IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 12, December 2024

DOI: 10.17148/IJARCCE.2024.131216

ENEMY DETECTION SYSTEM WITH AUTOMATIC WEAPON DELIVERY ROBOT

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Abstract: This project aims to create an integrated automation system in response to the growing demand for innovative solutions in use of robotics in military security, this work endeavors to bridge existing gaps by introducing an enemy detection system with automatic weapon delivery system integrates advanced recognition, encryption, and navigation technologies to address security challenges. The system enables authorized personnel registration using a user module that captures multiple angles and encrypts the data with a password. A robot equipped with a web camera identifies authorized and unauthorized individuals through a trained dataset of images. The weapon delivery subsystem employs a line-following sensor for accurate navigation to predefined base stations automatically and includes a manual control mode to navigate through any location. This modular approach ensures adaptability in dynamic environments without human intervention.

Keywords: Enemy Detection System, Weapon Delivery, Line Following, Predefined Base Stations

I. INTRODUCTION

In today's rapidly evolving technological landscape, security systems are becoming increasingly reliant on advanced robotics and artificial intelligence (AI) to enhance safety and operational efficiency. One such innovative solution is the development of an enemy detection system that integrates facial recognition, real-time surveillance, autonomous navigation, and automated weapon delivery. This system is designed to improve the accuracy and responsiveness of security operations, ensuring that potential threats are identified and neutralized quickly and effectively. The core components of this system include AI-based facial recognition, ultrasonic sensors for movement detection, a Bluetooth-enabled communication interface, and an autonomous weapon delivery mechanism and manually too.

The facial recognition system serves as the first line of defence, leveraging AI algorithms to accurately distinguish between authorized personnel and unauthorized individuals. This system is seamlessly integrated with a database of authorized personnel, ensuring that only those with the proper clearance can access sensitive areas. The use of a webcam for real-time facial recognition, combined with a separate dashboard, provides a comprehensive surveillance solution. Furthermore, the weapon delivery system is designed for autonomous operation, transporting tools such as bomb disposal equipment or non-lethal weapons to specific locations with precision. This is achieved through a line-following navigation system, which ensures the robot follows a safe, predetermined path to reach its destination. The robot is also equipped with laser targeting points to enhance accuracy in weapon delivery by combining multiple cutting-edge technologies, this enemy detection system offers a robust solution for modern security challenges, ensuring faster, more reliable responses to potential threats. It also opens the door for further innovations in autonomous systems, where human involvement can be minimized, and operational efficiency maximized.

1.1 MOTIVATION

The increasing need for advanced security systems in sensitive environments, such as military bases, industrial facilities, and public spaces, inspired the development of this project. By integrating facial recognition and automated navigation, and real-time communication the system aims to enhance safety, reduce human risk and provide a cost-effective solution for detecting unauthorized individuals and delivering critical tools or weapons efficiently. This innovation addresses growing security challenges and leverages technology to create a safer and more secure future.

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1.2 OBJECTIVE

The objectives of this work is to develop an AI-driven system that leverages facial recognition technology to identify authorized personnel, enhancing security protocols. Additionally, it aims to incorporate an automated security alert system for fast and effective communication, ensuring reliable control through a Bluetooth interface. Another key goal is to implement an autonomous delivery system capable of transporting tools or weapons to specific locations autonomously or manually. By achieving these objectives, the robot seeks to optimize security operations by automatically verifying personnel and minimizing human intervention in delivering critical resources. This integrated approach, combining AI, real-time communication, and autonomous navigation, enhances security and operational efficiency in complex environments.

II. METHODOLOGY

The primary task for this enemy detection system with automatic weapon delivery robot project involves a systematic approach combining hardware and software design, development, and integration. This section outlines the detailed steps for each component of the system, covering the design, implementation, and integration phases.

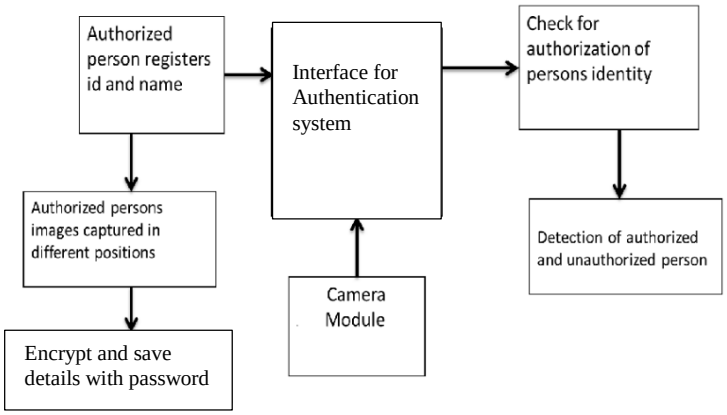

Fig 1 Block diagram for UNAUTHORIZED PERSON DETECTION

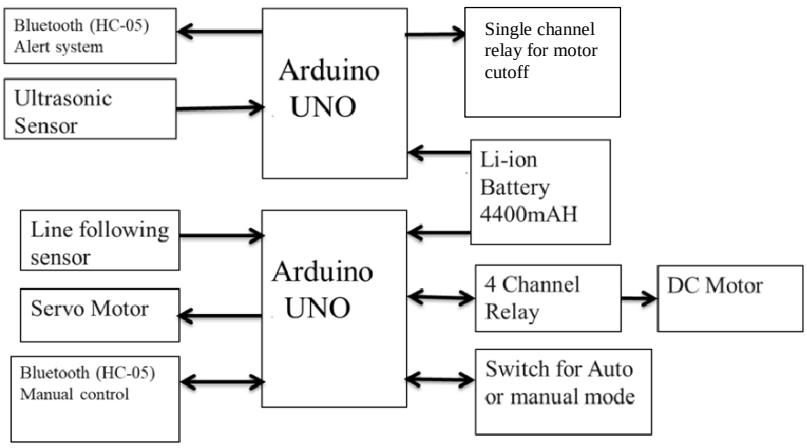

Fig 2 Block diagram of WEAPON DELIVERY ROBOT

➢ **User Registration and Training Module**:

This module captures and encrypts details of authorized personnel, including images taken from various angles. The dataset is used to train a recognition model for identifying authorized individuals accurately and the user dataset is being encrypted with secret key to make it secure.

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➢ **Recognition Module:**
The robot's web camera continuously captures images, which are compared against the trained dataset to distinguish between authorized and unauthorized individuals. Recognition results displayed on a screen for verification of the enemy detected.

➢ **Navigation System**:
The robot uses line-following sensors for precise navigation along predefined paths. An HC-05 Bluetooth module alerts the control interface when obstacles are detected, ensuring smooth operation.

➢ **Weapon Delivery System**:
The system includes a mode switch for automatic or manual delivery. The robot through the line following sensor delivers arms to predefined base stations in automatic mode. Bluetooth-controlled app enables manual navigation to non-predefined locations.

III. IMPLEMENTATION

3.1 Hardware Setup:

3.1.1 Integration of Arduino UNO: The Arduino UNO acts as the central control unit for the system. It interfaces with the sensors, motors, and communication modules to ensure seamless operation.

3.1.2 Web Camera for Real-Time Facial Recognition: A high-resolution web camera is mounted on the robot to capture live video feeds. This camera feeds data to the OpenCV-based facial recognition module running on an external computer or microcontroller.

3.1.3 Line-Following Sensor for Navigation: Line-following sensors are installed at the base of the robot to detect and follow predefined paths. The sensors use infrared (IR) technology to track reflective tape or black lines on the ground.

3.1.4 Ultrasonic Sensor for Obstacle Detection: An ultrasonic sensor is mounted at the front of the robot to detect obstacles in its path. It continuously measures the distance to nearby objects and sends alerts if an obstacle is encountered.

3.1.5 Bluetooth Module (HC-05) for Communication: The HC-05 Bluetooth module facilitates communication between the robot and the operator. It transmits alerts (e.g., obstacle detection) and allows for manual control via a mobile application.

3.1.6 DC Motors for Movement: DC motors drive the robot's wheels, providing mobility. These motors are controlled through a 4-channel relay connected to the Arduino UNO.

3.1.7 4-Channel Relay for Motor Control: The 4-channel relay module is used to manage the operations of DC motors and other actuators, ensuring precise and reliable control over movement and actions.

3.1.8 Power Supply: A rechargeable Li-ion battery powers all components, ensuring uninterrupted operation during missions.

3.2 Software Development:

3.2.1 Facial Recognition using OpenCV:
The OpenCV library is employed for facial recognition. The software captures live video streams from the web camera. Compares detected faces against the encrypted dataset of authorized personnel. Differentiates between authorized and unauthorized individuals in real time, displaying results on a connected screen.

3.2.2 Arduino IDE: The Arduino IDE is employed to program the microcontroller, handling tasks such as controlling the line-following sensors for precise navigation, processing ultrasonic sensor data to detect and avoid obstacles, and managing communication with the HC-05 Bluetooth module. The firmware ensures that hardware components operate in synchronization for reliable performance.

3.2.3 Python: Python serves as the integrative backbone of the system, facilitating seamless communication between various modules. It handles facial recognition through OpenCV, manages Bluetooth communication for sending and receiving alerts, and logs essential system data. Python's versatility ensures that all subsystems are interconnected and function cohesively in real-world scenarios.

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IV. RESULTS

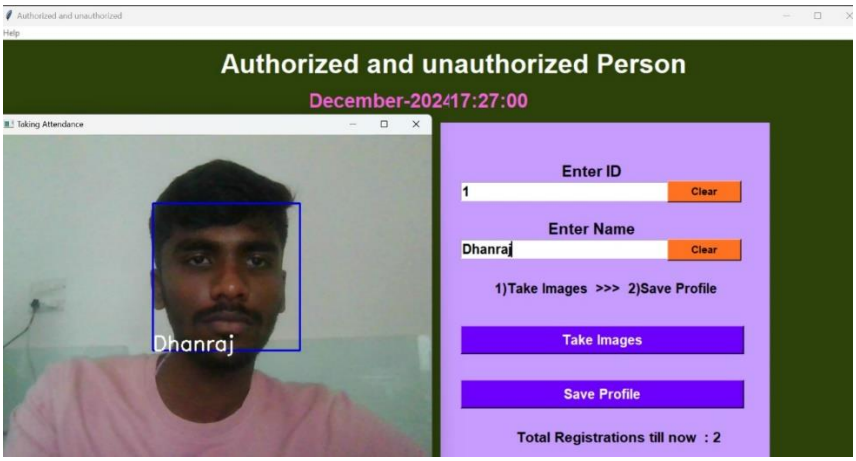

Fig 01. Authorized person registration interface

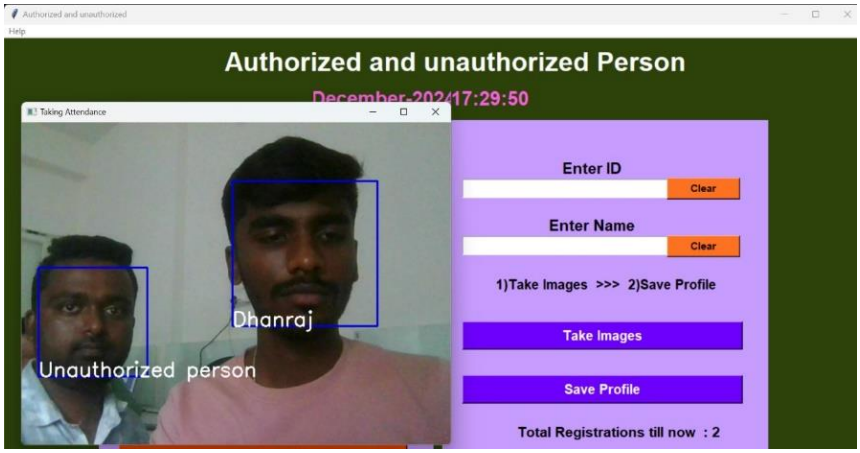

Fig 02. Enemy detection

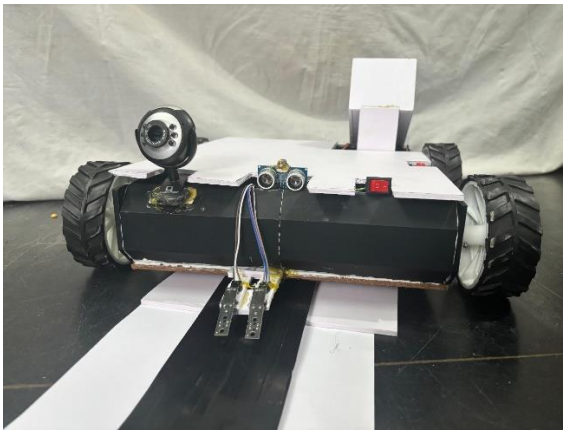

Fig 03. Weapon delivery robot

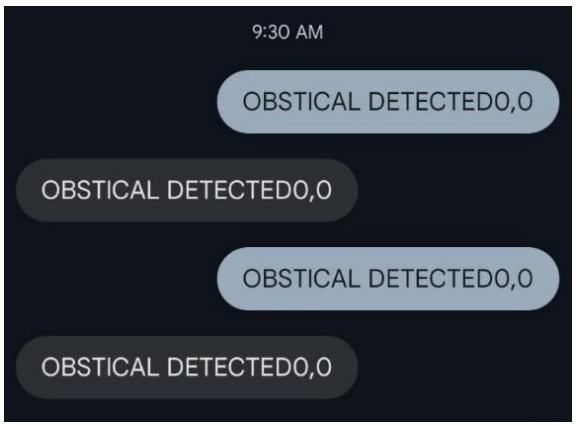

Fig 04. Obstacle detected alert message

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Fig 05. Weapon delivered to predefined base stations

IV. CONCLUSION

This project successfully demonstrated the potential of integrating the enemy detection system represents a significant leap forward in the integration of artificial intelligence, and security technologies leveraging facial recognition. The system ensures robust surveillance and prompt detection of unauthorized individuals.

The use of a real-time communication system with live video streaming enhances situational awareness and enables quick decision-making .The weapon delivery system, featuring automated delivery to predefined bases and precise navigation using line-following sensors, ensures efficient and safe transportation of critical equipment such as non-lethal tools or bomb disposal kits this functionality reduces human intervention in high-risk environments and optimizes operational efficiency.

V. FUTURE SCOPE

In future this weapon delivery mechanism can be implemented on border for security and also can be operated automatically without human intervention.

- **Integration with Advanced AI Systems**: Incorporating machine learning algorithms to improve the accuracy and adaptability of facial recognition in diverse and challenging conditions, such as low-light or crowded environments.

- **Expansion to Multi-Modal Security**: Adding additional biometric authentication methods like fingerprint or iris scanning for multi-layered security systems.

- **Scalability for Large Operations**: Designing the system to support larger-scale deployments in high-security environments such as military bases, airports, or industrial facilities.

- **Enhanced Navigation Capabilities**: Upgrading the autonomous delivery system with advanced sensors, GPS, and LiDAR for precise navigation in dynamic and complex terrains.

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VI. ACKNOWLEDGEMENT

I extend my heartfelt gratitude to everyone who supported and guided me throughout the journey of this project.

Firstly, I would like to express my deep appreciation to my project guide and faculty members for their invaluable insights, consistent support, and encouragement. Their expertise and guidance were pivotal to the successful completion of this work.

I am also thankful to the technical staff and my colleagues who assisted with hardware setup, troubleshooting, and system integration. Their collaborative efforts and practical suggestions were instrumental in resolving various challenges encountered during the project's development.

A special note of gratitude goes to my family and friends for their unwavering support and motivation, which helped me stay focused and determined throughout this process.

Lastly, I acknowledge the resources and tools made available by the university, along with the knowledge gained through online platforms, which significantly enriched my learning experience and contributed to the success of this project.

This accomplishment is a result of the collective efforts and contributions of all these individuals, and I am sincerely thankful for their support.

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