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AI-ENHANCED AUTONOMOUS MILITARY ROBOT FOR MINE DETECTION AND THREAT IDENTIFICATION

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Abstract - *The development of an advanced autonomous military robot that employs artificial intelligence (AI) and deep learning (DL) techniques for mine detection and threat identification. The machine learning model, trained to recognize mine patterns, allows the robot to identify potential threats through image analysis. Upon detection, the system provides precise latitude and longitude coordinates of the mine's location. Utilizing its trained deep learning model, the robot can identify and capture images of individuals displaying threatening behavior.This project introduces an AI-enhanced autonomous military robot designed for mine detection and threat identification. Using artificial intelligence, sensors, and computer vision, the robot can navigate, detect, and identify threats with high accuracy. It reduces human risk, improves mission safety, and provides a smart, reliable solution for military operations in hazardous areas.*

Key Words: Autonomous mine detection robot, AI mine detection, explosive ordnance detection, threat identification robot, autonomous EOD system

1.INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) and robotics has revolutionized modern defense technologies, enabling the development of intelligent and autonomous systems for critical military operations. One of the most significant applications of such technology is in mine detection and threat identification, where human involvement often poses severe risks. Traditional methods of landmine and explosive detection rely heavily on manual operations or remotely controlled vehicles, which are both time-consuming and hazardous.The AI-enhanced autonomous military robot is developed to perform mine detection and threat identification in dangerous areas. By combining artificial intelligence, sensors, and computer vision, it can detect landmines and identify threats without human risk. This technology improves safety, accuracy, and efficiency in modern military operations.

2.LITERATURE SURVEY

Tittle: Mine Detection using a Swarm of Robots
Year Published: 2020
Journal Name: IEEE
Author Name: Luca Bossi, Pierluigi Falorni, Gennadiy Pochanin,Timothy Bechtel, Jack Sinton,Fronefield Crawford Proposed Method in the paper:In this paper they have only used the sensors to detect the landmines while ysing the Sensor there will be a list of Problems like Accuracy,range etc...so we have Integrated the camera with that.
Advantage:I this paper we have worked to improve the Accuracy of the detection of the landmines in the war fields.
Recent studies show that AI and robotics are increasingly used for mine detection and threat identification in military operations. Existing systems use sensors and machine learning for detection but struggle in complex terrains. This project improves these methods by integrating AI, sensor fusion, and computer vision for safer and more accurate threat detection.

3.Methodology

The robot uses AI algorithms, sensors, and camera modules to detect objects and obstacles. It employs sensor fusion for mine detection and image processing for threat identification. The robot's microcontroller processes data and enables autonomous movement and decision-making.

4.Existing system

Metal Sensor: The existing system mainly relies on metal sensors to detect landmines. However, this method is not highly efficient as it can produce false alarms due to the presence of metallic debris.

Manual or Semi-Autonomous Control: Movement and detection are often manually operated or semi-autonomous, requiring human supervision for navigation and decision-making.

Arduino Controller: Most existing systems use Arduino as the main controller to process sensor data and control robot movement. However, it has limited processing power and lacks support for advanced image processing.

Limited Communication and GPS: Some systems include GPS to mark detected locations, but real-time data transmission and precise positioning are often limited or less reliable.

5.TECHNOLOGIES USED IN PROPOSED SYSTEM

Metal Sensor:
We have used to use the Meatal Sensor to detect the land mines even though this is no the efficient way we have used this as a source to detect the land mines.

Deep Learning:
We have Already discussed that detecting the landmines by using the sensor is not though efficient in this we have integrated the Deep learning Methods and open CV to Fine the land mines.

Raspberry Pi:

Raspberry pi is our main controller. Raspberry pi is known as a minicomputer by using this we can able to process what are the things we can do in our PC. In the existing system most of them have used the Arduino the reason for choosing the raspberry is they have a good processing speed compared to the Arduino. As well as the Arduino has No inbuilt camera port to connect the camera but our raspberry pi has a inbuilt camera port to connect the camera so it is an added advantage in this.

GPS:
By using the GPS module we are going to send the location of the mines.

Motor Driver:
Motor driver is a device by using this we are going to control our motor directions.

DC motor:
By using this DC motors we are going to move the robot.

Pi Camera:
Using this pi camera we are going to detect those mines.

6.ARCHITECTURE DIAGRAM

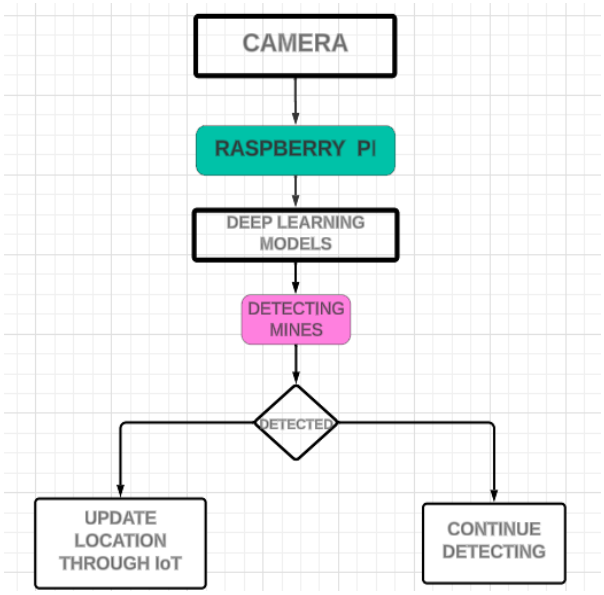


Fig-1: Architecture Diagram

7.UML DIAGRAM

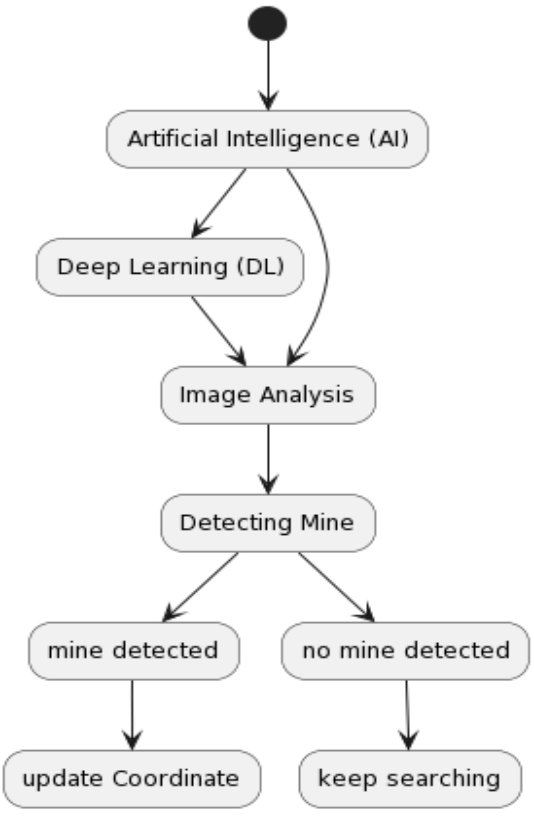


Fig-2: UML Diagram

8. Challenges in Autonomous Military Robot

1.Accurate Mine Detection: Detecting deeply buried or non-metallic mines remains difficult due to varying soil and terrain conditions.
2.Sensor Limitations: Sensors may give false readings due to environmental factors like humidity, temperature, or metallic interference.
3.Real-Time Processing: Implementing AI algorithms for quick and precise decision-making requires high processing power.

9 .CONCLUSION AND FUTURE WORK

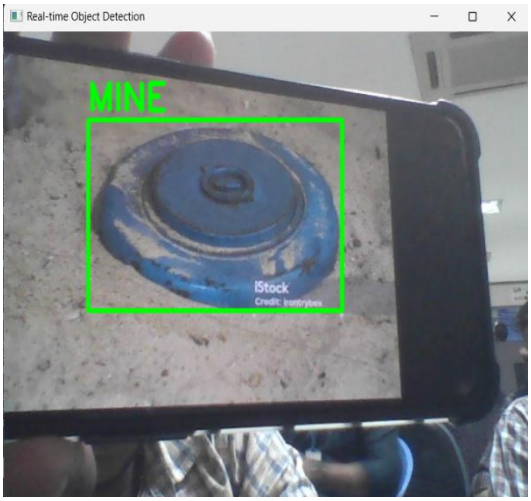
In conclusion, creating an advanced military robot with AI and deep learning is a big step forward for finding mines and spotting threats. The robot learns to recognize mine patterns and quickly finds potential dangers using pictures. It can also give exact locations of mines so they can be removed safely.

This robot can do more than find mines - it can take pictures of people acting suspiciously, helping soldiers stay aware in dangerous situations. By using AI and deep learning together, this robot makes it safer for soldiers and civilians in war zones.

In the future, we'll likely see even better robots thanks to more research. These robots will be smarter and able to handle more tasks in the military and maybe even beyond. But it's important to be careful, making sure these robots are used ethically, with people overseeing them, and following international laws as they become more common in the military.

SAMPLE CODE

```
import os
import cv2
from ultralytics import YOLO

image_dir= "C:/Users/fired/Downloads/mine_yolo/images"

image_path = os.path.join(image_dir, 'input.jpg')

cap = cv2.VideoCapture(0)
ret, frame = cap.read()
H, W, _ = frame.shape

model_path = os.path.join('C:/Users/fired/Downloads/mine_yolo/mine_yolo', 'runs', 'detect', 'train', 'weights', 'best.pt')

# Load a model
model = YOLO(model_path)  # load a custom model

threshold = 0.5

while ret:
    results = model(frame)[0]

    for result in results.boxes.data.tolist():
        x1, y1, x2, y2, score, class_id = result

        if score > threshold:
            cv2.rectangle(frame, (int(x1), int(y1)), (int(x2), int(y2)), (0, 255, 0), 4)
            cv2.putText(frame, results.names[int(class_id)].upper(), (int(x1), int(y1 - 10)),
                        cv2.FONT_HERSHEY_SIMPLEX, 1.3, (0, 255, 0), 3, cv2.LINE_AA)

    cv2.imshow('Real-time Object Detection', frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

    ret, frame = cap.read()

cap.release()
cv2.destroyAllWindows()
```



Output

10.REFERENCES

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