



HEXAPOD ROBOT FOR DEFENSE SYSTEM

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Abstract: The hexapod robot is one of the important classes in legged robots due to its great potential to operate in complex situation with high stability and flexibility. The robot is designed by using Arduino as its central control unit, integrating a laptop camera for visual data acquisition, Zigbee for communication, IR Sensor and Metal Sensor for obstacle detection, Missile Identification for threat assessment, Person Face Authentication for access control, and a Laser Gun for precise target engagement. The proposed system enhances the security in defense, by identifying threats and functions in challenging environments by safe navigation.

Key terms: hexapod robot, defense, zigbee, ir sensor, metal sensor, laser gun.

I. INTRODUCTION

In recent years characterized by dynamic security challenges and technological advancements. The Hexapod robot serves as a crucial asset in modern defense systems, where adaptability, versatility, and rapid response are paramount.

Hexapod robot in a defense system stands as a testament to innovation and adaptability. Metal Sensor, Missile Identification technology, Person Face Authentication, and a Laser Gun, represents a significant stride towards enhancing security and protection in a rapidly evolving world.

A. PROBLEM STATEMENT

To develop a Hexapod robot in Defense system, for identifying potential threats, providing rapid response and ensuring safe navigation through terrains.

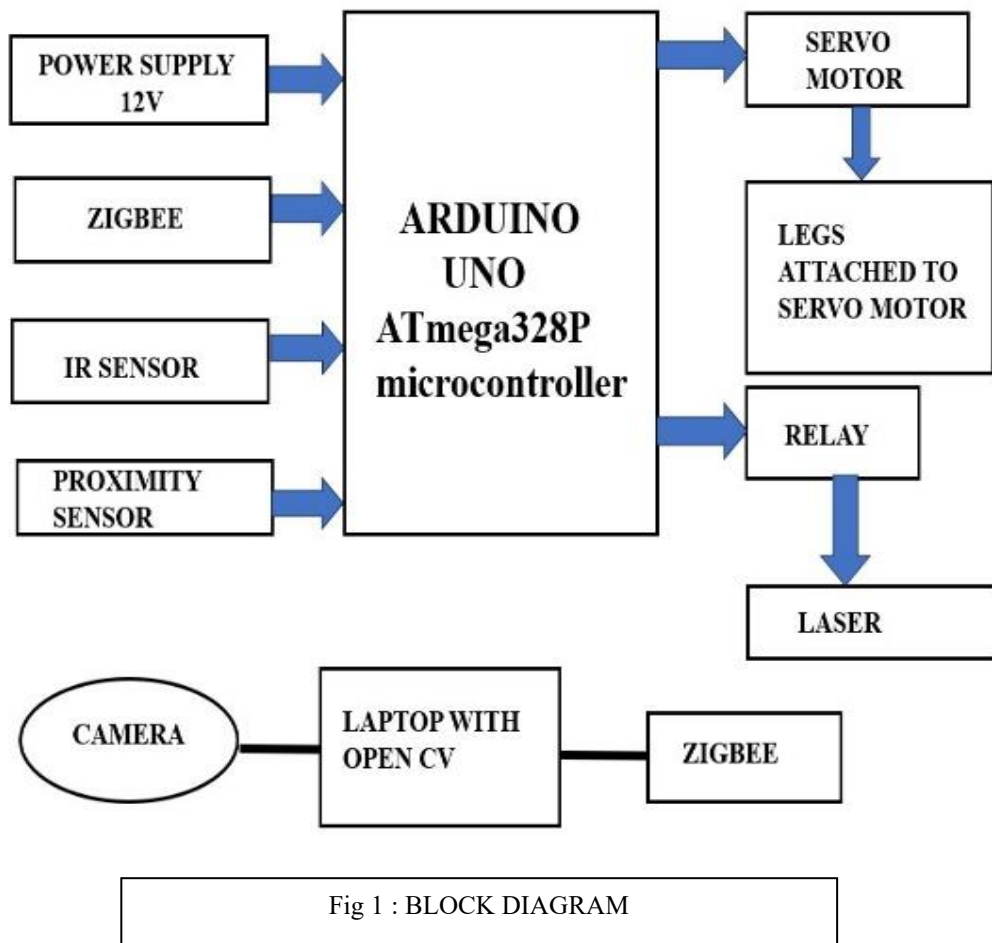
B. OBJECTIVES

To quickly identify the threats and classify potential threats like guns, knife, intruders etc. by using face recognition and IR sensor. It enables the robot to respond immediately to the identified threats either by altering human or by engaging laser gun. To enable the robot to navigate through challenging terrains safely and effectively by using spider like legs. To detect metals by using metal sensor.

II. METHODOLOGY

System Design and Requirement Analysis defines the specific operational requirements and objectives of the Hexapod robot in the defense system. Identify the integration points for each component and system.

Hardware Selection and Integration selects and integrates the necessary hardware components, ensuring compatibility and communication between Arduino, laptop camera, Zigbee, sensors, and the Laser Gun. Design and build the mechanical structure of the Hexapod robot to support these components.



The Arduino configures and programs the board as the central control unit, developing software for sensor data processing, motor control, and communication. Camera connects and configures the laptop camera for real time video capture and image processing. Develop software for image analysis, object recognition, and target tracking. Sensor develops driver's and software interfaces for the IR Sensor and Metal Sensor to collect data on environmental conditions and obstacles. Integrate the sensors into the robot's control system for obstacle detection and collision avoidance. The missile Identification System algorithms for missile threat detection, combining data from sensors and image analysis. Use machine learning or computer vision techniques to classify identified threats. Face Authentication System creates a facial recognition system using deep learning or computer vision approaches. Train the model with a comprehensive database of authorized personnel for access control. Navigation and Obstacle Avoidance develops navigation algorithms that incorporate sensor data to ensure safe and efficient movement. Implement obstacle avoidance strategies for the Hexapod robot to navigate complex terrains.

1 Arduino UNO

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2 POWER SUPPLY

The transformer 230Volts will be stepped down to 12-0-12 one side of the 12V is given to the 7805 and Lm317. In this project the microcontroller requires +5V power supply. The design description of power supply is given below. A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding.



3 IR SENSORS

The IR sensor or infrared sensor is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion. In many electronic devices, the IR sensor circuit is a very essential module. This kind of sensor is similar to human's visionary senses to detect obstacles.

4. METAL SENSORS

A metal detector is an instrument that detects the nearby presence of metal. Metal detectors are useful for finding metal objects on the surface, underground, and under water. The unit itself consists of a control box, and an adjustable shaft, which holds a pickup coil, which can vary in shape and size. If the pickup coil comes near a piece of metal, the control box will register its presence by a changing tone, a flashing light, and or by a needle moving on an indicator. Usually, the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes.

5 SERVOMOTOR

A servomotor (or servo motor or simply servo) is a rotary or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration in a mechanical system. It constitutes part of a servomechanism, and consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery, and automated manufacturing.

6 PYTHON

Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python is dynamically typed and garbage collected. It supports multiple programming paradigms, including structured (particularly procedural), object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library. Guido van Rossum began working on Python in the late 1980s as a successor to the ABC programming language and first released it in 1991 as Python 0.9.0 Python 2.0 was released in 2000. Python 3.0, released in 2008, was a major revision not completely backward compatible with earlier versions. Python 2.7.18, released in 2020, was the last release of Python 2. Python consistently ranks as one of the most popular programming languages and has gained widespread use in the machine learning community.

7 OpenCV

OpenCV's functions in Python are the fundamental building blocks of the library, providing low-level operations for manipulating and processing images and matrices. These functions form the backbone of OpenCV and are used by many of the higher-level functions and algorithms in the library. OpenCV provides functions for reading and writing images and videos in various formats. OpenCV also provides a set of basic image processing functions, such as image arithmetic, pixel manipulation, and colour space conversion.

8 ARDUINO IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

9 Embedded C

When designing software for a smaller embedded system with the 8051, it is very common place to develop the entire product using assembly code. With many projects, this is a feasible approach since the amount of code that must be generated typically less than 8 kilobytes and is relatively simple in nature. If a hardware engineer is tasked with designing both the hardware and the software, he or she will frequently be tempted to write the software in assembly language.

III. MOTIVATION

A sudden, violent attack from the terrorist causes the death of many innocent people. To circumvent this, the proposed system enhances the security of the defense system through identifying threats and by navigating in challenging environments.



IV. RESULTS

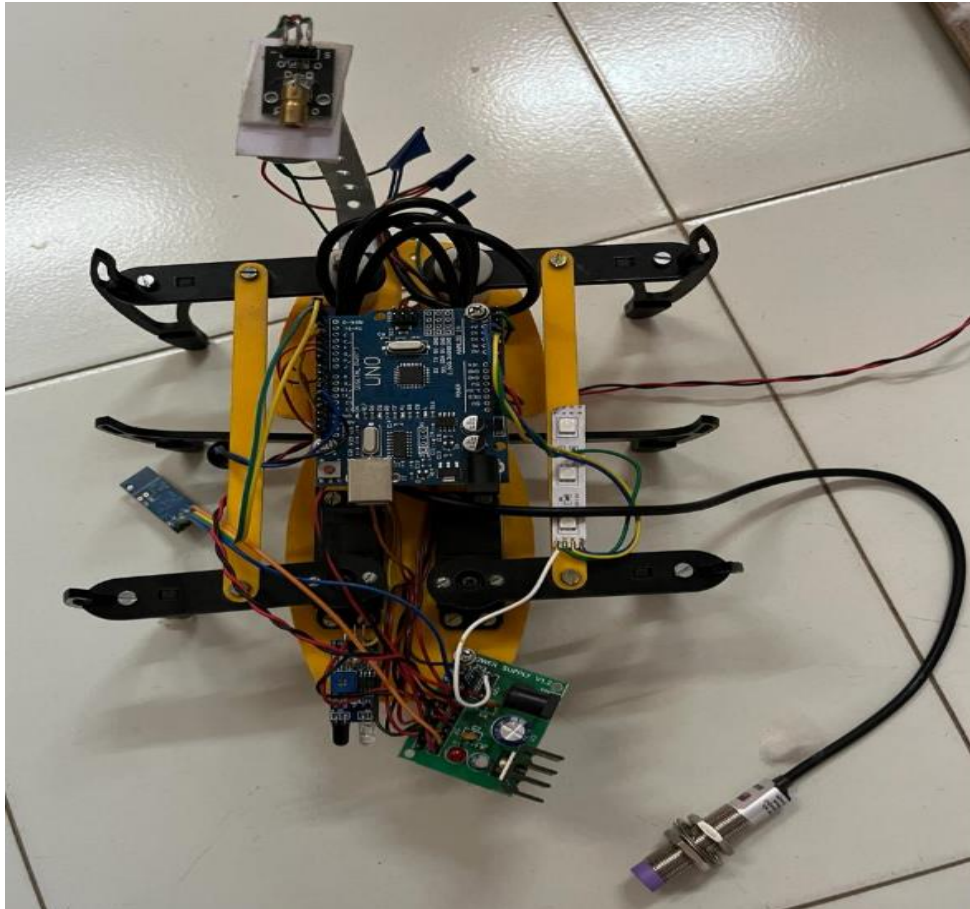


Fig:3 PROTOTYPE OF THE MODEL

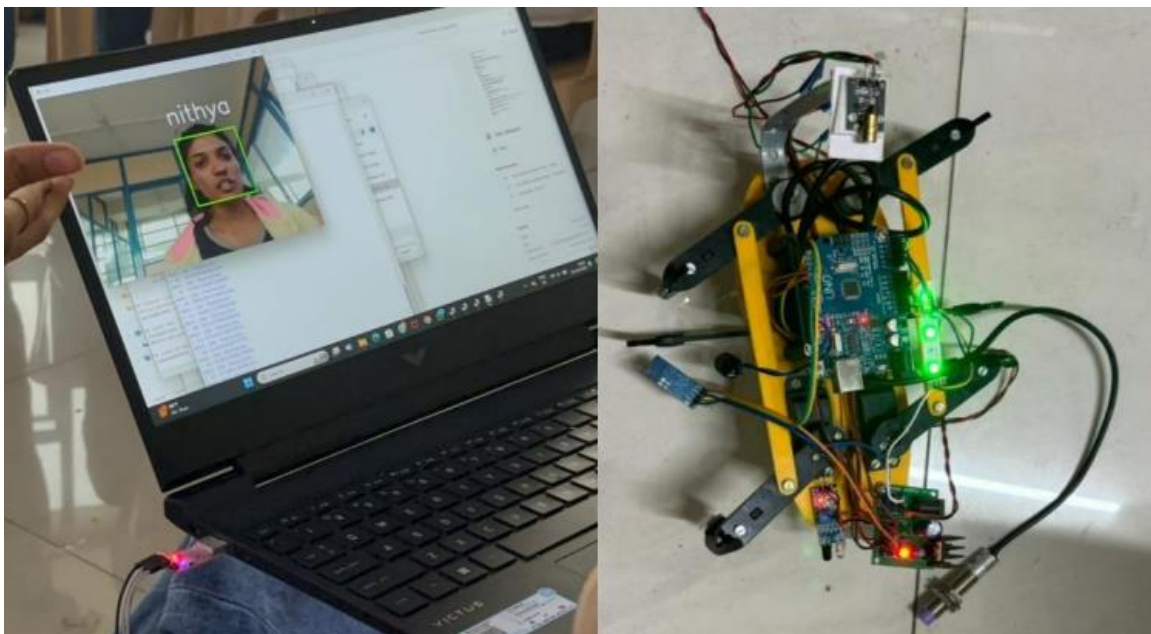


Fig 4: If known person is detected through laptop camera, green LED will be on.



Fig 5: missile detection, if any guns, bombs, knives are detected through laptop camera red LED will be on and immediate buzzer will be on.

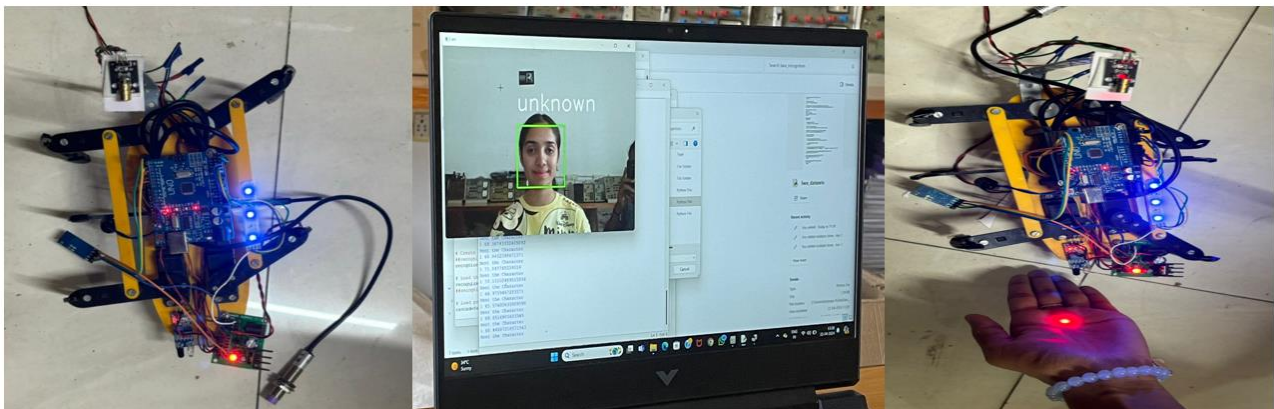


Fig 6 : if any unknown person is detected through laptop camera blue LED will on and immediately Laser gun will be spot on that person.

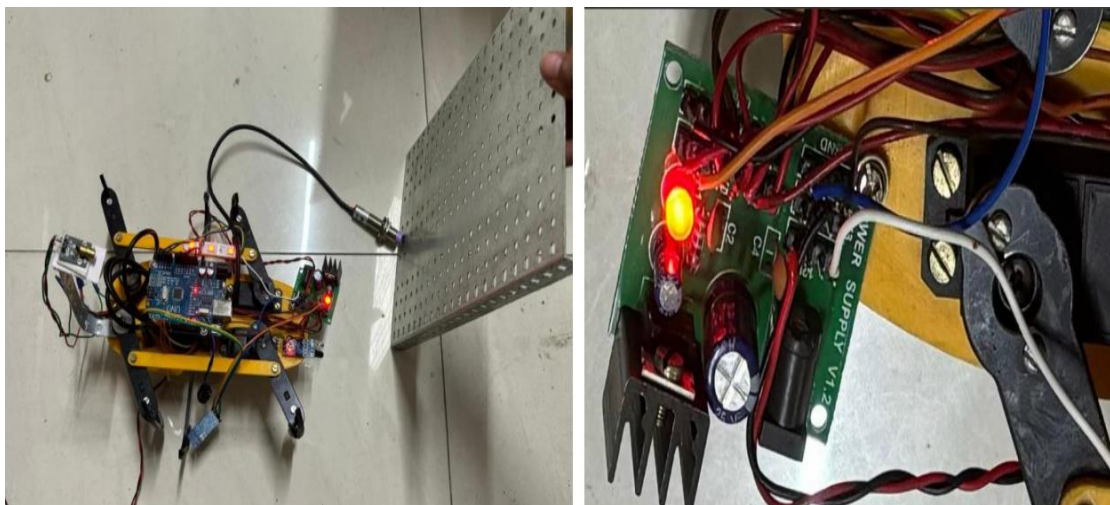


Fig 7 : metal detection, if any metal is detected red LED will be on and immediate buzzer beeps.



V. CONCLUSION AND FUTURE SCOPE

CONCLUSION:

The hexapod robot is designed using arduino, microcontroller with spider like legs to enhance security in defense system and to ensure safe navigation through challenging terrains. The proposed system effectively identifies potential threats and immediately provides rapid response by alerts through buzzer, LEDs and laser guns. For threat identification IR sensor, metal sensor and face recognition are used.

FUTURE SCOPE

Vertical climbing of hexapod robot.

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