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"A work on: Speech Guided Landmine Detector Robot"

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Abstract
Landmines pose a significant threat to civilian populations and military personnel in post-conflict regions. Traditional methods of landmine detection are often dangerous, time-consuming, and require substantial human involvement. This project presents the development of a speech-guided landmine detector robot designed to enhance the efficiency and safety of mine-clearing operations.
During field tests, the robot demonstrated high accuracy in detecting various types of landmines buried at different depths and in diverse soil conditions. The use of speech commands significantly improved the operational efficiency and safety, allowing operators to focus on strategic decision-making rather than manual control. This work focuses on designing and implementing an AI-based voice-controlled robot. The robot is equipped with speech recognition technology, which enables it to understand and respond to voice commands given by the user. The project involves the use of various AI technologies such as Natural Language Processing, Machine Learning, and Computer Vision, which allow the robot to interpret and respond to user commands accurately. The robot's performance is evaluated based on its ability to recognize and respond to different voice commands in real-time. The project aims to demonstrate the potential of AI-based voice-controlled robots and their potential to revolutionize the way we interact with machines.
Keywords: *Arduino UNO, DC Motor, LED, Robot Wheel Buzzer etc.*

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I. Introduction

Robots can be utilized to complete work in perilous zones and can be used to manage troublesome instability levels in such areas. Gradually robots are becoming dynamically vital for standard subject applications, for instance, Urban Hunt and Salvage and military applications. A variety of small robotic applications now arising where robots are utilized to complete an assortment of errands. By and large, robots are still utilized for unsafe work which is dangerous for humans, e.g., control automaton, spy robot, salvage robot, therapeutic operation and so forth. Robots are known to perform tasks automatically without much human intervention, except for initial programming and instruction set being provided to them. From a broad view, robotics is actually the continuous endeavor of robotics engineers to make machines capable of performing tasks as delicately as human can do and also the complicated, tough and repeated tasks which humans would prefer not to do. The advancements in the field robotics are made possible by use of microprocessors and microcontrollers with the intelligent combination of them with servo motors, sensors and actuators.

Metal detecting robot is utilized to search for metal objects covered up in ground. Military bomb-disposal specialists use metal detectors to scan for area mines covered up beneath streets and in mine fields. Electricians also use metal detectors to scan for electrical cables hidden in walls. At airplane terminals, metal finders are utilized to scan travelers for metal protests, for example, cuts and firearms. For searching old combat zones and historical sites. hoping to find treasures, jewelry and old coins, metal detectors are frequently used. In food factories, they are used to check and verify that no metal things have fallen from industrial factory into the food Unintentionally. This project focuses on designing and developing a robotic vehicle that can sense metal in front of it on its way like detecting land mines. A metal detector circuit interfaced to the control unit that alarms the user about a suspected metal ahead. The metal detector circuit is mounted on a robotic vehicle and its operation is to detect metals underneath automatically. Researchers proposed several methods to promote the metal detection robot for identifying strong and weak conductive metals. Here, we aim to make a robot and to connect the metal detector circuit to it.

1.1 Problem statement

There are many things that can interfere with the proper operation of a metal detector. Easily 80% of

"metal detector" problems are found to be caused by outside influences rather than the metal detector itself. Today's metal detectors are sophisticated electronic devices. Because the metal detector is made of a transmitting and receiving antenna, it is susceptible to other signals that might be present in the area. The best method to minimize the interference is to place a shield around the possible source and electrically ground the shield.

II. Literature Review

B. Sai Kiran et.al., [1] proposes Remote controlled technology that detects using Beagle Bone Black in embedded system domain. This project works with the proximity sensor as its metal detector. When the metal is detected it send the output to the mail. The signal getting from RF transmitter through RF receiver is also sent to the Beagle Bone Black. The Beagle Bone Black directly cannot drive the motors.so Beagle Bone Black sends the output to the L293 motor driver. This motor driver runs the motors. The advantage of this technology is Improvement of detection rate. This project can be further enhanced by using live streaming and used wireless by using Wi-Fi modules in the robot.

Tania Alauddin et.al., [2] proposed Efficient Design of a Metal Detector Equipped Remote- Controlled Robotic Vehicle using Bluetooth communication and Android smartphone; mobile app Technology. This project focuses on designing and developing a robotic vehicle that can sense metals in front of it on its way like detecting land mines. Aims at reducing the cost of production, so this robotic system can be deployed in a low budget situation, which istypical in the developing and the underdeveloped world. The one drawback to any locator design is its requirement of a coil, which must be very precisely and inflexibly positioned.

S. Sasikumar et.al., [3] proposed Multi Utility Landmine Detecting Robotic Vehicle using the most common method is electromagnetic induction (EMI) based sensors can detect metal mines at a low cost. This project aims at designing a landmine detecting robot that uses GPS technology and is controlled by the 328p microcontroller. This Provides less complex structure and reduces the cost to build a landmine detection robot and this robot offers is the safety for the soldiers on war field. In case of plastic landmine detection, the detector can be replaced by ground penetrating radar or other detection mechanism.

Narendra Prasad M et.al., [4] proposes IOT controlled metal detecting robot with remote video transmission to assist bomb detection and rescue team using RPI. The technology OS used in Raspberry pi is Linux. The important advantage of this project is Remote Operation. Industries are using IoT solutions for monitoring, control, process, inventory tracking, data links and bar code reading devices.

Ananya Bhattacharyya [5] implements a new type of robot that uses a metal detector sensor to detect metallic object passing over the metal detector. The robotic vehicle is controlled using android application for metal detection operation controlled with the help of Bluetooth technology. This project can be widely used because of its simplicity and ability to modify to meet changes of needs. Based on experimental studies, it was found that the mobile controlled robot can move in any direction as per the desired instruction and the beeper in the metal detector circuit beeps whenever it encounters any metallic object.

III. Objective

To build a robotic vehicle that can sense metals ahead of it.

1. Metal detectors is an electronic device specially designed for detecting of metal objects such as iron, nickel, copper, brass, aluminum, tin, lead, gold, silver and bronze**.** and various kinds of precious and non-precious metals.
2. It works based on a principle of Electromagnetic Induction. In electromagnetic detectors for example there are two copper coils in the search head [search coil] of the metal detector. One coil act as a transmitter, and the other coil acts as a receiver. The first one transmits a magnetic field that is generated by electricity that moves through the coil.
3. That magnetic field that is being transmitted will cause electricity to flow into metal objects that it comes into contact with. The second coil, the receiver, identifies the difference in the magnetic field that is created as the buried metal absorbs it and the electricity begins to flow through it.
4. When the change is detected, the second coil sends the alert to the control box through the attached cable, and you hear the signal from the speakers or your headphones. The weaker the returning magnetic field the weaker the alert.
5. These devices have a limited scope of depth and relatively cheap prices and It is the most widespread devices in the world because it is easy to manufacture and reliable for hobby.

IV. Methodology

1) Install any Bluetooth Application for Arduino.
2) When the app is operating in the system, themicrophone on the mobile is used to identify uservoice

commands.

3) Pair the HC-05 Bluetooth module with the smartphone using the security key "1234" or "0000".
4) Click on the "MIC" icon in the app to speak the desired command to the robot.
5) Commands are interpreted and the program utilizes Google's speech recognition software to translate voice to text within the app.
6) The text will then be sent with the aid of smartphone's Bluetooth to the receiver part.
7) These commands are received on the robotic device with the help of Bluetooth module setintegrated in it.
8) The Bluetooth Module receives the string, decodes it and compares it with the Instructions that are described in the program and moves the robot as per the command.
9) The L298N motor driver circuit is used to run theDC motors and manipulate the velocity of the car.
10) The ultrasonic sensor detects any object in the path of the vehicle.
11) The complete circuitry is powered by a 12V rechargeable battery.
12) Table above displays the basic voice commands used to control and monitor the robot and its functions.

V. Working

A speech-guided landmine detector robot uses voice commands to navigate and detect landmines. Here's an overview of how such a robot works, focusing on its components, functionality, and a basic outline of its implementation:

5.1 Components:

- Arduino Board: Central controller for the robot.
- Bluetooth Module: For receiving voice commands via a smartphone or other device.
- H-bridge Motor Driver: Controls the motors for movement.
- DC Motors: Drive the robot.
- 12V Battery: Powers the robot and components.
- Metal Detector Sensor: Detects landmines.
- Voice Command App: Translates voice commands to Bluetooth signals.
- Wheels and Chassis: Physical structure of the robot.

5.2 Working Principles:

1. Voice Command Reception:

- Voice Commands: The user speaks commands into a smartphone app that converts speech to text and sends corresponding signals via Bluetooth to the Arduino.
- Bluetooth Module: The module receives these commands and transmits them to the Arduino.

2. Motor Control:

- Arduino Processing: The Arduino interprets the received commands to control the H- bridge motor driver.
- Movement: Based on the command (e.g., forward, backward, left, right, stop), the Arduino sets the appropriate pins on the H-bridge to drive the motors.

3. Landmine Detection:

- Metal Detector Sensor: Continuously scans the ground for metal objects.
- Alert Mechanism: When the sensor detects a metal object, it sends a signal to the Arduino.
- Response: The Arduino can trigger an alert (e.g., LED indicator, buzzer) and stop the robot.

5.3 Implementation Steps:

Hardware Setup:

1. Connect the Motors and H-bridge: Wire the DC motors to the output terminals of the H-bridge. Connect the H-bridge inputs to the Arduino digital pins.
2. Connect the Bluetooth Module: Wire the Bluetooth module to the Arduino's RX and TX pins.
3. Metal Detector Sensor: Connect the sensor output to an analog or digital pin on the Arduino.
4. Power Connections: Ensure all components are powered correctly using the 12V battery and voltage regulators if necessary.

Software:

1. Arduino Code: Write the sketch to handle Bluetooth communication, motor control, and sensor reading.

5.4 Voice Command App:

Use a smartphone app like Bluetooth Voice Control for Arduino.
Configure the app to send specific characters (e.g., 'F' for forward, 'B' for backward) when commands are spoken.

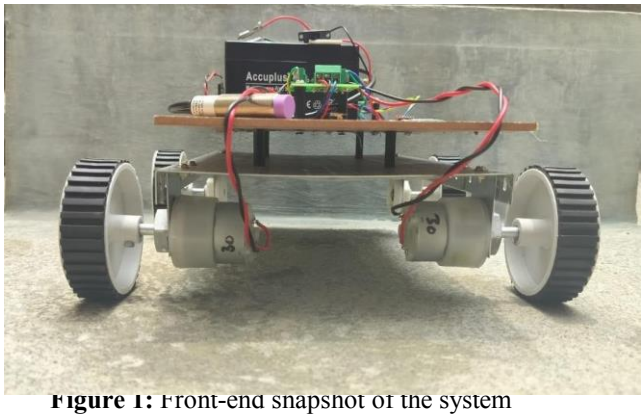

Figure 1: Front-end snapshot of the system

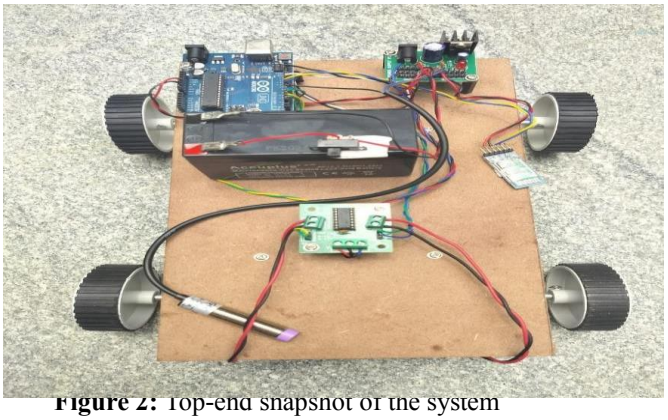

Figure 2: Top-end snapshot of the system

VI. Results and Discussion

6.1Command Results

Table 1: Forwarded command result

Command: Move forward/Forward			
Sr. No.	**Conditions**	**Presenceof Obstacles**	**Vehicle movement**
1.	Distance<45cm	Yes	Stop Check for distance>45cm inleft or right direction and turnin that direction Wait for next voice command
2.	Distance>45cm	Yes	Moves ahead
		No	

Table 2: Leftward command result

Command: Turn left/Left	
Vehicle movement	**Angle of rotation**
Turns to the left side	Rotates 90 degrees anti- clockwise

Table 3: rightward command result

Command: Turn right/Right	
Vehicle movement	**Angle of rotation**
Turns to the right side	Rotates 90 degreesclockwise

Table 4: Backward command result

Command: Move backward/Backward	
Vehicle movement	**Angle of rotation**
Turns back and movesahead	Rotates 180 degreesclockwise

Table5: Backward Command Result

Command: Move backward/Backward	
Vehicle	**Angle of rotation**

movement	
Turns back and movesahead	Rotates 180 degreesclockwise

Table 6: Stop Command Result

Command: Stop
Stops the movement of the vehicle

6.2 Response Time Tabulated Result:

Voice Commands	Response Time (in sec)	Distance (in m)
Forward	**1.40**	**100**
Backward	**1.30**	**100**
Right	**1.80**	**100**
Left	**1.59**	**100**
Stop	**1.63**	**100**

Table 7: Tabulated result of the system

6.3 Response Time Graphical Result:

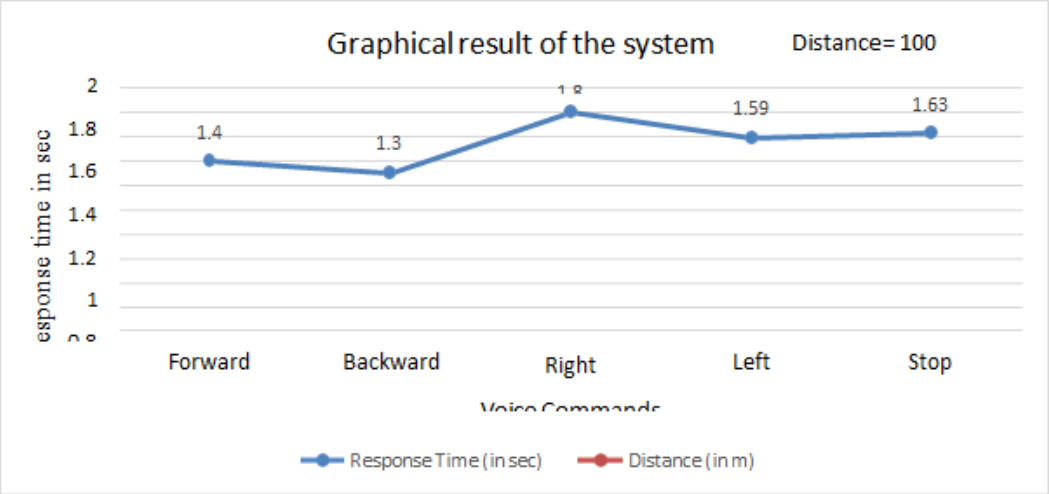

Figure 3: Graphical result of the system

VII. Advantages & Applications of Speech Guided Landmine Detector Robot

7.1 Advantages of a Speech-Guided Landmine Detector Robot:

Hands-Free Operation:

- Voice Control: Allows operators to control the robot without using their hands, which can be crucial in hazardous environments.
- Ease of Use: Voice commands simplify the operation, making it accessible to operators with minimal training.

Safety:

- Remote Operation: Operators can control the robot from a safe distance, reducing the risk of injury from potential landmine explosions.
- Reduced Exposure: Minimizes the need for humans to enter potentially dangerous areas.

Precision and Efficiency:

- Accurate Detection: The metal detector sensor provides precise identification of landmines, improving the efficiency of demining operations.
- Automated Alerts: Immediate alerts upon detecting metal reduce the likelihood of missed

landmines.

Flexibility:

- Adaptable Commands: The system can be programmed to recognize a variety of commands, allowing for flexible and dynamic operation.
- Multi-Terrain Capability: The robot can be designed to navigate different types of terrain, enhancing its utility in diverse environments.

Enhanced Productivity:

- Continuous Operation: Robots can operate continuously without fatigue, increasing the overall productivity of demining operations.
- Reduced Manpower: Fewer personnel are needed on the ground, lowering operational costs and risks.

7.2 Applications of a Speech-Guided Landmine Detector Robot:

Military and Defense:

1. Mine Clearance Operations: Used by military forces to clear landmines in conflict zones or former battlefields.
2. Peacekeeping Missions: Supports international peacekeeping efforts by safely removing landmines from war-torn regions.

Humanitarian Demining:

3. Post-Conflict Recovery: Assists NGOs and humanitarian organizations in clearing landmines to make land safe for civilian use.
4. Community Safety: Helps in making residential and agricultural land safe, enabling displaced populations to return home.

Search and Rescue Operations:

5. Disaster Response: Deployed in areas affected by natural disasters where landmines may have been displaced or exposed.
6. Rapid Area Assessment: Quickly surveys and clears pathways for rescue teams.

Infrastructure Development:

7. Construction and Development: Ensures that areas earmarked for construction, road building, or other infrastructure projects are free of landmines.
8. Public Works: Supports government and private sector projects by providing safe access to land.

Research and Development:

9. Robotics and AI: Used in academic and industrial research to develop advanced robotics, AI, and sensor technologies.
10. Engineering Projects: Serves as a platform for engineering students and professionals to innovate and improve demining technologies.

Environmental Protection:

11. Conservation Areas: Ensures that wildlife conservation areas and natural parks are free from landmines, protecting both wildlife and visitors.
12. Sustainable Land Use: Helps in restoring and rehabilitating land for safe and sustainable use.

VIII. Conclusion

The field of Robotics has been vastly explored in this project which has led to the development of the proposed robotic vehicle. The entire coding has been done from the ground level to make the project run successfully. During the designing of the project, a complete working of Arduino UNO, a Bluetooth module, and ultrasonic sensor is executed and understood. Exposure to various software such as Arduino IDE and Proteus gave us a profound knowledge of how these software works. The voice recognition software has a high accuracy for identifying a voice command and it is also highly sensitive to the surrounding noise.

Different commands have been built in the code for different ways of the movement of vehicle. Henceforth, we were successful in implementing a simple model of voice controlled robotic vehicle which runs successfully on various voice commands given by the user. Additionally, the vehicle successfully detects any obstacle encountered in front of it and stops the movement thereby avoiding collision.

REFERENCES

[1] B. Sai Kiran, P. VijayKanth, B. Naresh Kumar, "Remote controlled metal Detecting robot with image transmission", IJCRT | Volume 6, Issue 2 April 2018.

[2] Tania Alauddin, Md. Tamzid Islam and Hasan U. Zaman, "Efficient Design of A Metal Detector Equipped Remote-Controlled Robotic Vehicle" 978-1-4673-6621- © 2016 IEEE.

[3] S.Sasikumar, K.Suganya, K.Santhosh Kumar, N.Karthikeyan, Prof.S.Kalpanadevi M.E.(PHD),"Multi Utility Landmine Detecting

Robotic Vehicle", IJCRT | Volume 6, Issue 2 April 2018.
[4] Narendra Prasad M, "IOT controlled metal detecting robot with remote video transmission to assist bomb detection and rescue team using RPI", International Journal For Technological Research In Engineering Volume 4, Issue 11, July-2017.
[5] Ananya Bhattacharyya, "Bluetooth Controlled Metal Detector Robot", ADBU Journal of Electrical and Electronics Engineering (AJEEE) Volume 1, Issue 1, may 2017.
[6] Hakim Adil Kadhim, Nabeel Salih Ali, Dheyaa M. Abdulsahib, "Management and achieving system for metal detection robot using wireless-based technology and online database registry", International Journal of Power Electronics and Drive System (IJPEDS) Vol. 10, No. 1, March 2019.
[7] Pavithra A C Dept. of ECE ATMECE, "Obstacle Avoidance Robot Using Arduino ", (IJERT) ISSN: 2278-0181,year-2020.
[8] K.Suresh, K.Vidyasagar, Abdul Farooq Basha, "Multi Directional Conductive Metal Detection Robot Control", Volume 109 – No. 4, January 2019.
[9] Petr Nováček, Jan Roháč, Jakub Šimánek, and Pavel Ripka, "Metal Detector Signal Imprints of Detected Objects", IEEE Transactions on magnetics, Vol. 49, No. 1, January 2020.
[10] Indhu Mathi, P. Saranya, R. Susmitha, L. Jiban Priya Devi4, "Wireless Robo-Pi for Landmine Detection using Voice Control ", Volume-2, Issue-2, February-2019.
[11] P.Greeshma Shivani, Somani Harshit, Ch. Vamsi Varma, R. Mahalakshmi, "Land mine detection using unmanned ground vehicle", IEEE Xplore Part Number: CFP20J32-ART; ISBN: 978-1-7281-55180, September-2019.
[12] Thuraya Nasser Ibrahim Alrumaih, "The Construction of a Robotic Vehicle Metal Detector as a Tool for Searching Archaeology Sites", Year-2016.
[13] Salman-ul-Hassan Dar, Zoya Tanzeel, Fatima Mahmood, Umer Izhar, "GPS-Based Landmine Detection System for Multiple Operating Units", Year-2017.
[14] Jakub Svatos , "Metal Discrimination Using Time Domain Processed Sinc Signal", October3-5, 2018.
[15] Kunaraj , J. Joy Mathavan , M. Mathushan , G.M. Kamalesan , "Sensor Controlled Defense Purpose Robot for Land Mine Detection ", CFP20V90-ART; ISBN: 978-1- 7281-5461-2019.
[16] M. Yuvaraju, P.M.Benson Mansingh, G Sekar, "A Li-Fi Based Collision Avoidance System For Vehicles Using Visible Light Communication", 2021 17th International Conference on Electrical Energy Systems(ICEES), 26 March 2021.
[17] Roheshkumar Lavate, "Design and Analysis of metal detecting rover vehicle using rocker bogie suspension', Year-2017.
[18] Hirzi Mohd Ishak, Herdawatie Abdul Kadir, Lim Chain Fat, "Autonomous metal detector robot with monitoring system", 2018 International Symposium on Information Technology, 26 September 2018.
[19] M. Sirisha, Prof. Sonali S. Patil, "Bluetooth controlled metal detecting robot with message alert", International Journal of Creative Research Thoughts (IJCRT), | ISSN: 2320-2882, Volume 9, Issue 4 April 2021.
[20] N. P. Jawarkar, Vasif Ahmed, "Implementation of Autonomous Metal Detection Robot with Image and Message Transmission using Cell Phone", International Journal of Science and Research (IJSR) (Vol.5, No.1), year-2017.