Autonomous Drone Shadowing with AI

Advancements in Drone Management

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The Growing Need for Drone Traffic Management

Drones in Use

10M+

Drones are being used across various industries like delivery, agriculture, surveillance, and entertainment.

Annual Growth

75%

The drone industry is experiencing an exponential growth rate annually.

Countries Adopting

50+

More than 50 countries have integrated drones into their airspace, increasing the need for efficient management.

Autonomous Drone Shadowing

Motivation

- To ensure safe drone traffic management, our approach begins with enabling drones to recognize and avoid each other autonomously.

- These steps demonstrate how drones can detect, pursue, and shadow targets as an initial framework for autonomous traffic management.

Step 1

Drone detects target using onboard sensors and cameras.

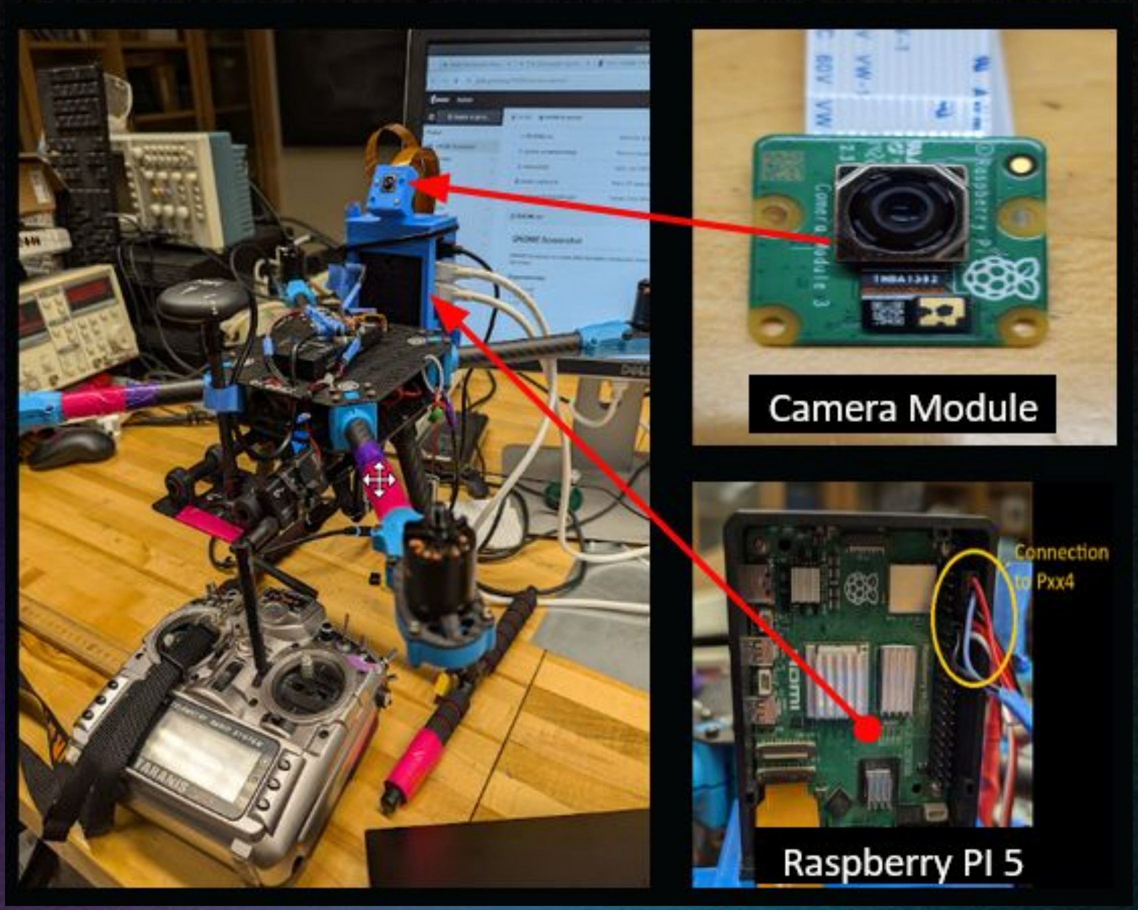
Step 2

Drone calculates optimal pursuit path based on target's movements.

Step 3

Drone autonomously shadows the target, maintaining a safe distance.

Tools and Technologies



Strengths

- Detection using TensorFlow Lite, highlighting its efficiency for real-time object recognition on resource-limited devices.

Weaknesses

- Processing on Raspberry Pi, which limits model complexity and speed.

Opportunities

- Control through PyMavlink, enabling autonomous navigation and response to real-time data.

Threats

- Flying objects similar to our drone, which may interfere with accurate identification and tracking.

Software Architecture Overview

1. **Data Capture**

   Camera captures live video feed.

2. **Data Processing**

   TensorFlow Lite processes video to detect objects.

3. **AI Analysis**

   AI analyzes object data, identifying position and distance.

4. **Data Transmission**

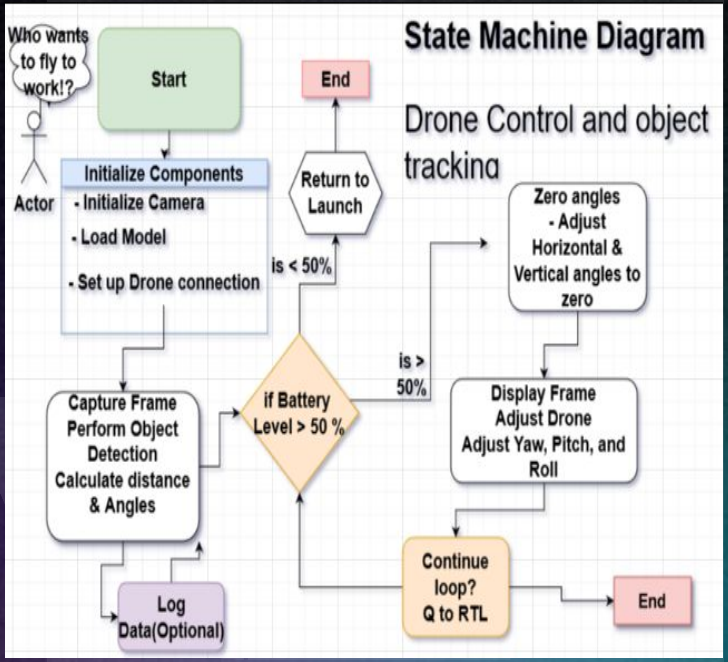
   Sends analyzed data to PyMavlink for flight adjustments.

5. **Drone Control**

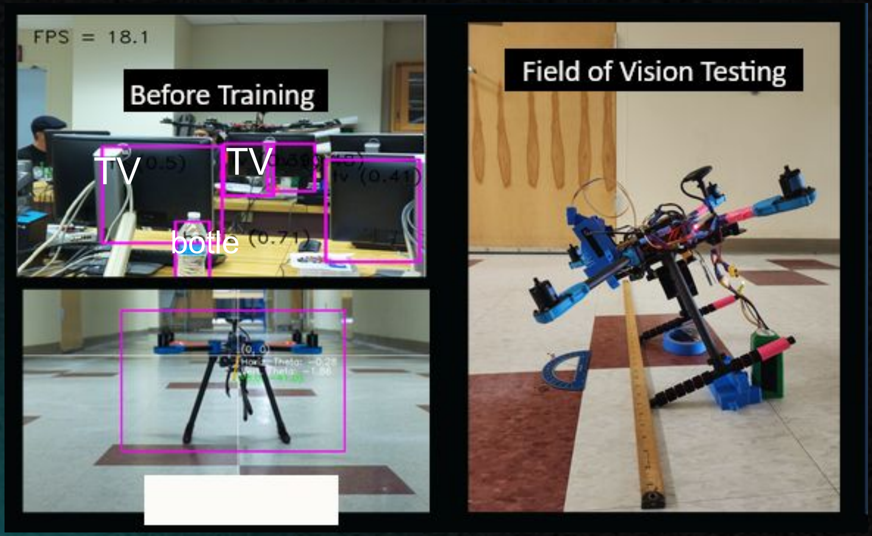
   Drone adjusts position based on AI-generated commands.

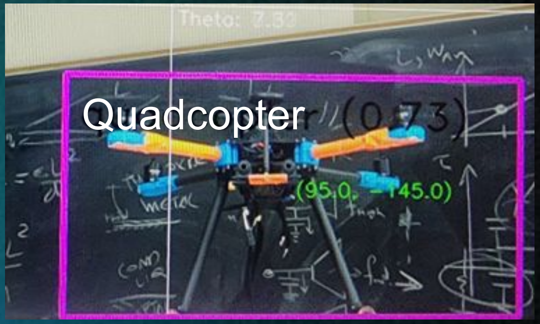
Training and Testing the Model

Infographic

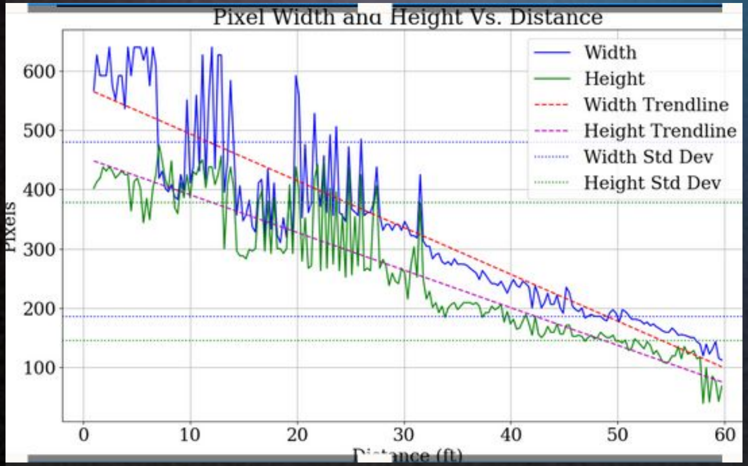


Images





Graph



accuracy in detecting drone size decreases with distance. Width measurements show greater variability than height, indicating less consistent width detection. Standard deviations highlight significant fluctuations in both, especially at shorter distances. Optimal results were attained from the range of 30-60 ft.

Key Results

Detection Performance

90%

The system achieved 90% or higher accuracy within the optimal range of 10-20 meters. This demonstrates the reliability of the AI model in identifying and tracking drones in real-time under controlled conditions.

Optimal Range

10-20m

Testing showed that the system performed best between 10-20 meters, maintaining high detection accuracy and stable tracking. This range represents the ideal operational distance for effective autonomous shadowing.

System Performance

Strengths & Weaknesses

The strengths of the system within the 10-20 meter range and weaknesses encountered at longer distances or r in low-light conditions.

Successful Tracking

Real-world Scenario

The system successfully detected a drone in a stationary test. While flight testing has not yet occurred, the system is expected to track and follow drones effectively in-flight based on current results.

Challenges and Limitations

Limited Battery Life

Drones typically have a limited flight time due to battery constraints.

Regulatory Restrictions

Compliance with airspace regulations and privacy laws poses challenges for drone operations.

Weather Dependency

Adverse weather conditions such as strong winds, rain, or fog can impact drone performance.

Data Security Concerns

Ensuring the security of data collected by drones and transmitted to ground stations is crucial.

Conclusion and Future Work

Successful Implementation of Autonomous Drone Shadowing

Demonstrated effective tracking and shadowing capabilities.

Integration of Cutting-Edge Tools and Technologies

Utilized TensorFlow Lite, Raspberry Pi, PyMavlink, and Dronecode for seamless operations.

Robust Software Architecture

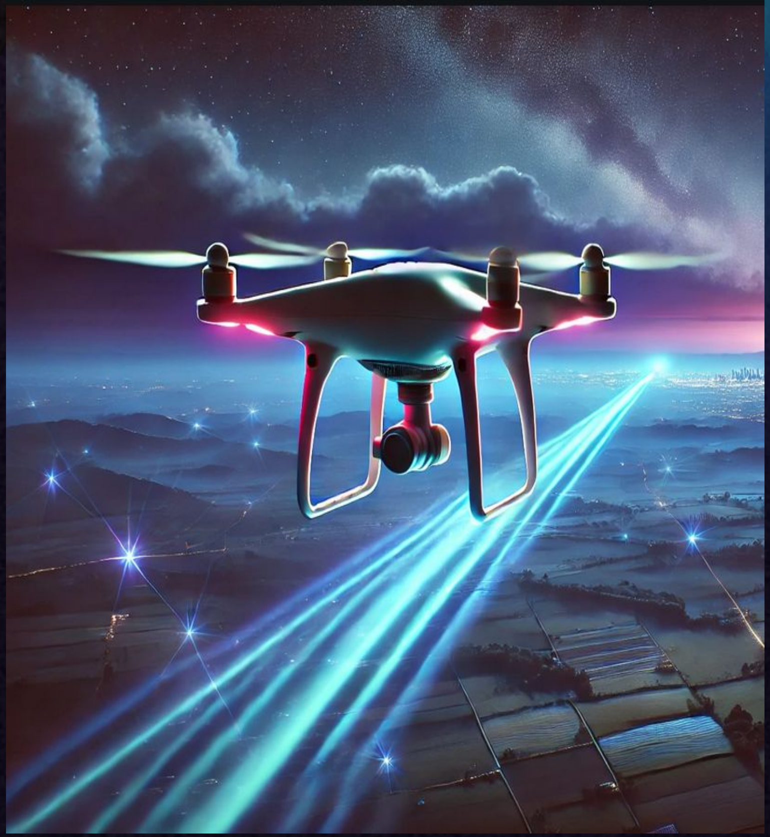
Established a streamlined flow from camera input to AI model for precise control.

Rigorous Training and Testing Procedures

Conducted extensive testing across various environments to ensure optimal performance.

Key Results and Achievements

Achieved high detection accuracy within the optimal range of 10-20 meters.



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