T.I.T.A.N.L

INTEGRATION OF RASPERRY PI 4 AND YOLO V8 FOR PRECISION LASER-GUIDED TARGET DETECTION AND TRACKING IN LOITERING APPLICATIONS

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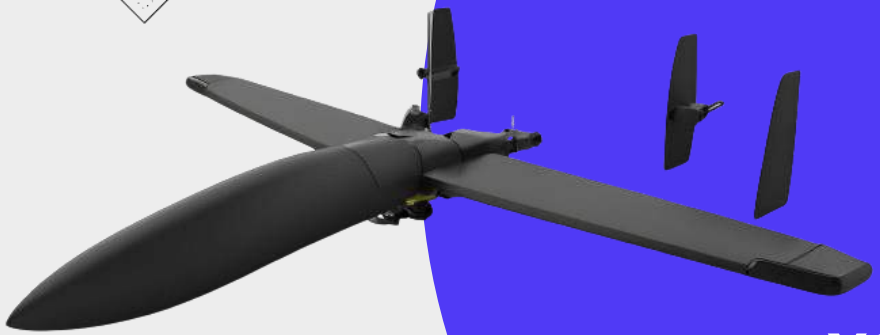


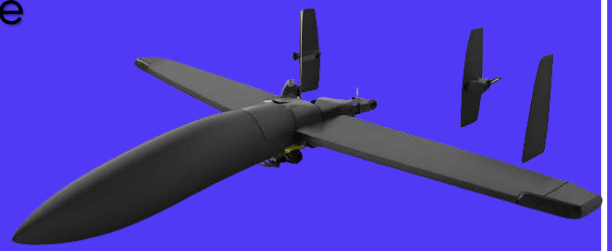
Project Intro

The Tactical Indigenous Targeted Aerial Navigator for Loitering (TITAN.L) marks a big change by offering a quick and effective way for military actions.

This project uses the YOLO v8 algorithm to spot objects and relies on a Raspberry Pi 4 as its main control center.

OBJECTIVE

- This research focuses on designing a loitering munition using a compact procedure designed for target destruction in a war zone scenario.
- Equipped with a warhead, the UAV autonomously identifies and neutralizes potential targets using the YOLOv8 algorithm for object recognition.
- Operating without the complexity the UAV relies on control systems and communicates with a base station for navigation and mission execution.



NEXT

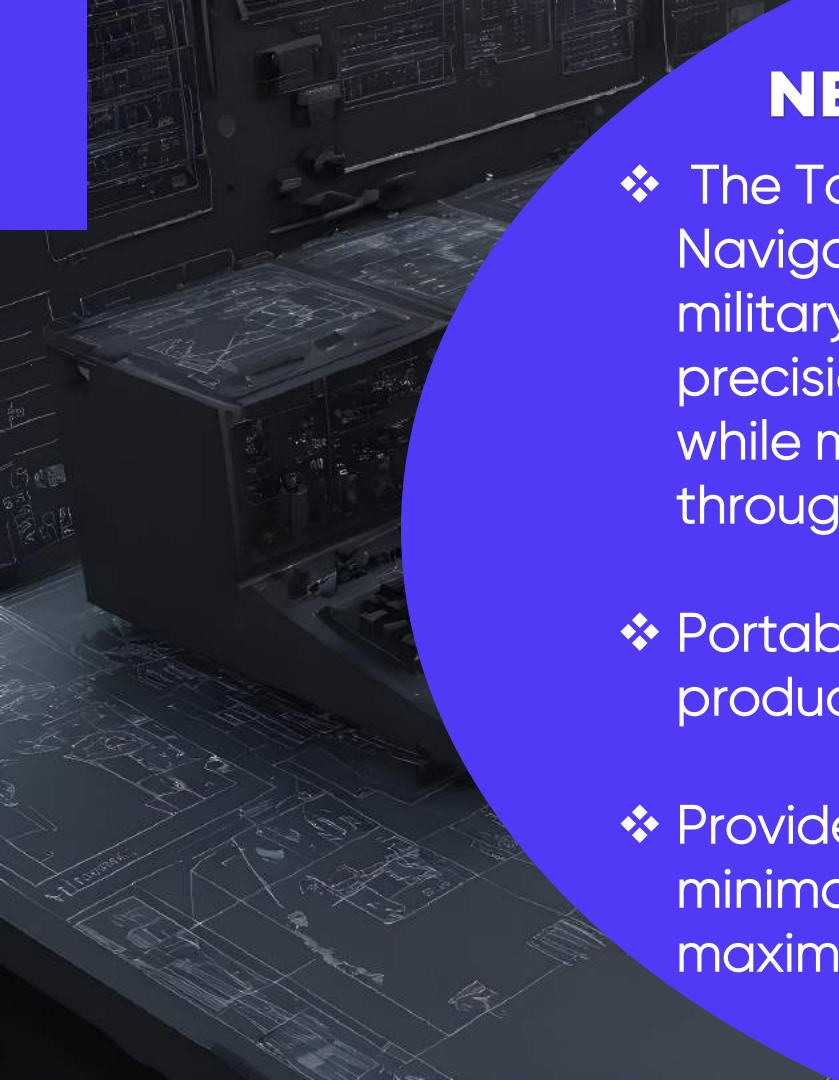
INTRODUCTION

- The evolution of Unmanned Aerial Vehicles (UAVs) has witnessed substantial progress, particularly in the context of loitering munitions.
- This comprehensive system ensures the successful execution of missions, offering potential applications in surveillance, reconnaissance, or other fields requiring precise target acquisition and tracking.
- This research diverges from conventional surveillance applications, emphasizing a small yet formidable model tailored for target destruction.
- Object recognition and target localization are achieved through the YOLOv8 algorithm, underscoring the UAV's precision in identifying and neutralizing potential threats.

LITERATURE SURVEY

S.NO	TITLE	AUTHOR & JOURNAL	METHOD	INFERENCE
1	**Path Following for Unmanned Combat Aerial Vehicles Using Three-Dimensional Nonlinear Guidance.**	**Zian Wang , Zheng Gong , Jinfa Xu, Jin Wu , and Ming Liu , Senior Member, IEEE**	**3-D Nonlinear Guidance**	**An effective path-following guidance algorithm for unmanned combat aerial vehicles by pursuing a look-ahead target-point along the desired path is devised using 3-D path Following method.**
2	**Small object detection in UAV image based on slicing aided module.**	**Hengshan Zong,Hongbo Pu,Haolong Zhang,Xingyu Wang,Zhenyu Zhong,Zeyu Jiao 2022 IEEE 4th International Conference on Power, Intelligent Computing and Systems**	**YOLOV5 Algorithm**	**The proposed method makes use of the relatively abundant small target features in the shallow network, adds a layer to the YOLOV5 detection head to upsample the feature map, continues to expand the feature map**

S.NO	TITLE	AUTHOR & JOURNAL	METHOD	INFERENCE
3	**Secure, Efficient and Lightweight Authentication Mechanism for Unmanned Aerial Vehicle Network**	**Waqas Salam Syed Khaliq-ur-Rehman Raazi Nauman Hafeez Ansari 2023 7th International Multi-Topic ICT Conference**	**SELTHA has defined three phases for a drone-to-ground control station and drone-todrone authentication and key agreement (AKA)**	**SELTHA mechanism to secure drone communication with the ground control server and with droneto-drone.**
4	**Hierarchical Intrusion Detection System for Secured Military Drone Network**	**Vivian Ukamaka Ihekoronye, Simeon Okechukwu Ajakwe, Dong-Seong Kim, Jae Min Lee**	**This study proposes an optimized e IDS framework to provide artificial intelligence (AI)-based security to the IoD network, securing their activities**	**This paper proposed an optimized hierarchical anomalybased intrusion detection system capable of detecting and alerting the internet of drone networks of lethal attacks in military operations.**



NEED FOR THE PROJECT

- The Tactical Indigenous Targeted Aerial Navigator for Loitering epitomizes a new era in military capabilities, offering unparalleled precision in responding to emerging threats while maintaining a strategic advantage through selective targeting.
- Portable, robust and suitable for mass production to engage in army arsenals
- Provides High-Profile Target Destruction with minimal amount of inventory cost and maximum amount of efficiency.

Novelty of our Project

- Utilizing Efficient Yolo V8 Algorithm and CSL angle processing.(CSL angle processing helps in detecting corners or junctions in aerial images. Corners are important features in image processing, especially in tasks like object recognition, scene understanding, and image stitching).
- This System Supports to a Aerial Vehicle with good Portability and Payload Capacity
  (upto 1.5to2 Kg).

EXISTING SYSTEM

- Traditional target detection and tracking systems often lack integration of efficient techniques and coordination.
- The traditional target detection method uses the Three dimensional Non-Linear Guidance Method when target is detected.
- Lack of real-time spatial information, hindering efficient decision-making and autonomous operation.
- Also The Existing system utilizes the traditional Yolo v3 Algorithm and Small object detection method

Proposed System

- In our project, the Raspberry Pi 4 serves as the central processing unit, orchestrating the entire system.
- The Pi Camera is utilized for target detection, capturing visual data that is processed to identify the target using YOLO V8 ALGORITHM.
- A servo motor is employed to precisely point a laser light at the detected target, enhancing accuracy. Simultaneously, a laser light sensor is utilized to further confirm the presence of the target.
- The GPS module integrated with the Raspberry Pi enables real-time location tracking, providing crucial spatial information.

Proposed System

- Our project is Divided into Three Modules:
- Target Detection, ModuleTarget Tracking, Confirmation Module and Action Initiation and Execution Module.

1. TARGET DETECTION MODULE:

- In our project, the Raspberry Pi 4 serves as the central processing unit, orchestrating the entire system.
- The Pi Camera is utilized for capturing visual data, which is then processed to identify the target. This involves computer vision technique such as object detection using YOLO V8 ALGORITHM.

Proposed System

2. TARGET TRACKING AND CONFIRMATION MODULE:

- A servo motor is employed to precisely point a laser light at the detected target, enhancing accuracy. Simultaneously, a laser light sensor is utilized to further confirm the presence of the target.
- This ensures that the system not only detects the target but also confirms its position reliably.

3. ACTION INITIATION AND EXECUTION MODULE:

- The GPS module integrated with the Raspberry Pi enables real-time location tracking, providing crucial spatial information.
- Once the target is confirmed and its location is determined, the Raspberry Pi triggers the necessary actions.

- The Necessary actions includes to switch the relay as it ignites the payload.
- The payload or Warhead Contains the Explosives with chemical agents and Electronic trigger(Relay).
- Once the target is confirmed the co-ordinates is sent wirelessly.If the target abortion message received within a minute the relay switches back thus the ignited payload can be switched off. Or else after certain verge the ignition part carried on and payload destruction takes places.
- Accuracy will be increased in target acquisition due to reliance on additional processes by sensors.The distance of the target is measured by ultrasonic sensor and the inner temmperature is monitored as sensor measures the internal temperature. Finally the PIR sensor detects the motion of personnel.

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HARDWARE REQUIREMENTS

01. RASPBERRY PI

02. GLOBAL POSITIONING SYSTEM

03. PI CAM 8MP

04. SERVO MOTOR

05. LASER LIGHT

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HARDWARE REQUIREMENTS

06. **POWER BANK 5V 3AMP**

07. **MEMORY CARD 32 GB**

08. **RELAY**

09. **UAV FRAME/BODY**

10. **CONTROL SYSTEMS**
(PIC16F77A,ULTRASONIC,TEMPERATURE, PIR SENSOR)

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SOFTWARE REQUIREMENTS

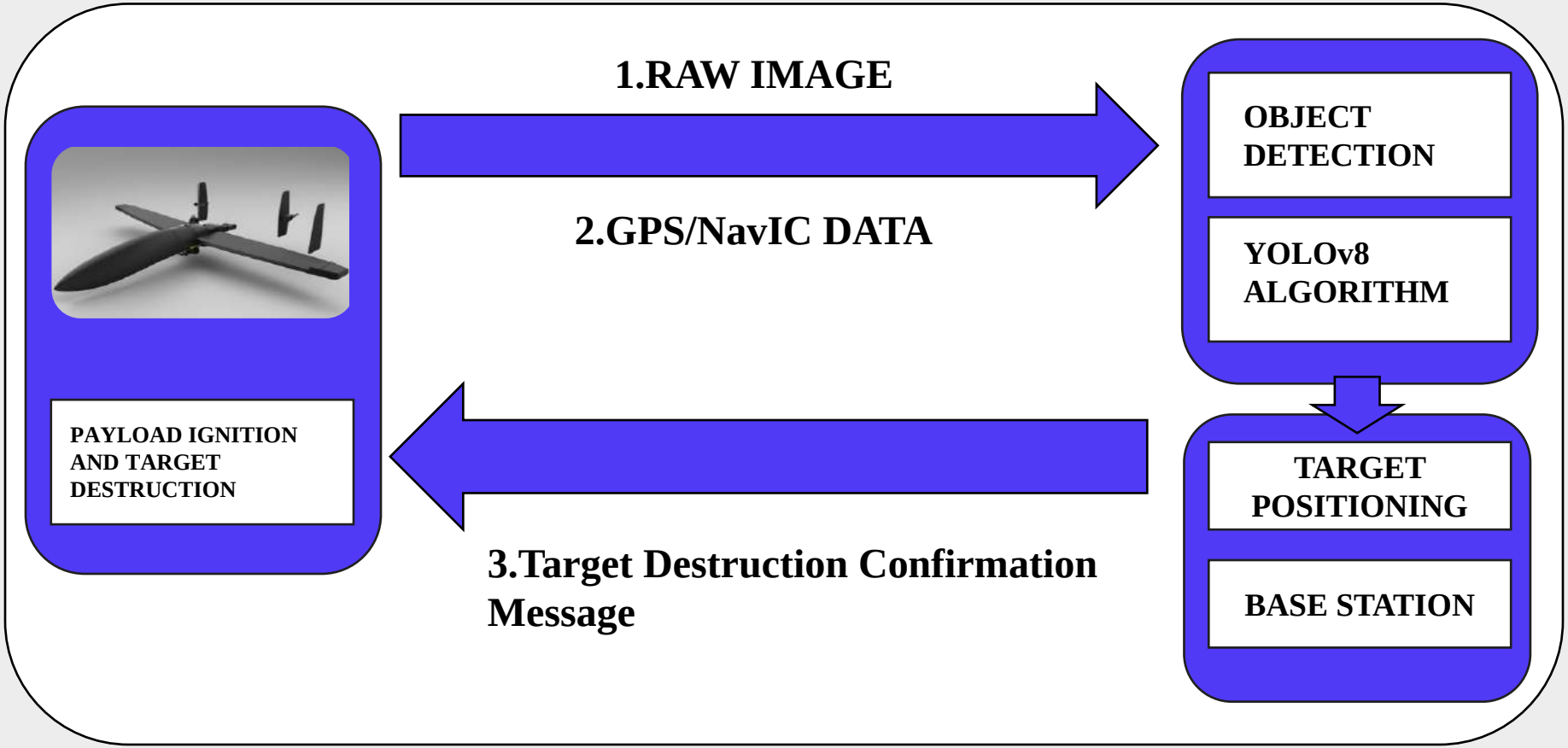
01. Raspbian OS+VNC Viewer+PuTTY

02. EMBEDDED C

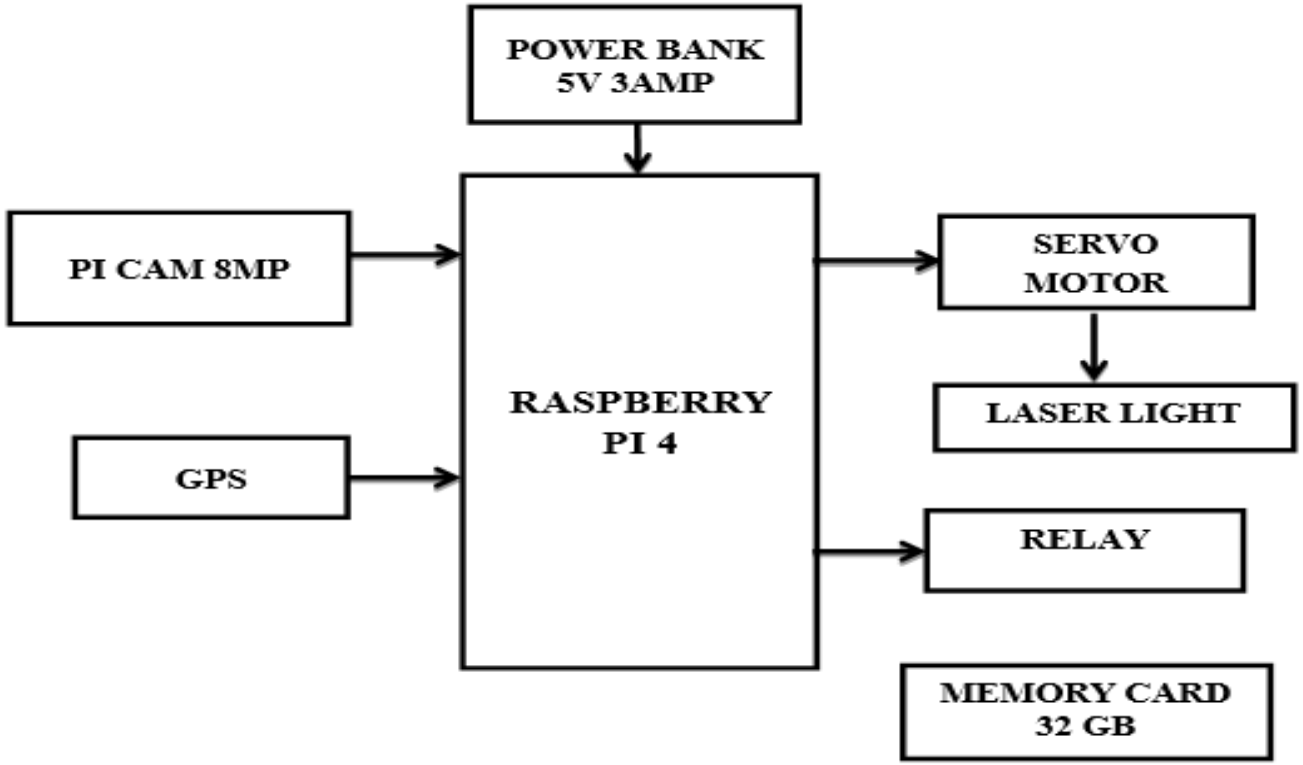
03. YoloV8 Algorithm.

PROJECT

FLOW CHART DIAGRAM



BLOCK DIAGRAM



RESULTS

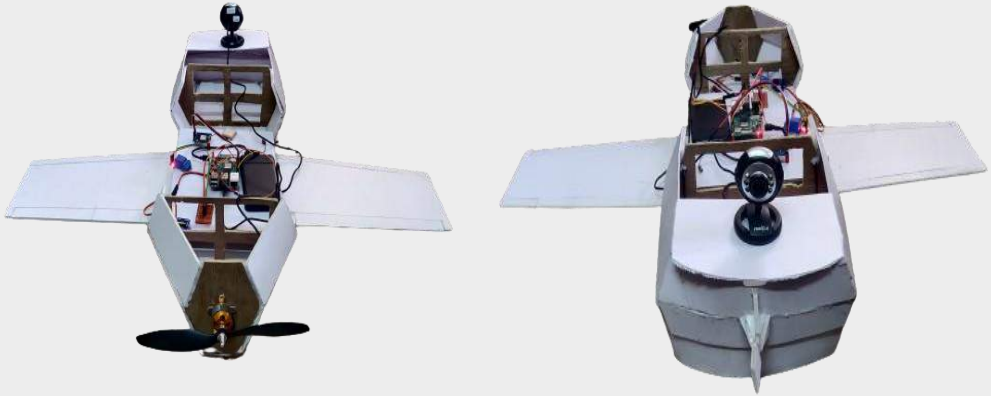


FIG 1: BACK AND FRONT VIEW OF HARDWARE

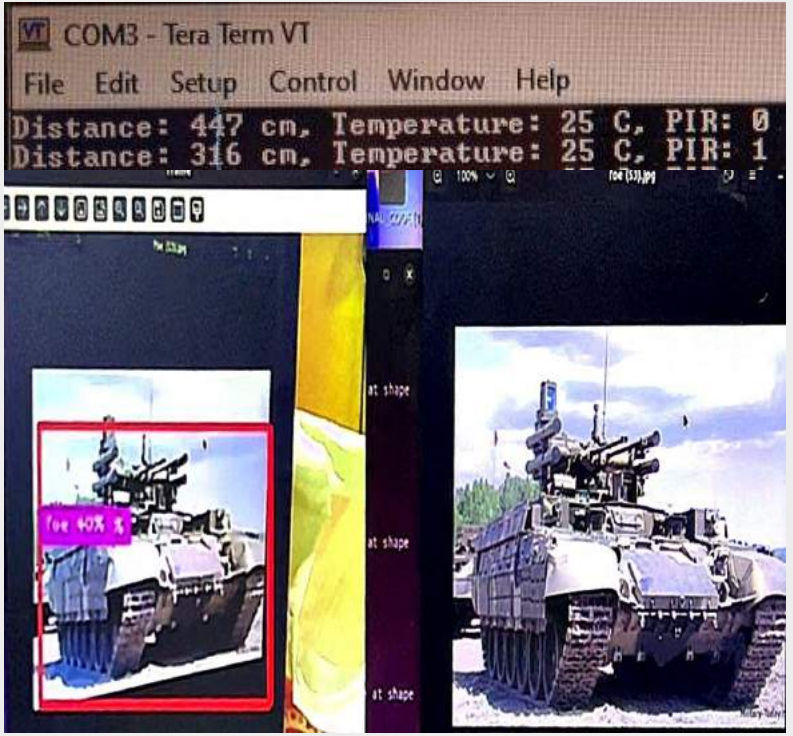


FIG 2: DETAILED VIEW OF TARGET DETECTION

Application Scenario

In urban environments, where distinguishing between combatants and non-combatants can be challenging, the precision of loitering munitions is particularlUrban Warfarey valuable. They can be used to strike enemy positions within buildings or urban structures while minimizing the risk to civilians and collateral damage.

Loitering munitions can also be deployed in maritime environments to target naval vessels, patrol boats, or even submarines close to the surface. Their ability to loiter makes them ideal for monitoring vast ocean areas and engaging enemy vessels with precision.

In asymmetric conflicts, where one side may not have access to advanced air forces or traditional guided munitions, loitering munitions offer a cost-effective and technologically accessible option for striking high-value targets. They can level the playing field by providing precision strike capabilities smaller nations.

Future Advancements

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- Implementation of information sharing among multiple drones and the base station, creating a networked environment.
- Implementing RF absorber coatings for stealth enhancement, reducing the radar cross-section of UAVs, thus minimizing the risk of detection by enemy radar systems in operational environments.
- Proposing a robust Intrusion Detection System (IDS) for the Internet of Drones (IoD), this system monitors telemetry data among participating nodes, effectively thwarting potential malicious attacks. Utilizing a hierarchical and optimized Random Forest (RF) anomaly-based model, fine-tuned through Randomized Search Cross-Validation (RSCV)
- In the future, our project aims to incorporate advanced machine learning algorithms for target identification and tracking, leveraging neural network architectures to improve accuracy and adaptability in varying environments.

ADVANTAGES

- Efficiency: The Raspberry Pi 4 serves as a powerful central processing unit, capable of efficiently coordinating multiple components for target detection and tracking.

- Accuracy: Utilizing a servo motor to direct a laser light towards the target enhances precision, ensuring accurate identification and tracking.

- Real-time Tracking: Integrated GPS enables real-time location tracking, providing crucial spatial information for effective target monitoring.

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