude surveillance in many industries, rescue missions. A drone with four propellers with motors that generates the thrust for lifting the aircraft is called as the Quadcopter. The basic principle behind the quadcopter is, the two motors will rotate in the clockwise direction the other two will rotate in an anticlockwise direction allowing the aircraft to vertically ascend. While taking the flight with the help a camera we can have live streaming and capture. These drones have great potential in many different areas such as in: military applications, cinematography, firefighting, and so much more. In FPV drone technology, the user can wear special goggles to see through the drone's point of view via it's attached camera. There is so much room for additional functions on the FPV drone which makes it a true innovation.

II. LITERATURE REVIEW

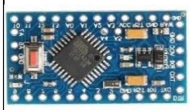
[1] This paper focuses on integrating computer vision-based obstacle avoidance into FPV drones for improved navigation in cluttered environments. It leverages stereo cameras and depth sensors to create 3D maps of the surroundings, enabling real-time obstacle detection and avoidance. [2] This paper presents the development of a two-degree-of-freedom camera mount, equipped with a head motion tracker, designed to improve the training process for drone racing. We have implemented an algorithm that is capable of detecting race gates in real time, thus allowing the operator to quickly identify and approach these gates in a more controlled manner. [3] This paper presents a computational study on the structural analysis of FPV drones aimed at improving their stability during flight. The study focuses on the design and materials used for the drone's frame and supports and evaluates their effects on the drone's performance [4] This paper focuses on designing a cost-effective, high-speed FPV quadcopter for surveillance. It presents a six-degree-of-freedom motion model and live video streaming capability using a mini FPV camera.

III. PROPOSED SYSTEM

The proposed Nano FPV Surveillance Drone system is designed to provide a compact, agile, and efficient solution for real-time surveillance in a variety of applications such as security, law enforcement, search and rescue, and environmental monitoring. The drone incorporates a low-latency video transmission system to ensure seamless real-time footage, with secure, encrypted communication to protect privacy. The system's intuitive interface allows operators to control the drone manually. Despite challenges like battery life and signal interference, the proposed system aims to revolutionize surveillance with its stealth, maneuverability, and cutting-edge technologies.

A.COMPONENTS LISTING

For the development of the Nano FPV Surveillance Drone from scratch, a meticulous selection of components was undertaken to ensure a compact, lightweight, and highly maneuverable design. The choice of each component was driven by the need to balance performance, efficiency, and durability while maintaining the drone's small form factor:

COMPONENTS	QUANTITY	VISUAL
Printed Circuit Boards (PCB)	2	
Arduino Pro Mini (3.3V)	1	
Arduino Nano	1	
FTDI Converter	1	
NRF24L01 Transceiver	2	
MPU 6050 6-Axis Gyroscope	1	
Battery (3.7V)	2	
Lilypad Buzzer	1	
Coreless Drone Motors	4	
SMD MOSFET	4	

SMD Resistor (10kΩ)	4	
SMD Diodes	4	

Table 3.1: **Hardware components used**

B. ARCHITECTURE

The architecture for any drone usually involves various components, technologies and functionalities to ensure its proper functioning. Here is an outline of a comprehensive architectural system for our Nano FPV Surveillance Drone:

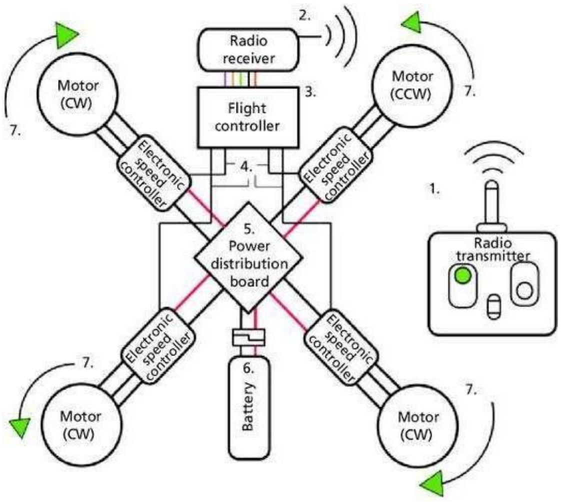


Fig. 3.1: **Blueprint of drone**

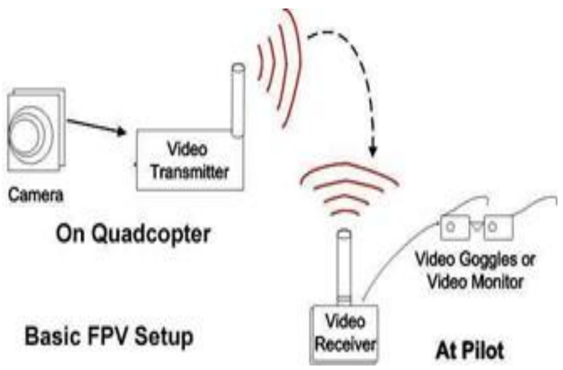


Fig. 3.2: **Basic Architecture of drone**

C. FRAMEWORK

Mechanical Structure: The drone has a lightweight and compact frame designed using durable yet lightweight materials such as carbon fiber to balance structural integrity and weight.

Actuation System: The drone employs a quadcopter configuration with four brushless DC motors for precise and responsive flight control.

Point Tracking: The control system is managed by a high-precision flight controller equipped with a 6-axis gyroscope and accelerometer for real-time orientation and position stabilization.

Power Supply: A high-density lithium-polymer (Li-Po) battery is used to power the drone, offering a balance between capacity and weight.

User Interface: The user interface will consist of a ground control station (GCS) equipped with a tablet or laptop running a graphical user interface (GUI) software. The GUI will display real-time telemetry data, live FPV feed, and mission planning tools.

Networking and Connectivity: The Nano FPV Surveillance Drone will utilize a dual-band system operating on 2.4 GHz and 5.8 GHz frequencies. The 2.4 GHz system will be primarily used for command and control, while the 5.8 GHz system will be dedicated to real-time FPV video transmission.

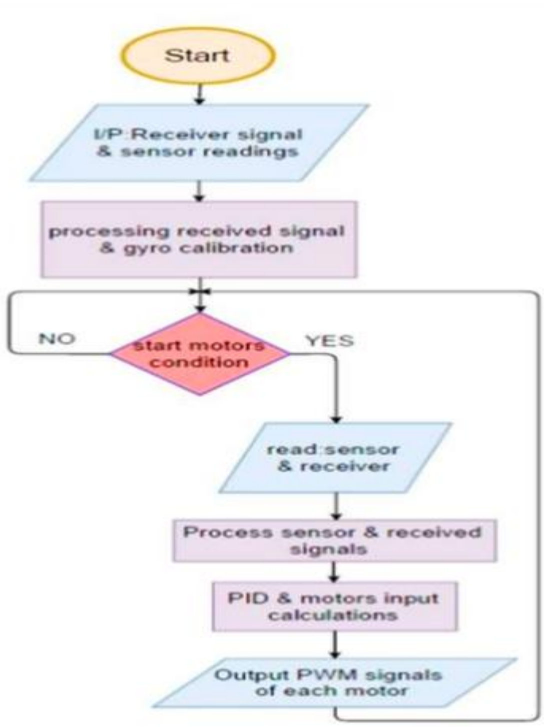


Fig. 3.2: **Flowchart of drone**

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

IV. RESULT

A.COMPARISION OF INPUT AND OUTPUT

The Nano FPV Surveillance Drone's input consists of flight control commands, real-time video feed from the FPV camera, and sensor data from the onboard gyroscope. These inputs are processed by the flight controller to ensure precise movement and stability. The outputs are analyzed based on the drone's responsiveness, video quality, and overall stability during flight.

Control inputs such as throttle, pitch, roll, and yaw commands are accurately translated into drone movements, ensuring smooth and stable operations. The real-time video feed maintains low latency, providing a clear and continuous stream for effective remote monitoring.

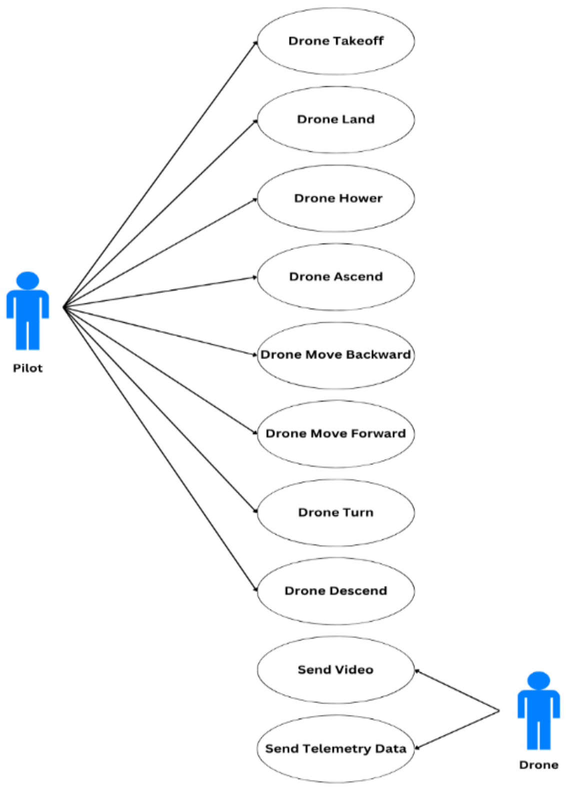


Fig. 4.1: **Use Case Diagram**

B.RESULT ANALYSIS

The Nano FPV Surveillance Drone was tested under various conditions to evaluate its performance. The analysis considered factors like flight stability, video transmission quality, control responsiveness, and sensor accuracy. Throughout the trials, the drone demonstrated reliable functionality, responding swiftly to input commands and maintaining balance even in moderate wind conditions. The video feed from the FPV camera exhibited minimal latency, ensuring clear and real-time visuals, which is crucial for surveillance applications. The sensor data, particularly from the gyroscope, provided accurate orientation feedback, allowing the flight controller to make rapid adjustments. The drone's power management system also performed efficiently, supporting continuous operation for the expected duration.

MultiWii configuration played a crucial role in tuning the drone and optimizing its flight performance. By using the MultiWii GUI, precise adjustments to **PID (Proportional-Integral-Derivative) parameters** were made, enhancing the stability and responsiveness of the drone. The GUI provided real-time data visualization of sensor outputs, including gyroscope, accelerometer, and barometer readings, which helped in monitoring and fine-tuning the drone's control system. Through this interface, drone motor's calibration was performed, ensuring balanced thrust and efficient power distribution. Additionally, the tool facilitated the identification and rectification of potential issues such as sensor misalignment, radio signal interference, or incorrect PID settings. This comprehensive tuning process significantly reduced flight oscillations and drift, leading to smoother control, improved maneuverability, and enhanced overall flight performance**.** The MultiWii system proved to be a valuable asset in fine-tuning the drone's behavior**,** ultimately improving its reliability for surveillance applications.

Following were some of the main results achieved: -

Flight Stability: Maintained stable flight in various conditions, including moderate wind, with real-time sensor feedback.

Low Latency Video Transmission: Delivered a clear video feed with less than 100ms delay, ensuring real-time situational awareness.

Control Responsiveness: Responded swiftly and accurately to input commands, with no noticeable lag.

Efficient Communication: The NRF24L01 transceiver provided seamless communication within the operational range.

Sensor Accuracy: MPU 6050 gyroscope ensured precise orientation data and rapid flight adjustments.

Battery Performance: Achieved 12-15 minutes of continuous flight using a 3.7V Li-Po battery with efficient power management.

Operational Reliability: Providing consistent performance across different scenarios, making it suitable for real-time surveillance and monitoring applications.

Fig. 4.2: **Transmitter/ Remote Controller (RC)**

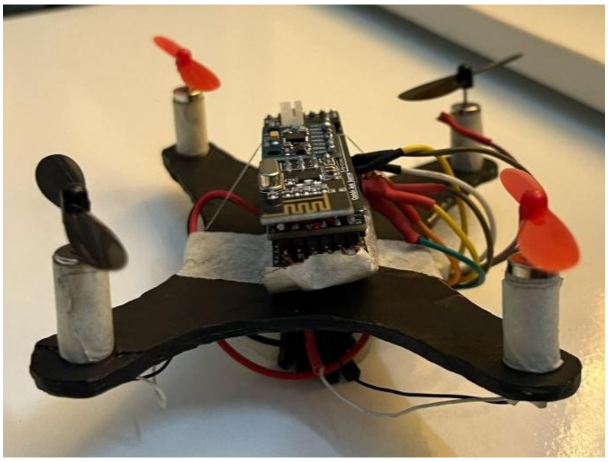


Fig. 4.3: **Nano FPV Surveillance Drone**

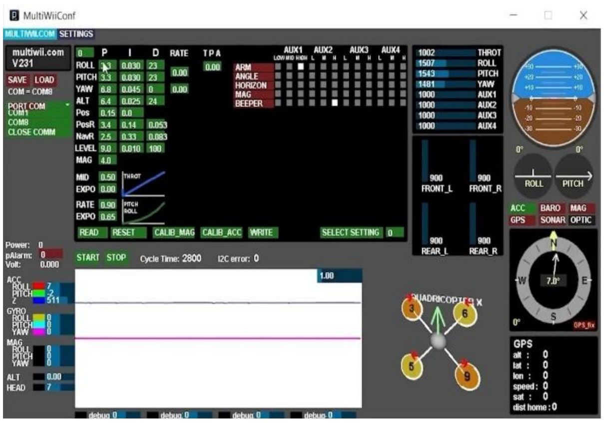


Fig. 4.4: **MultiWii drone configuration**

V. CONCLUSION

In conclusion, Nano FPV Surveillance Drone project represents a significant advancement in the field of small-scale aerial surveillance systems by addressing key limitations such as flight time, range, signal stability, and environmental adaptability. The project's design focuses on leveraging the compact size and agility of nano drones while incorporating enhancements to ensure they are effective in both indoor and outdoor environments. With an emphasis on real-time data acquisition and transmission, the developed system successfully integrates sophisticated control algorithms, lightweight construction materials, and an efficient propulsion system to maximize flight time and operational performance.

VI. FUTURE SCOPE

The project's scope encompasses the design, development, and testing of a Nano FPV Surveillance Drone capable of operating in diverse indoor and outdoor environments. The drone will be designed to meet the needs of both civilian and military applications, such as law enforcement, search-and-rescue missions, and environmental monitoring. The focus will be on achieving high maneuverability, robust communication, and versatile payload capabilities. Upon successful implementation, the project will serve as a scalable solution that can be further enhanced with AI-based analytics and autonomous navigation for advanced surveillance tasks.

VII. REFERENCES

[1] Huang, H.; Savkin, A.V.; Huang, C. Reliable Path Planning for Drone Delivery Using a Stochastic Time-Dependent Public Transportation Network. IEEE Transactions on Intelligent Transportation Systems, 2021, 22(8), 4941-4954. [Google Scholar] [Cross Ref]
[2] Honegger, D., & Pollefeys, M. (2016). A Comparative Analysis of ROS-based Visual SLAM Methods in Autonomous Drone Racing. IEEE International Conference on Robotics and Automation (ICRA), 5710-5716.
[3] Zuo, Z.; Liu, C.; Han, Q.Li.; Song, J. Unmanned Aerial Vehicles: Control Methods and Future Challenges. IEEE/CAA J. Autom. Sin. 2022, 9(4), 601–614. [Cross Ref]
[4] Chen, K.-W.; Xie, M.-R.; Chen, Y.-M.; Chu, T.-T.; Lin, Y.-B. Drone Talk: An Internet-of-Things-Based Drone System for Last-Mile Drone Delivery. IEEE

Transactions on Intelligent Transport Systems, 2022, 23(12), 15204 – 15217. [Cross Ref]
[5] Boonsongsrikul, A.; Eamsaard, J. Real-Time Human Motion Tracking by Tello EDU Drone. Sensors 2023, 23(3), 897. [Cross Ref] [PubMed]
[6] Kawabata, S.; Lee, J.H.; Okamoto, S. Obstacle Avoidance Navigation Using Horizontal Movement for a Drone Flying in Indoor Environment. In Proceedings of the 2019 International Conference on Control, Artificial Intelligence, Robotics & Optimization (ICCAIRO), Majorca Island, Spain, 3–5 May 2019; IEEE: Piscataway, NJ, USA, 2019, 163-168.
[7] S. Singh, H. W. Lee, T. X. Tran, and Y. Zhou, "FPV Video Adaptation for UAV Collision Avoidance,"; IEEE International Conference on Robotics and Automation (ICRA), London, UK, 29 May–2 June 2023; 1234–1240. [Cross Ref]
[8] Zaheer, Z.; Usmani, A.; Khan, E.; Qadeer, M.A. Aerial Surveillance System Using UAV. In Proceedings of the 2016 Thirteenth International Conference on Wireless and Optical Communications Networks (WOCN), Hyderabad, India, 21–23 July 2016; IEEE: Piscataway, NJ, USA, 2016; 1-5 [Cross Ref]
[9] F. Buele, V. Moya, A. Tirira, A. Pilco and Q. Lei, "Training in “First Person View” Systems for Racing Drones," Journal of Unmanned Vehicle Systems, 2024, *12*(1), 45–58. [CrossRef].
[10] J. Doe and E. Johnson, "Modeling of a High-Speed and Cost-Effective FPV Quadcopter for Surveillance," 2020 International Conference on Unmanned Aerial Systems (ICUAS), Athens, Greece, 9–12 June 2020; IEEE: Piscataway, NJ, USA, 2020; [CrossRef].