Automatic Landmine Detection Using Robot

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Abstract— The Landmine detecting robots are designed to cover maximum possible area of landmine field for detection of landmines. The detected landmines along with scanned and leftover area are represented on a visual map with accuracy in millimeters. This paper presents a prototype model of land mine detecting robot that is powerful yet low cost and easily controllable. A graphical user interface is developed for plotting the landmines, scanned & leftover area presentation, PID tuning and camera alignment. Emphasis is placed on the control of the differential drive robot in auto mode, semi-auto mode and the manual mode. Image processing technique is employed to find the accurate position of robot which provides the live reckoning feedback to the dead reckoning servo control of the robot. Metal detector is the sensor used to detect landmines. The graphical user interface for the remote terminal computer provides the effective control for the robot. The system is simple but powerful and intelligible to achieve the required results.

Index Terms— Automatic Robot, Changing Place of Landmine, Landmine Detection, Micro- controller-based Robot.

I. INTRODUCTION

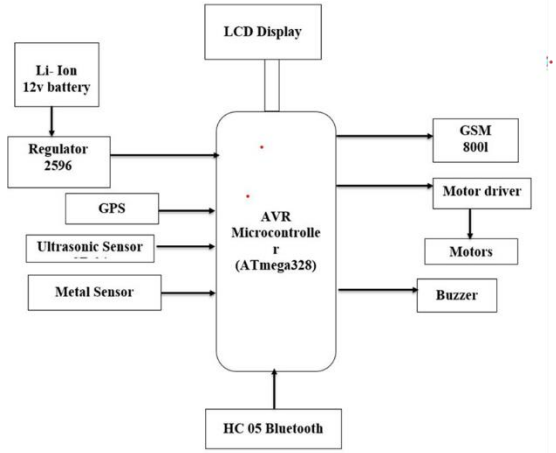
In today's world, keeping our country safe is very important because there are many weapons that can cause harm. One dangerous threat is landmines, which are hidden explosives placed underground by enemies. They explode when someone steps on them or a vehicle drives over them. This explosion happens because the weight of the person or vehicle triggers the explosive. Landmines can cause deadly damage, so it's crucial to find and remove them before anyone accidentally triggers them. Detecting landmines without setting them off is a big challenge. The process of finding them is called minesweeping, and removing them safely is called demining.

In the past, animals like dogs and rats were trained to help find landmines, but now we use technology like metal detectors and special tools attached to vehicles. These tools help us find landmines without risking human lives. Robots are also used in many industries for various tasks. They are advanced machines that can perform different activities. Nowadays, we use robots called Landmine Detection Robotic Vehicles and unmanned robots to find landmines. These robots are very reliable and accurate in detecting landmines, and they keep humans safe by allowing operators to control them from a distance, using wireless or remote control. The robots use metal detectors to find buried landmines because most of them have metal parts. They move in a zig-zag pattern to cover more ground efficiently. This system keeps the operator at a safe distance while the robot does the dangerous work of finding and removing landmines.

II. OBJECTIVES

By developing such a robotic vehicle, The "Landmine Detector Robotic Vehicle" aims to significantly improve the efficiency and safety of landmine clearance operations. The autonomous nature of the vehicle allows for increased speed and precision in detecting and marking landmines, reducing the time and resources required for clearance. The specific objectives of a Landmine Detector Robotic Vehicle project includes: safety, efficiency, accuracy, integration, facilitate mobile control and coordination and field testing.

III. PROPOSED MODEL



IV. WORKING

Firstly, the robot is equipped with a metal sensor that can detect metallic objects, such as landmines, buried underground. This sensor is positioned at the front of the robot, ensuring that it can detect any metals in its path as it moves.

The robot's movement is controlled remotely via SMS commands. The operator sends specific commands via SMS to the robot's registered mobile number. These commands can include instructions to start, stop, or change the direction of the robot's movement. As the robot moves forward, its metal sensor continuously scans the ground. If the sensor detects any metal, indicating the presence of a landmine, the robot immediately stops its movement. Simultaneously, it sends an SMS alert to the registered mobile number, notifying the operator about the detected metal object.

Additionally, the robot is equipped with a 16x2 LCD display. This display shows important information about the robot's status and the detected metal object. For example, it can show messages like "Metal Detected - STOPPED" or "No Metal Detected - Proceeding."

The SMS sent by the robot also includes the Google Maps location of where the metal object was detected. This feature is possible due to the robot's GPS capabilities. By including the location in the SMS alert, the operator can easily track and pinpoint the exact location of the detected landmine on a map.

In summary, the robot's working involves remote control via SMS commands, metal detection using a sensor, immediate stopping upon detecting metal, sending SMS alerts with location information, and displaying relevant data on an LCD screen. These features combine to create an efficient and safe method for detecting and tracking landmines in real-time.

V. HARDWARE AND SOFTWARE REQUIREMENTS

- Software Requirement

1. AVR studio (Programming C): - AVR studio is an Integrated Development Environment (IDE) developed by ATMEL for developing different embedded applications based on 8-bit AVR microcontroller.
2. Express PCB (Circuit &layout design)

- Hardware Requirement

1. Microcontroller (AT mega 328): The high-performance Microchip 8-bit AVR® RISC-based microcontroller combines 32 KB ISP Flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts
2. GPS: The Global Positioning System (GPS), it provides users with positioning, navigation, and timing (PNT) services
3. Battery 12v: The battery supplies 12 volts under a nominal load
4. GSM 800L: - SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls.
5. Regulator (2596): Regulator. LM2596. The LM2596 regulator is monolithic integrated circuit ideally suited for easy and convenient

design of a step−down switching regulator (buck conv

6. LCD 16*2 & SR 04: An electronic device that is used to display data and the message.
7. Metel detection: The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar.
8. HC -05: - The HC-05 is a class 2 Bluetooth module designed for transparent wireless serial communication.
9. Motor driver: - Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive.
10. DC 12v motors 30RPM: - This DC Motor of 12V 30 RPM can be used in all-terrain robots and a variety of robotic applications.
11. Motor driver: Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive.

VI. RESULTS

- Movement in all Four Directions: The robot is designed to move in all four directions - right, left, front, and back. This versatility allows it to navigate various terrains and cover a wide area efficiently during its mine detection operations.

Detection of Mines Ahead: Equipped with a metal sensor positioned at the front, the robot can detect mines ahead of its path as it moves. This proactive approach ensures that potential threats are identified before the robot comes into direct contact with them, enhancing safety for both the robot and the operator.

Simplified Design and Cost Reduction: The model of this robot is designed to be less complex, making it more cost-effective to build compared to more intricate robotic systems. This aspect is crucial for making landmine detection technology accessible and affordable, especially in regions where resources may be limited.

GPS Positioning for Precise Location: Incorporating a GPS module enables the robot to provide precise latitude and longitude coordinates of the detected landmine's location. This capability is invaluable as it allows operators and response teams to pinpoint the exact position of the threat on a map, facilitating efficient and targeted demining operations.

In conclusion, the landmine-detecting robot's ability to move in all directions, detect mines ahead, offer a simplified design for cost reduction, and provide accurate GPS coordinates significantly enhances its effectiveness in identifying and addressing landmine threats in a safe and economical manner

CONCLUSION

Anti-Personnel (AP) Landmines are a significant threat to both military personnel and civilians globally, as well as posing challenges to agriculture, ecosystems, and infrastructure in post-conflict areas worldwide. This project focuses on developing a landmine-detecting robot using GSM technology and controlled by an AT89C51 microcontroller. The robot's capability to move in all directions and detect metallic landmines with a metal detecting sensor marks a crucial step in enhancing landmine detection technology.

However, it's important to note that the current model is limited to detecting metallic landmines and cannot identify non-metallic (such as plastic) mines. Additionally, the system lacks the capability to provide detailed information about the type of landmine detected or its metal content due to the absence of an image processing system.

FUTURE USE

Moving forward, there are several areas for potential improvement and future use of this landmine-detecting robot. One important aspect is the integration of a camera system into the robot, allowing real-time surveillance of minefields and providing visual feedback to human operators. This enhancement would enable precise detection and easier defusing of landmines by pinpointing their exact positions.

Moreover, to address the limitation in detecting non-metallic mines, future iterations could incorporate ground penetrating radar or alternative detection mechanisms capable of identifying plastic

or composite landmines. This advancement would significantly broaden the robot's capabilities and effectiveness in diverse environments.

Additionally, incorporating shock absorbers and adjusters into the robot's wheels would enhance its mobility, allowing it to traverse challenging terrains with ease. This adaptability is crucial for ensuring the robot's functionality across a wide range of landscapes, including rugged or uneven surfaces commonly found in conflict zones.

In summary, future developments in this landmine-detecting robot could include the integration of a camera system for visual feedback, alternative detection mechanisms for non-metallic mines, and improved mobility features for increased versatility and effectiveness in mine detection and clearance operations.

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