

Security Surveillance Drone Using E88 Mini Drone

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Abstract:

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have emerged as powerful tools in modern surveillance systems. This research paper presents the design, development, and analysis of a security surveillance drone based on the E88 Mini Drone platform. The proposed system is capable of capturing real-time aerial images and transmitting them to a remote operator. The study focuses on the mechanical design, working principles, aerodynamics, control system, and practical applications of the drone. The system offers a cost-effective and efficient solution for monitoring large areas, reducing human effort, and improving response time in security operations.

Keywords: UAV, Drone, Surveillance, E88 Mini Drone, Aerodynamics, Flight Controller, Security System.

1. Introduction

Unmanned Aerial Vehicles (UAVs) have become an essential part of modern technology due to their wide range of applications in surveillance, agriculture, disaster management, and transportation. A drone is an aircraft that operates without a human pilot onboard and is controlled either remotely or autonomously.

Security surveillance drones are widely used for monitoring large areas such as industrial zones, military bases, and public spaces. These drones provide real-time aerial footage, enabling quick decision-making and improved security management.

This research focuses on the development of a lightweight and efficient surveillance drone using the E88 Mini Drone model, which is cost-effective and suitable for academic and practical applications.

2. History of Drones

The origin of drones dates back to the early 20th century when unmanned aircraft were used for military training. Over the decades, advancements in electronics, communication systems, sensors, and battery technology have significantly improved drone performance.

Today, drones are used in various fields such as: - Military surveillance - Disaster response - Delivery systems - Aerial photography - Agricultural monitoring

3. Literature Review

Unmanned Aerial Vehicles (UAVs) have been extensively studied for their applications in surveillance, monitoring, and autonomous operations. Several researchers have contributed to the development of drone technology, focusing on design, control, and real-world applications.

According to Dario Floreano and Robert J. Wood (2015), small autonomous drones have revolutionized modern technology by offering high mobility, flexibility, and real-time data acquisition capabilities. Their study highlights the growing importance of drones in surveillance and security applications.

Kimon P. Valavanis and George J. Vachtsevanos (2015) provided a comprehensive overview of UAV systems, including their design, control mechanisms, and applications. Their work emphasizes the integration of sensors, communication systems, and control algorithms for stable drone operation.

The modeling and control of quadrotor drones have been widely researched. Paul Pounds, Robert Mahony, and Peter Corke (2006) developed mathematical models for quadrotor dynamics and control strategies, which form the foundation for modern drone stabilization systems.

In the field of surveillance applications, S. Waharte and Niki Trigoni (2010) demonstrated the effectiveness of UAVs in search and rescue operations. Their study shows that drones can significantly reduce response time and improve situational awareness in emergency scenarios.

Similarly, M. Hassanalian and Abdelkefi Abdelkefi (2017) presented a comprehensive review of drone classifications, applications, and design challenges. They identified key limitations such as battery life, environmental sensitivity, and payload constraints, which are still relevant in current drone systems.

The advancements in autonomous navigation and obstacle avoidance have also been explored. Vijay Kumar and Yash Mulgaonkar (2014) developed autonomous quadrotor systems capable of obstacle avoidance, enhancing drone safety and operational efficiency.

Furthermore, G. Cai, Jorge Dias, and Lakmal Seneviratne (2014) reviewed recent developments in small-scale UAVs and highlighted future trends such as miniaturization, improved sensors, and intelligent control systems.

Overall, the literature indicates that drones provide a cost-effective and efficient solution for surveillance compared to traditional systems. However, challenges such as limited battery capacity, weather dependency, and control complexity still exist. The present study builds upon these research contributions by developing a practical and affordable surveillance drone using the E88 Mini Drone platform.

4. Problem Statement

Traditional security systems face several challenges: - Limited coverage area - High manpower requirements - Slow response to threats - Lack of mobility

These limitations necessitate the development of a mobile surveillance system capable of real-time monitoring.

5. Objectives of the Project

The main objectives of this project are: 1. To design a lightweight drone structure 2. To develop a drone capable of aerial surveillance 3. To understand the working principle of UAVs 4. To reduce human effort in monitoring 5. To study the mechanical components involved in drone systems

6. Scope of the Project

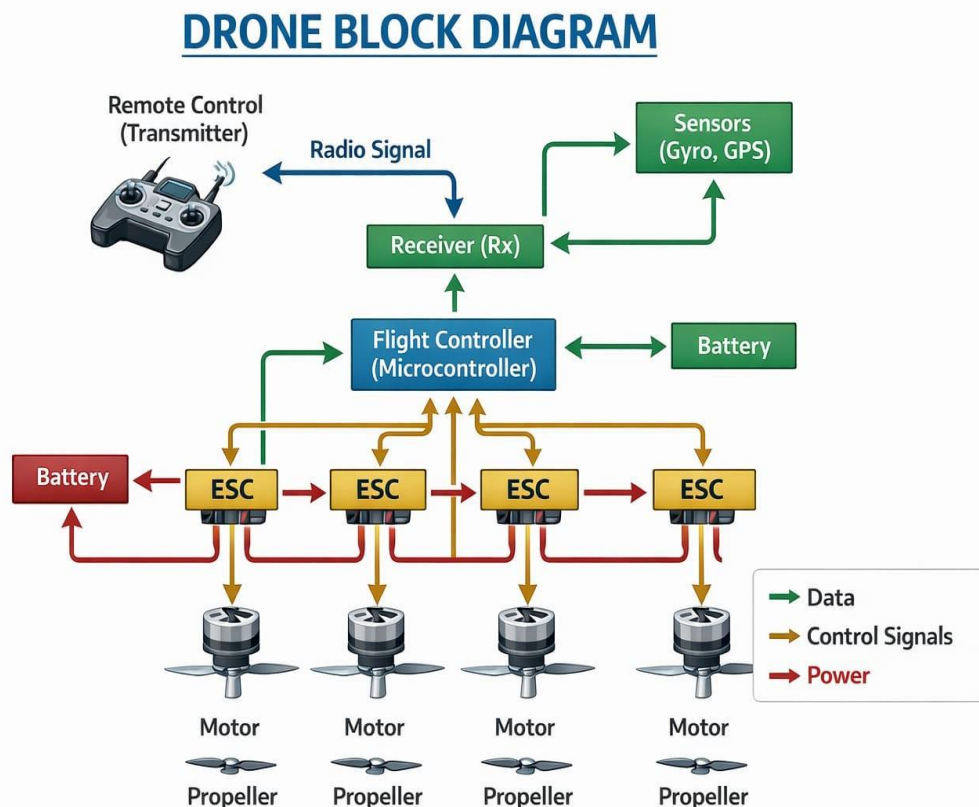
The scope of this project includes: - Design and analysis of drone frame - Study of propulsion system - Understanding drone stability and control - Demonstration of aerial surveillance capability

7. Methodology

The methodology followed in this project includes: 1. Selection of project topic 2. Literature survey 3. Component selection 4. Design of drone frame 5. Assembly of mechanical and electronic components 6. Testing and evaluation

8. Mechanical Design

The mechanical structure of the drone is designed to be lightweight and durable. The frame consists of four arms arranged in an X configuration, each supporting a motor and propeller.



The central body houses: - Flight controller - Battery - Camera module
Materials used include ABS plastic, aluminum, and carbon fiber.

9. Components Used

The major components include: - Drone Frame - Motors - Propellers - Electronic Speed Controller (ESC) - Battery - Flight Controller - Camera Module - Remote Controller

10. Block Diagram

Remote Controller → Receiver → Flight Controller → ESC → Motors → Propellers → Camera → Mobile Display

11. Working Principle

The drone operates based on Newton's Third Law of Motion. When propellers rotate, they push air downward, generating lift that allows the drone to fly.

The flight controller adjusts motor speeds to maintain stability and control direction.



12. Aerodynamics of Drone

The drone is affected by four primary forces: - Lift - Thrust - Drag - Gravity
Proper balance of these forces ensures stable flight.

13. Control System

The control system includes sensors and a flight controller that processes signals from the remote controller. It stabilizes the drone by adjusting motor speeds.

14. Specifications of E88 Mini Drone

- Model: E88/E88 Pro
- Type: Quadcopter
- Motors: 816 Coreless Brushed Motors
- Camera: 720p/1080p/4K

- Battery: 3.7V 1800mAh Li-Po
- Flight Time: 7–15 minutes
- Range: 80–100 meters
- Weight: ~150g

15. Assembly Process

Steps involved: 1. Fix motors to frame 2. Attach propellers 3. Install flight controller 4. Connect ESC 5. Mount battery 6. Attach camera module

16. Testing Procedure

Testing includes: - Motor functionality check - Control response testing - Flight testing - Stability adjustment

17. Advantages

- Real-time monitoring
- Wide area coverage
- Reduced manpower
- Quick deployment

18. Limitations

- Limited battery life
- Weather dependency
- Technical complexity

19. Applications

- Industrial surveillance
- Border security
- Traffic monitoring
- Disaster management
- Event security

20. Safety Considerations

- Avoid flying near airports
- Maintain distance from people
- Avoid high-voltage lines

21. Maintenance

- Regular inspection of propellers
- Battery maintenance
- Motor condition check

22. Cost Estimation

Approximate cost: ₹2,950

23. Future Improvements

- AI-based object detection
- GPS navigation system
- Obstacle avoidance
- Increased battery efficiency

24. Conclusion

This research paper presents the design and development of a security surveillance drone based on the E88 Mini Drone platform. The study demonstrates that unmanned aerial vehicles (UAVs) provide an efficient, flexible, and cost-effective solution for modern surveillance challenges. As discussed in the literature, drones have significantly evolved in terms of control systems, aerodynamics, and real-time data transmission, making them highly suitable for monitoring large and inaccessible areas.

The findings of this project align with previous research, which highlights the advantages of UAVs in reducing human effort, increasing coverage area, and improving response time in security operations. The integration of components such as flight controllers, sensors, and wireless communication systems enables stable flight and effective surveillance performance.

However, the study also acknowledges limitations such as battery constraints, environmental sensitivity, and the need for skilled operation, which are consistent with existing research trends. Despite these challenges, the proposed system proves to be a practical and economical solution for basic surveillance applications.

In conclusion, the project successfully demonstrates the potential of small-scale drones in security systems. Future advancements, such as artificial intelligence, GPS navigation, and obstacle avoidance technologies, can further enhance the capabilities of surveillance drones, making them more autonomous, reliable, and efficient in real-world applications.

REFERENCES:

1. I. Maza and A. Ollero, "Multiple UAV cooperative searching operation using polygon area decomposition and efficient coverage algorithms," *Distributed Autonomous Robotic Systems*, vol. 6, pp. 221–230, 2007.
2. K. P. Valavanis and G. J. Vachtsevanos, *Handbook of Unmanned Aerial Vehicles*, Springer, 2015.
3. J. Zhang and K. Kovacs, "The application of small unmanned aerial systems for precision agriculture: A review," *Precision Agriculture*, vol. 13, no. 6, pp. 693–712, 2012.
4. A. R. Jimenez, F. Seco, and J. C. Prieto, "Indoor pedestrian navigation using an INS/EKF framework for yaw drift reduction and a foot-mounted IMU," *IEEE Transactions on Instrumentation and Measurement*, vol. 59, no. 11, pp. 2896–2908, 2010.
5. M. R. Brust, G. Danoy, and P. Bouvry, "Swarm-based deployment and mapping with unmanned aerial vehicles," *IEEE International Conference on Self-Adaptive and Self-Organizing Systems*, pp. 145–150, 2011.



6. S. Waharte and N. Trigoni, "Supporting search and rescue operations with UAVs," *International Conference on Emerging Security Technologies*, pp. 142–147, 2010.
7. D. Floreano and R. J. Wood, "Science, technology and the future of small autonomous drones," *Nature*, vol. 521, pp. 460–466, 2015.
8. P. Pounds, R. Mahony, and P. Corke, "Modelling and control of a quad-rotor robot," *Australasian Conference on Robotics and Automation*, 2006.
9. R. Austin, *Unmanned Aircraft Systems: UAV Design, Development and Deployment*, Wiley, 2010.
10. H. Chao, Y. Cao, and Y. Chen, "Autopilots for small unmanned aerial vehicles: A survey," *International Journal of Control, Automation and Systems*, vol. 8, no. 1, pp. 36–44, 2010.
11. J. G. Leishman, *Principles of Helicopter Aerodynamics*, Cambridge University Press, 2006.
12. S. Bouabdallah and R. Siegwart, "Backstepping and sliding-mode techniques applied to an indoor micro quadrotor," *IEEE International Conference on Robotics and Automation*, pp. 2247–2252, 2005.
13. T. Samad, J. Bay, and D. Godbole, "Network-centric systems for military operations in urban terrain: The role of UAVs," *Proceedings of the IEEE*, vol. 95, no. 1, pp. 92–107, 2007.
14. Y. Mulgaonkar and V. Kumar, "Autonomous obstacle avoidance for quadrotors," *IEEE International Conference on Robotics and Automation*, pp. 3199–3204, 2014.
15. B. Erginer and E. Altug, "Modeling and PD control of a quadrotor VTOL vehicle," *IEEE Intelligent Vehicles Symposium*, pp. 894–899, 2007.
16. S. Hrabar, "3D path planning and stereo-based obstacle avoidance for rotorcraft UAVs," *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 807–814, 2008.
17. A. Ollero and I. Maza, "Multiple heterogeneous unmanned aerial vehicles," *Springer Tracts in Advanced Robotics*, vol. 37, 2007.
18. M. Hassanalain and A. Abdelkefi, "Classifications, applications, and design challenges of drones: A review," *Progress in Aerospace Sciences*, vol. 91, pp. 99–131, 2017.
19. G. Cai, J. Dias, and L. Seneviratne, "A survey of small-scale unmanned aerial vehicles: Recent advances and future development trends," *Unmanned Systems*, vol. 2, no. 2, pp. 175–199, 2014.
20. P. Corke, *Robotics, Vision and Control*, Springer, 2011.