

Executive Summary

This project demonstrates an Indoor Autonomous Security Drone capable of remote monitoring, obstacle detection, and real-time surveillance. The drone uses an onboard Raspberry Pi running ArduPilot, paired with a Cube Orange Plus flight controller, to achieve reliable and stable flight.

The drone autonomously navigates indoor environments while capturing and storing images via an onboard camera. A separate distance sensor enables obstacle detection. All data feeds into a web-based interface that supports live streaming and remote operation.

This system offers a cost-effective, scalable approach to indoor security with fully remote deployment capability.

Background

The approach to indoor security today in spaces such as offices, warehouses, and even facilities, are handled through the use of manual patrols and static cameras.

- Human patrols consume time and are not consistent
- Fixed cameras have a limited field of view

These limitations allow for there to be an increased risk in security. Through recent advancements that have been made in UAV technologies, autonomous navigation, and embedded systems have enabled the for dynamic monitoring through the use of mobile surveillance platforms.

With this project the need for intelligent obstacle avoidance, autonomous indoor surveillance, and real time monitoring and data storage will be addressed.

Through the leveraging of flight control systems, and embedded computing this drone provide intelligent and flexible alternative to traditional security systems.

Experimental Setup

Hardware components:

- Raspberry Pi:
 - Handles web communication
 - Operates Ardupilot software
- Cube Orange Plus:
 - Handles control algorithms and flight stabilization
 - Interfaces with Actuators and sensors
- Camera:
 - Handles capturing images for surveillance
 - Provides distance estimation and object and person detection
- Motors & ESCs:
 - Provides maneuverability and propulsion for flight
 - Controls the speed, direction and the power provided from the battery to the motors
- Altitude Sensor:
 - Measures the height of the drone to maintain stable flight height

Software Components:

- Python Scripts for:
 - communication and drone operation
- Web Server for:
 - image processing, command execution, and remote access

Experimental Test Plan

1. Flight Stability Test
 - Objective: To maintain a stable hover and controlled movement
 - Method: Operations will be done through scripts, and stability will be determined by Ardupilot and Cube Orange Plus
2. Obstacle Detection Test
 - Objective: Verify camera-based Object and distance detection
 - Method: Place objects in various locations to verify detection and distance
3. Image Capture and Storage Test
 - Objective: Verify that images are being captured and stored correctly
 - Method: Verify image upload and storage through web interface
4. Web Interface Control Test
 - Objective: Test remote connectivity and flight operation
 - Method: Run commands through web interface and observe the operation on the drone.

Experimental Results

1. Flight Stability
 - Able to achieve stable hovering using controlled movements with minimal flight disturbance
2. Obstacle Detection
 - Successful identification of obstacles
 - Accurate detection of obstacle range with an error of around ~0.5 meters
3. Altitude Control
 - Successful height maintenance along with minimal deviations from determined height
4. Data Storage
 - Images are successfully captured and stored onto the web server
5. Remote Operation
 - Able to successfully run python scripts from web server, controlling the drone
 - Able to successfully monitor live stream to the website and see the object detection of the camera mounted onto the drone

Conclusions

This Indoor Autonomous Security Drone successfully demonstrated the viability of a low-cost, autonomous approach to indoor security. The Cube Orange Plus provided reliable and stable flight control, while the Raspberry Pi served as the central hub for communication and drone operation. Obstacle detection and identification performed accurately, and altitude control remained consistent throughout testing.

The web interface proved fully functional, enabling users to launch drone operation scripts, live stream camera footage, and store captured images — all remotely. Together, these components form a cohesive system that offers a more reliable and efficient alternative to traditional indoor security methods, with minimal errors and strong potential for further development and scaling.

References

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