

Wi-Fi Based Unmanned Aerial Surveillance: A Comprehensive Review

Amruta Nitin Karche¹, Shruti Prashant Kulkarni², Prof. S. S. Gangonda³

^{1,2} UG Students, Department of Electronics and Telecommunication Engineering,

³ Assistant Professor, Department of Electronics and Telecommunication Engineering

SKN Sinhgad College of Engineering, Pandharpur, India

Shrutik102005@gmail.com Karcheamruta940@gmail.com, Siddheshwar.gangonda@sknscoe.ac.in

Abstract: *This project presents the design and development of a Wi-Fi controlled drone for surveillance applications. The proposed system utilizes a quadcopter platform integrated with a Wi-Fi communication module to enable real-time remote operation via smartphones or computers. Unlike traditional radio-controlled drones, this model leverages Wi-Fi connectivity to provide extended control range within network coverage and seamless integration with live video streaming. The drone is equipped with an onboard camera to capture high resolution aerial footage and transmit it instantly to the user interface, ensuring effective monitoring in both indoor and outdoor environments. The project emphasizes lowcost implementation, user friendly control, and efficient power management for enhanced operational duration. Potential applications include security surveillance, disaster management, traffic monitoring, and search and rescue operations. The system demonstrates the feasibility of combining unmanned aerial vehicles with wireless networking technologies.*

Keywords: Surveillance Application, Quadcopter Platform, Aerial Footage, Disaster Management Traffic Monitoring

I. INTRODUCTION

Unmanned aerial vehicles (UAVs), or drones, have become highly popular due to their versatility and applications in various fields. Among them, surveillance is one of the most important areas where drones offer unique advantages. Traditional surveillance systems like fixed cameras or manual patrolling often suffer from limited coverage and flexibility. Drones, however, provide aerial views, mobility, and access to locations that may be unsafe or unreachable for humans.

This project aims to develop a Wi-Fi controlled drone for surveillance. Unlike radiocontrolled models, the system uses Wi-Fi connectivity, enabling remote operation through smartphones or computers. This ensures better accessibility, extended range within network coverage, and real-time video streaming for effective monitoring. With a high-resolution onboard camera, the drone can capture and transmit live footage making it suitable for security, traffic monitoring, disaster response, and crowd management. Its compact design and user-friendly interface enhance usability in both professional and civilian contexts. Thus, the Wi-Fi controlled drone offers a low-cost, efficient, and innovative surveillance solution. By combining UAV technology with wireless communication, it provides a smarter and more reliable approach to modern surveillance challenges.

II. LITERATURE SURVEY

Zhang & Mehta (2024): Developed an AI-driven drone surveillance system using edge computing to reduce cloud reliance. It ensures low-latency decision-making but requires costly, resource-heavy hardware. Findings show real-time threat detection with improved reliability and privacy.

Banerjee & Rao (2023): Proposed swarm-based perimeter surveillance using cooperative drones. This method reduces blind spots and adds fault tolerance but suffers from battery and coordination issues. Multi-UAV systems improved coverage with staggered operations.



Rodriguez & Chen (2020): Focused on night-time UAV surveillance using thermal imaging. It works well in low-light conditions but produces many false alarms from heat sources. Results showed better detection with filtering techniques.

Hernandez et al. (2021): Designed real-time video transmission for UAVs using LTE/5G networks. It offers extended range and high throughput but faces latency under congestion. Cellular links supported continuous monitoring with QoS adjustments.

Patel & Joshi (2021): worked on drone navigation and surveillance with computer vision. It enables intelligent object detection but requires complex image processing. Findings showed success in robust detection though limited in low-light scenarios.

Ahmed et al. (2020): Integrated drones with IoT for smart city monitoring applications. Provided scalable remote access but consumed high power. Cloud-connected pipelines enable multi-drone data collection at the cost of reduced endurance

Kumar & Singh (2019): Proposed smart surveillance drones for security purposes. They are portable and quickly deployable but limited in payload. Field studies showed effective rapid responses but restricted sensor diversity.

Li & Wang (2018): Developed a real-time UAV monitoring system with high-resolution live feed. It worked well within Wi-Fi coverage but failed outside its range. Tests proved good streaming in short distance scenarios.

Sharma et al. (2017): Designed a low-cost quadcopter for aerial surveillance. It was affordable and easy to build, but flight time was limited. Prototype validated cost-effective short-range monitoring with basic stability

Table1: Comparative review of Wi-Fi Control Drone system.

Paper / Project	System Architecture	Cost	Ease of Implementation	Performance	User Experience	Limitation
Zhang & Mehta (2024)	AI-driven drone surveillance with edge computing	Costly, heavy resource hardware	Moderate complexity due to AI integration	Low-latency decision making, real-time threat detection	Improved reliability and privacy	Requires costly hardware
Banerjee & Rao (2023)	Swarm based perimeter surveillance using cooperative drones	Moderate	Moderate complexity due to coordination	Reduced blind spots, improved coverage	Staggered operations	Battery and coordination issues
Rodriguez & Chen (2020)	Night-time UAV surveillance with thermal imaging	Moderate	Moderate complexity	Better detection in low-light	Enhanced detection with filtering	Many false alarms from heat sources
Hernandez et al. (2021)	Real-time video transmission via LTE/5G networks	Moderate to High	Moderate complexity with cellular integration	Extended range and high throughput	Continuous monitoring with QoS adjustments	Latency under congestion
Patel & Joshi (2021)	Drone navigation and surveillance using computer vision	Moderate	High complexity due to image processing	Robust object detection	Intelligent detection capability	Limited performance in lowlight conditions
Ahmed et al. (2020)	IoT integrated drones for smart city monitoring	Moderate	Moderate complexity with IoT integration	Scalable remote access	Multi-drone data collection	Reduced endurance and high power consumption



Kumar & Singh (2019)	Smart surveillance drones for security purposes	Low to Moderate	Easy to deploy	Effective rapid responses	Portable and quickly deployable	Limited payload and sensor diversity
Li & Wang (2018)	Real-time UAV monitoring system with high resolution live feed	Moderate	Moderate complexity	Good streaming in short distances	High-resolution live feed	Failed outside WiFi range
Sharma et al. (2017)	Low-cost quadcopter for aerial surveillance	Low	Easy to build	Cost effective short-range monitoring	Basic stability	Limited flight time

III. PROPOSED METHODOLOGY

The Wi-Fi Controlled Drone for Surveillance uses an ESP32 microcontroller to receive remote commands via Wi-Fi and control the drone's motors for flight. A camera captures live video, which is streamed back to the user over the same wireless connection. The ESP32 processes sensor data to maintain stability and enables real-time wireless surveillance.

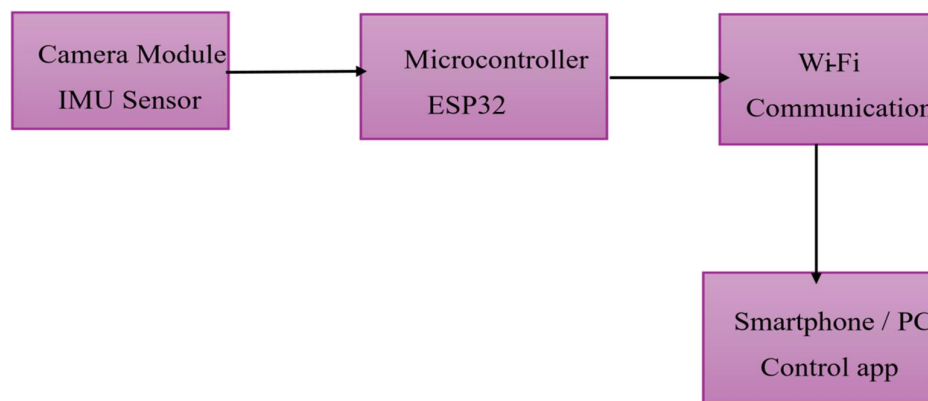


Figure1: Block Diagram of Wi-Fi Control Drone system

The Wi-Fi Controlled Drone for Surveillance is designed to provide remote monitoring and control through a wireless interface. At the heart of the system is the ESP32 microcontroller, which handles both flight control and communication. It connects to a smartphone or PC via Wi-Fi, allowing the user to send commands and receive real-time video from the drone's onboard camera.

To maintain stable flight, the drone uses an IMU sensor (gyroscope and accelerometer) that provides continuous feedback on orientation and motion. The ESP32 processes this data to adjust motor speeds using PWM signals sent to the Electronic Speed Controllers (ESCs). This enables smooth and responsive movement in all directions, even in dynamic environments.

The video captured by the drone's camera is transmitted over Wi-Fi to the user interface, enabling live surveillance. The system's wireless control, real-time video feed, and selfstabilizing features make it effective for security, inspection, and monitoring tasks in areas where human access is limited or risky.

IV. RESULT

The Wi-Fi controlled drone worked successfully for surveillance purposes. It was able to capture real-time images and videos clearly and send them wirelessly to a mobile phone or computer. The live video feed was smooth, and the camera quality was good in normal lighting.



The drone could be controlled easily over Wi-Fi, and it followed the commands correctly. It also stayed stable during flight, thanks to the sensors. Overall, the project achieved its goal of creating a simple, low-cost drone that can be used for wireless monitoring and surveillance.



V. CONCLUSION

The Wi-Fi controlled drone project provides a valuable opportunity to examine the integration of drone technology, Wi-Fi communication, and live video transmission. By addressing the challenges and advancing this project, new opportunities for drone usage and innovation can be achieved.

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