



Drone Detection and Protection using Embedded Systems

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Agenda

Introduction to the Project

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Introduction to the Project

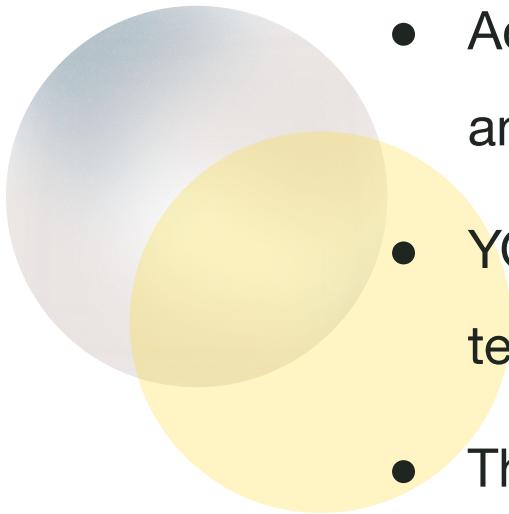


This project is centered around developing a cutting-edge embedded system. The system's primary function is to detect drones using the state-of-the-art YOLOv8 model and respond by precisely aiming a laser pointer at the identified drone.

Literature Review: Drone Detection Technologies

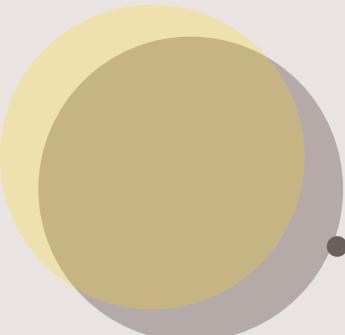
- Traditional drone detection methods include radar, RF analysis, and acoustic detection.
- Radar is effective at long ranges but struggles with small, low-flying drones.
- RF analysis is limited against autonomous drones.
- Acoustic detection is less reliable in noisy environments.

Literature Review: Computer Vision and AI for Drone Detection



- Advances in computer vision and AI have led to efficient and accurate drone detection systems.
- YOLOv8, with its improved architecture and training techniques, enhances detection performance.
- The use of YOLOv8 in embedded systems offers real-time drone detection and mitigation solutions.

Literature Review: Embedded Systems for Real-Time Applications

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- Embedded systems are crucial for real-time drone detection and response due to their low power consumption and ability to interface with various sensors and actuators.
 - Arduino microcontrollers are favored for their simplicity, versatility, and strong community support in embedded systems.
 - The combination of Arduino with servo motors offers an effective solution for creating responsive systems that can track and target moving objects.

Problematic



The surge in drone usage raises security and privacy issues, especially with unauthorized drones threatening sensitive areas. Current detection methods are often costly and complex, lacking efficiency against small drones. An affordable, efficient system for real-time drone detection is urgently needed, addressing these challenges.

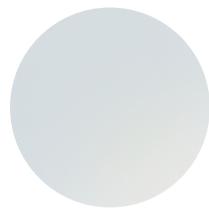
Methodology



AI Model Training



**Python
Communication**

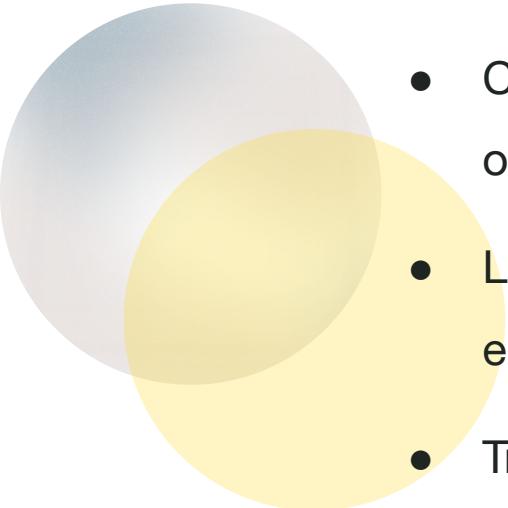


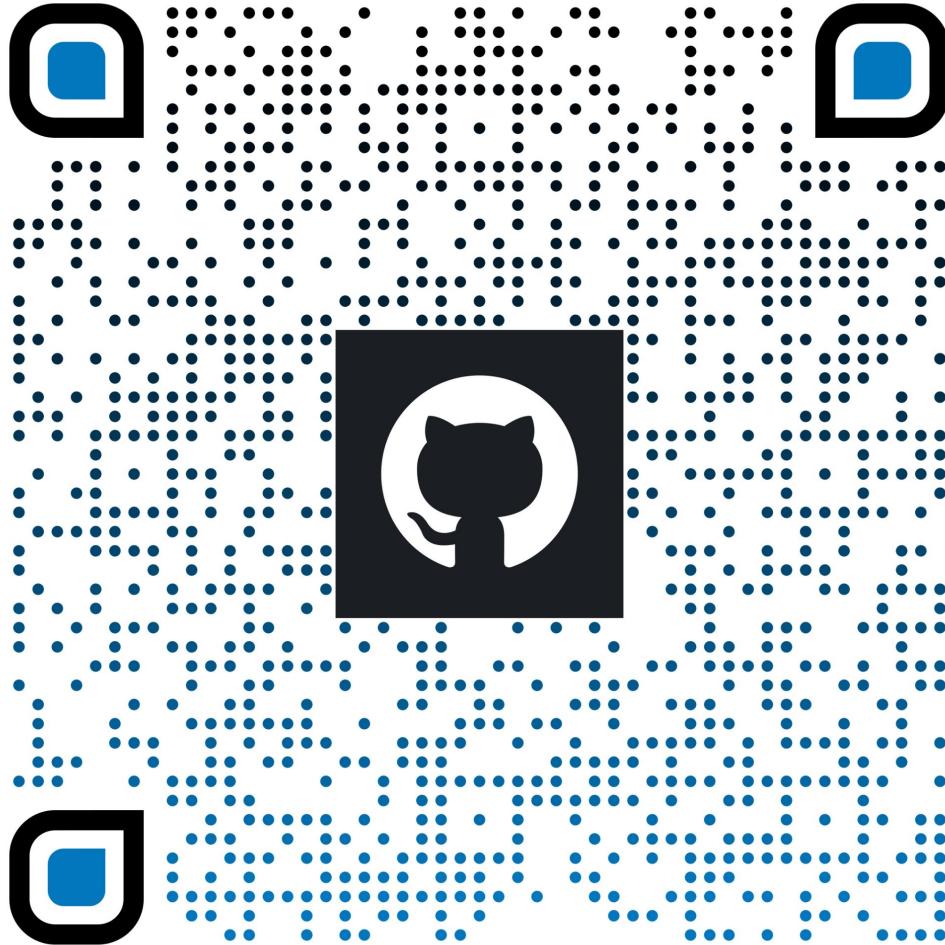
**Hardware
Integration**



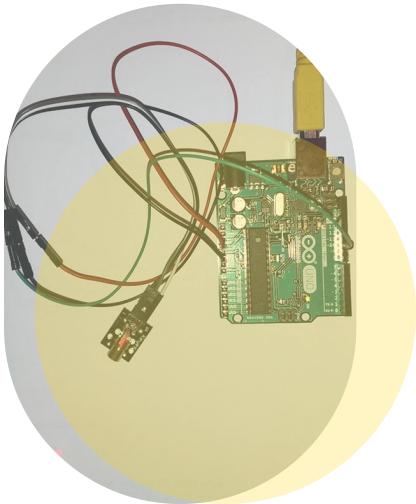
Servo Control

Software Implementation

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- Prepared a virtual environment using Anaconda3 for model training and project execution.
 - Collected drone images from the internet, ensuring a diverse dataset of drone types, angles, and backgrounds.
 - Labeled the images with a tool called "LabelImg" in the Anaconda environment, using the YOLO format for compatibility.
 - Trained the YOLOv8 model with the custom dataset, utilizing the nano version for compatibility with the setup.
 - Developed Python code to control drone detection and send data to the Arduino for targeting and laser activation.

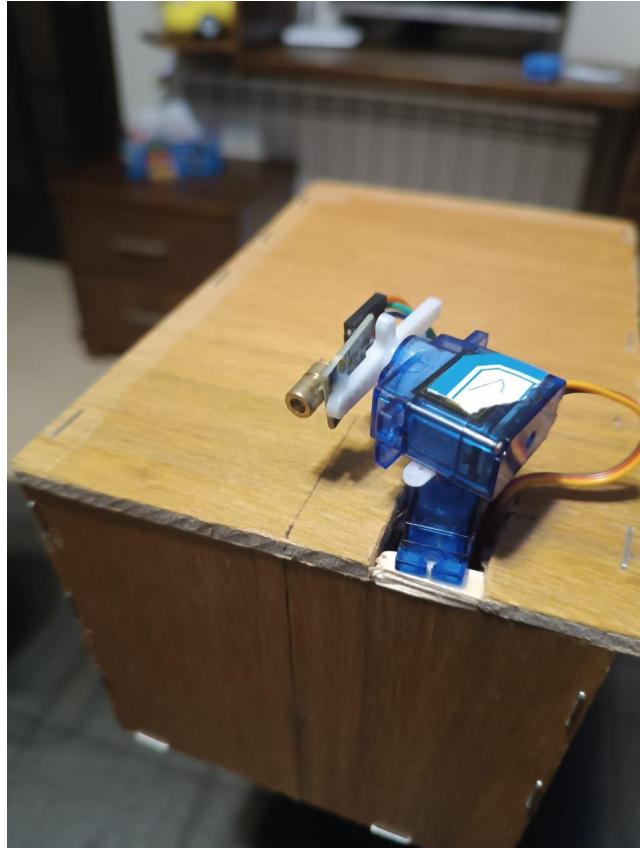
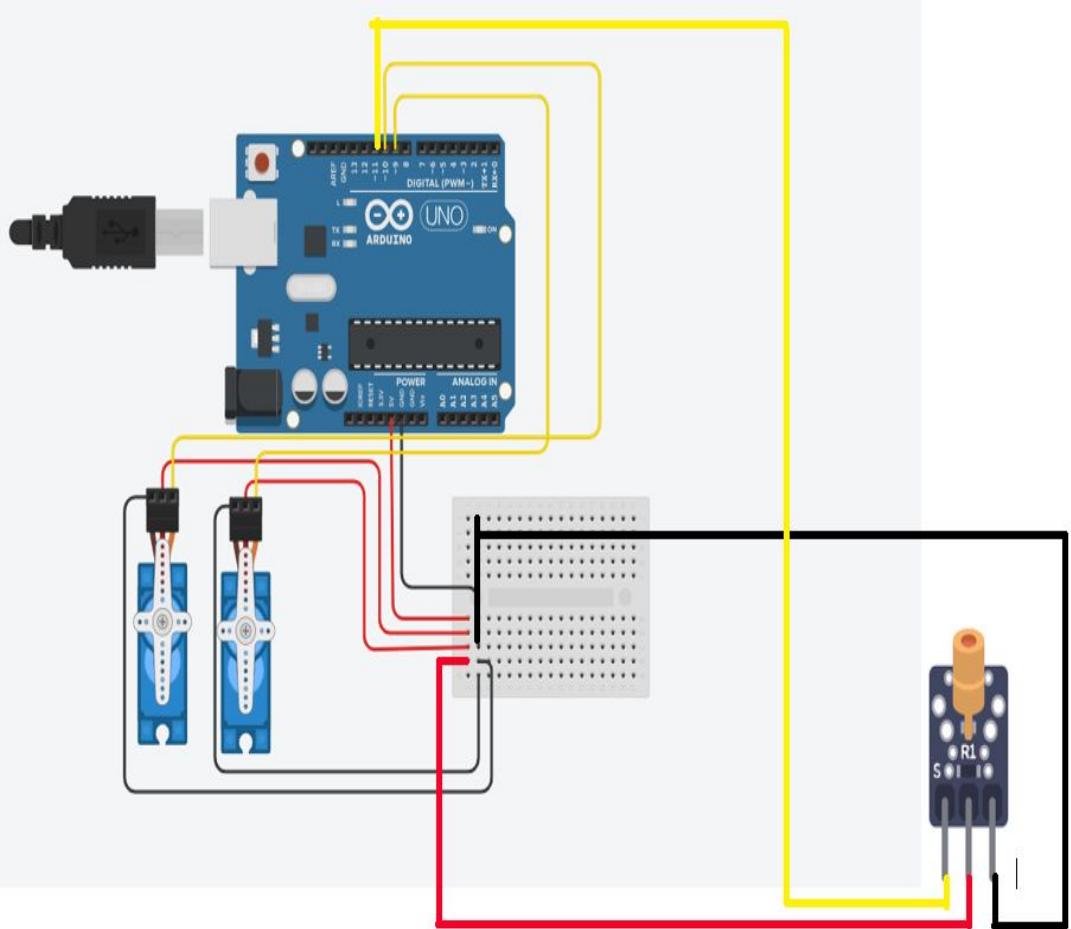


Hardware Implementation



Connection Details

- Utilized Arduino Uno to power servos and laser with 5V pin for VCC and GND pin for ground.
- Controlled horizontal angle with pin 9, vertical angle with pin 10, and laser signal with pin 11.
- Ensured proper power and signal distribution for effective operation of servos and laser beam.



Results and Discussion

Short-Range Detection Success

- The system accurately targets drones in close proximity, demonstrating effective short-range detection.
- Initial testing shows precise angle calculations for short distances, ensuring the laser pointer hits the target accurately.
- The Python script successfully transmits data to the Arduino for positioning the protection system.

Results and Discussion



Challenges in Long-Range Accuracy

- Accuracy diminishes as drones move farther away due to limitations in the detection algorithm and angle calculation errors.
- The system struggles to maintain precision for distant drones, leading to the laser beam missing the target.
- Factors like perspective changes and the camera's fixed position affect the system's accuracy over long distances.

Conclusion and Perspective

- The AI model accurately sends angles to hardware but long-distance detection is a challenge.
- Future focus on enhancing detection algorithm and angle calculation for precision.
- Plan to transition to Raspberry Pi for portability, integrate radar for 360-degree detection, and add air gun for protection.

Thank you.