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Landmine Detection Robot with Live Surveillance

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Abstract

Nowadays in war-torn communities around the world, landmines are causing immense civilian casualties. A land mine is an explosive device, which is meant to destroy or disable enemy and buried under or on the ground, especially in the mined countries like Afghanistan and Iraq. Accordingly, the majority of land mines are located under the ground surface and are triggered by pressure or tripwire. Mostly the surface of the landmines will have many metallic pipes for detection purposes. The mines lying amid the war time may remain unfounded. To conclude, as the name implies, Metal Detector Sensor is used in this case and can be done deeper into the mine more precisely. This project relates to the concept of designing and implementing the robotic vehicle which can locate the landmine and indicates their places via text message to the respective authorities. A live surveillance system will be available in the robotic vehicle, which will also increase visibility and safety. The special function of this robot is to deliver ammunition to dogface that are in the hard-to-reach area during war without human loss. In addition to that, it can be employed to target deadly places in advance for losers and munitions at the same time. It is expected that the robot will possess the ability to identify and mark landmines, avoiding stepping on those mines and shooting live images to authorities thereby reporting the hazard. questions and other colorful ones in this area have caused us to improve the mine-detecting robots.

Keywords: Landmine detection robot, metal detector sensor, ATmega328 IC, GSM module, ESP32-CAM module, DC motors, motor driver.

INTRODUCTION

In warfare, most of the antecedents are made by buried landmines. The unexploded landmines take many lives even after closing of a conflict. Brutal parcels of landmines are once it's active, it can be operable for a genuinely long time. Hence, there's always a danger of fatalities damage and injury causing death. Landmines became effective ammunition in warfare as it's cheap and easy to make. Mostly, it consists of snare along with some driving medium. driving may be caused by weight. Depending upon weight it demanded to get touched off there are many types of landmines. When ready, they are buried at a shallow depth in soil and hence not fluently get mindful with naked eyes. You can give landmine over to someone and if the person puts the landmine on the ground, it will make an explosion killing the person.

Landmines can be buried in certain patterns to surround movements of an adversary. They can be buried in a zigzag pattern to slow the movement of the adversary as they flee or they be placed in such a way to force the adversaries to leave their path and lead them into an ambush. Due to these numerous features, they are placed to be very effective armament as they can be buried easily, they remain

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undetected, and they are in such place for a great amount of time. This paper will include an overview of the beings and latest ways created for the discovery of landmines. Electronics had played a great role in the development and successful application of some of these ways.

Many ways that are bandied then includes the use of metal sensors, mechanical styles. Working, advantages and limitations of each fashion are bandied. The performance of the discovery system can be enhanced by using multiple ways. Landmines continue to be a constant issue. Many landmines that remain active today were buried because of wars and conflicts in bygone eras; de-mining them is a challenging, risky, and time-consuming process. As is customary, if the expected solution results in the loss of human life, it is unacceptable. Technology makes it possible to use robots to handle this problem scientifically and without endangering human life.

Aims

1. To Design and Develop a Landmine detection Robot that will detect the presence of a Landmine in military areas with the help of Metal Detector Sensor and various other sensors.
2. To Trace the Location of a potential Landmine with the help of a GPS Module which will locate the co-ordinates and a GSM Module which will send a Alert Message to the Respected Authorities.
3. To Implement Live Surveillance by using Esp Cam and hence, ensuring the Safety and Security of Civilians and detecting the presence or potential movements of the enemies.

Objectives

1. To develop a safe and reliable landmine detection robot at minimum cost. The robot should be capable of detecting landmines in different terrains and weather conditions and operate either autonomously or remotely.
2. To build a more robust landmine detection robot capable of functioning on rough terrain, and heavy vegetation. The robot should adjust to modifications in the environment.
3. To develop a landmine detection robot which can be safely and conveniently operated by human operators.

LITERATURE REVIEW

Ibrahim A. Hameed, Norwegian University of Science and Technology NTNU Faculty of Engineering and Natural Sciences has reported, Demining or mine clearing is the process of identifying and moving land mine from that place. Up to 70 countries around the world have faced the problem of uncleared landmines that are both humanitarian and economic burdens. This disease causes lifelong disability if not death, and the treatment is exceptionally unnecessary demanding. Further, the other expenditures including of the land, roads, and underground resources that becomes useless. The demining process is so hazardous. Demining work is mostly done by hand using a metal detector and a prodder for now. For that iteration of 5,000 mines off the streets, one person dies, and two others are injured. A variety of engineering and scientific backgrounds have also contributed advanced technology to enhance the safety and production of space mining missions. In this article, a motion planning setup to enable land mine detection and clearing robot to scan a minefield, locate mines and clear is proposed [1].

Robots can be a very useful tool in situations where explosive conditions are present, considerable smoke is present, or unstable ground conditions prevent team members from penetrating a mine. Since the beginning of mining, there have been mishaps. From 1900 to 2007, there were 525 mining catastrophes (incidents with five or more fatalities) in the United States, resulting in 12,823 fatalities in both coal and metal/nonmetal mines [2].

Vishnu Prakash, Pramod Sreedharan, Department of Mechanical Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, India points out the fact that due to the magnitude of destruction both human life and economic losses, landmine detection and investigation are the key to the recovery and well-

being of the affected population. This process has resulted in growing numbers of effective and safe means that allow for mine detection, marking, and clearance. Often it is the case that the equipment needed is costly, complex to operate and necessitates professionally trained technicians. A major part of this activity had been performed by human workers for a long time. Traditional approaches are very dangerous and human life is threatened. The adoption of these kinds of conventional techniques necessitates thorough training and utmost care. To decrease the amount of people who are involved the modern technology use mobile robots to track buried landmines. The mobile robot is furnished with several sensors for landmine detection and autonomous mobility. This paper develops and models a concept of the mobile robot, which is meant to detect and locate buried mines on the battlefield to cut down the number of human activities [3].

Using GPS technology, a robot has been designed by Subramanian et al to identify these landmines and locate their positions. To help pinpoint the precise location of the landmines, further feedback regarding the latitude and longitude location results is transmitted to the server via Global System for Mobile Communication (GSM) technology. Using the same GSM technology, feedback can be received on mobile devices to notify the bomb squad member. The robot has a camera built into it for navigation, which allows it to identify obstacles in its path and trouble spots by taking pictures and using them to guide its movements. Both fragmentation mines and blast mines, which are anti-personnel landmines, may be dealt with by this robot. This robot works well for defensive applications in times of war and peace, when it is desired to eliminate the threat posed by landmines and improve the quality of life for residents [4].

With Girish Santosh Bagale, Abhishek Jire, Assistant professor, Mukesh Patel School of Technology Management and Engineering, Mumbai, Maharashtra, India as a team member, the group proposed a robotic vehicle which can detect landmines, mark their figures, and avoid those landmines towards a particular destination where the person intends to go. Some of the prime cases of when to use this type of robot is supplying to soldiers living in remote areas in war situation without losing human life minimum as much as possible. It can be especially used for this purpose to scout out if the area is unsafe before soldiers can enter, for example in the search for mines or caches of arms. It will be capable of detecting the landmines, simply by displaying them on maps, no one can step on those landmines and push the button and activating them. So much research in this field was conducted and they really did serve as our roadmap to creating more mine-detecting robots that are more sophisticated. Like us, we want to pay tribute to the professional life of the engineers by providing the demonstration [5].

Researching the current scenarios in places like Afghanistan and Iraq, Vrushali P. D. Pawar, Priyanka B. Patkare, Pooja A. Naik, Nikita B. Patil also reveal that civilians are exposed to the life taking dangers of the land mines. A land mine is a type of explosive that has been buried or placed on the ground, with the most prominent mine affected country such as Afghanistan and Iraq, to destroy and damage the enemy in the surroundings. Most land mines are immersed in the subsurface of land and have different modes of activation which can be pressure or tripwire. Typically ground mines consist of different metal components that will serve during their own detection. The hidden mines might be remnants of wartime and thus can be overlooked (or not identified.) Considering the explanation, Metal Detector makes detection possible and hence can be done at a further distance from the mine with high care. The mine detection robot will have to do the same, letting soldiers cross the dangerous landmine areas. The second technique involves the special purpose robots and is the trip of remote-control lands mine which is done through the ground. This is to ensure safety and efficiency in landmine detection [6].

In the project, the team consisting of Dave Watson, Vicky Hoag, Tom Syvertsen, Clark Davenport and advisor Professor Carl Erikson went through the stages of complex tasks before the final satisfied product was achieved. These phases are investigation, design, projection, and acceptance. Once the spring semester of this project started, so did the research and design stages. Accordingly, the research works on mine fields and the requirements of deminers were my initial study subjects, and this research became a foundation for higher-level decisions that later influenced the vehicle design. For my robot

car in my solar robot car project, some of the things I will be talking about are the detailed dataset that include the vehicle size, shape, and weight; the type of materials used to build the vehicle; the type of tires; the type of the batteries and so on [7].

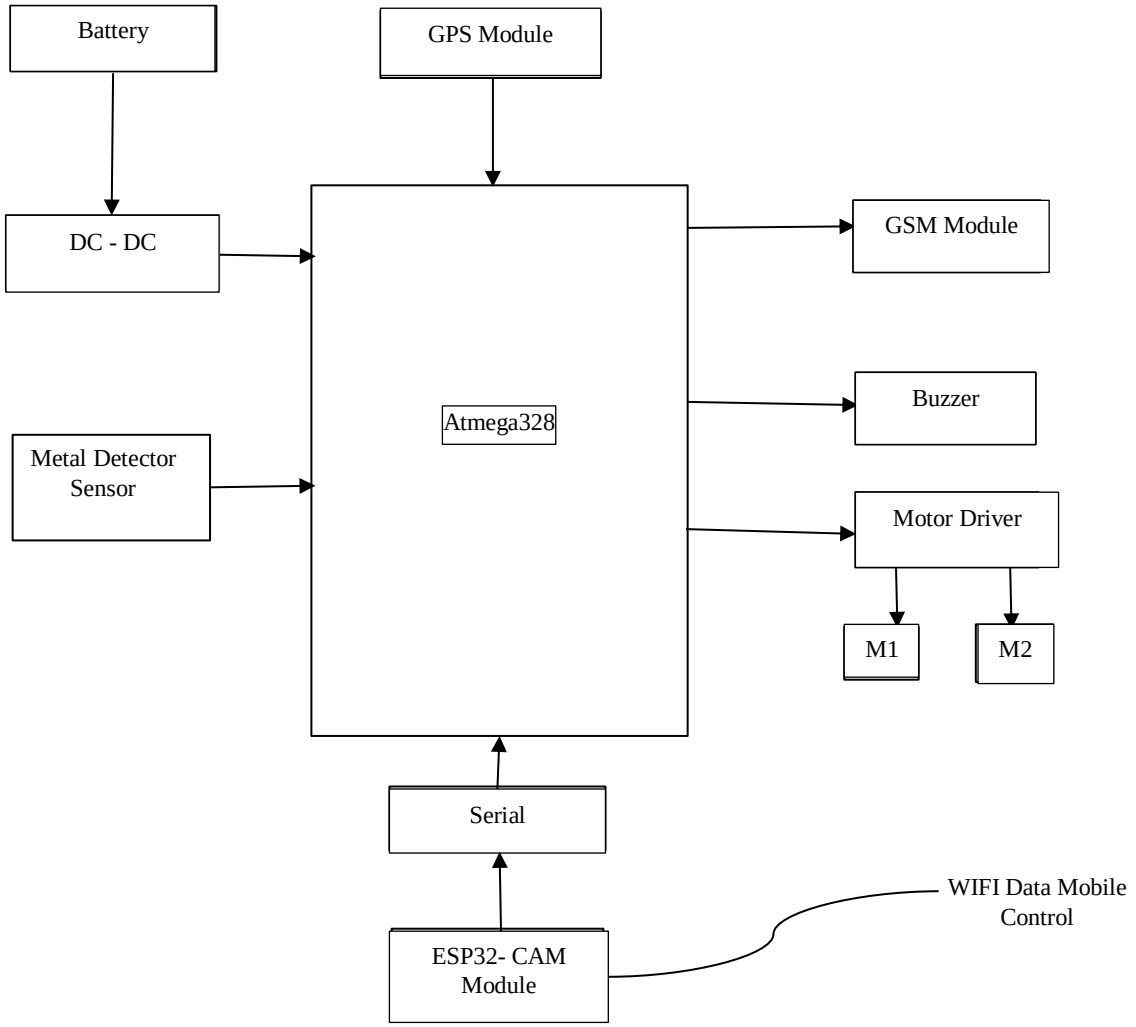

Figure 1. Block Diagram of the Landmine Detection Robot.

The Block Diagram in Figure 1 can be understood as follows:

Battery: The robot makes use of the battery for power source.

DC-DC Converter: This device increases the voltage of the circuit more than the original source voltage. Charge the battery with a certain voltage and use the setup to charge other components.

Metal Detector: Landmines have metallic fragments-like parts, and ore is the widely known element in minerals; It mainly detects metal.

GPS: The robot will navigate the position by the radar Track the robot position.

GSM: If a robot is near the designated area, the robot will send and alert the message to the nearby authority.

Atmega328: This robot is an embedded system, and microcontroller is like the brain of the system. It transmutes sensory data directly into determinant control signals and guides other peripheral actuators.

Serial: This is used for communication with the other sections of the body such as metal detectors, GPS, and GSM modules.

ESP32: Also, it will be this microcontroller too to incorporate extra resources such as Wi-Fi to the robot. Therefore, in such case this module will lets live surveillance for a better understand of the surrounding area.

Motor driver: It governs the speed and direction of the motors. (M1 & M2)

The System flow chart presented in Figure 2 shows the working mechanism.

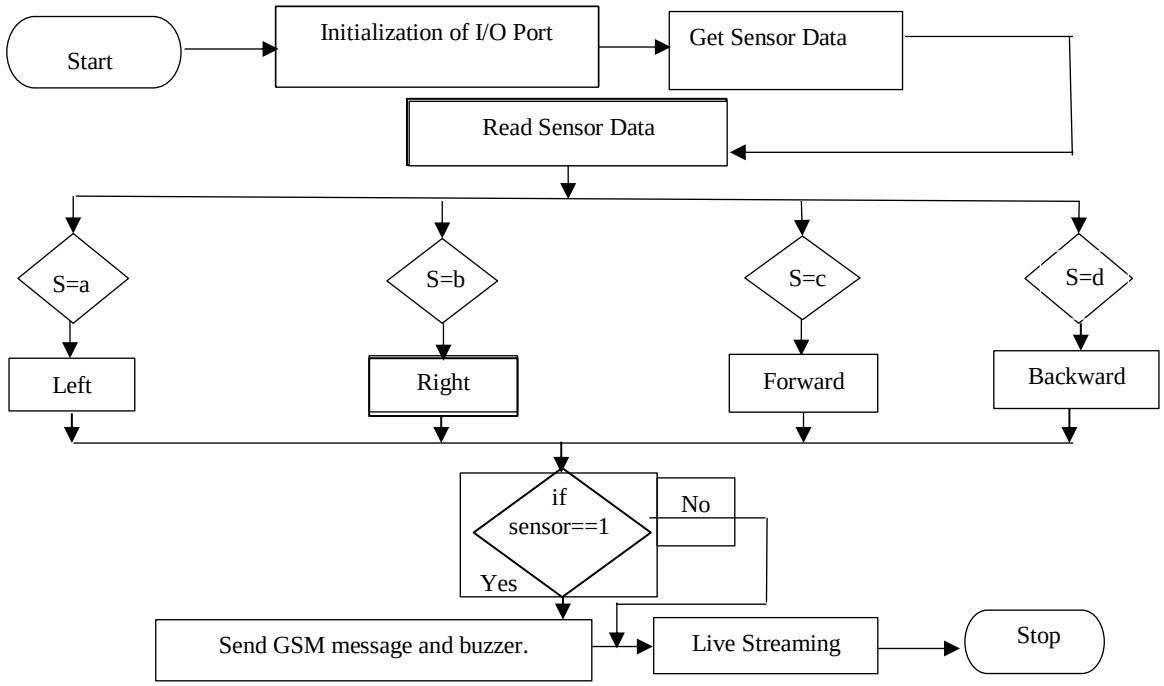

Figure 2. Flow Chart for Landmine Detection Robot

Step 1: Setting Up an I/O Port Point

First, the microcontroller of the robot should be capable of interacting with the outside world, so an I/O port should be established, which is the interface that the robot provides. With the help of it, the robot will be able to send/receive the information to/from the GSM module and the buzzer. The pin assignment layout of the microcontroller will be determined to choose the engine to active the I/O port of the robot. One can also set an oscilloscope to examine them and to do one of the tasks, for example, you can set these pins to be input or output and chose the voltage setpoint for them all [8-11].

Step 2: Provide signal data

Metal detector is mainly a probe used for determining metals. Robot uses metal detector for discovering spots that metal is supposed to be present on landmines. The voltage level from the pin of metal detector to help the robot's microcontroller math volunteer for getting the sensor data. The robot can detect a mine in the scanning zone once the current, which the sensor source, exceeds a specific level of the sensor criticality.

Step 3: Read sensors data

As the next Step, the robot needs to process this sensor data and form conclusion, whether it found a landmine or not. In the previous steps, we described that microcontroller needs to change the level of

signal of the sensors data pin into the binary one, the output pin is the microcontroller. So, only when the robot decodes the higher-order digit values and sees whether a particular threshold value has been overridden. Therefore, it can make a conclusion that a robot has recognized a signal of a landmine.

Step 4: The Device Will Send a Short Message Service Alert and Buzz.

The machine clearing route must report remotely and sound alarm should it detect any mines. To achieve this the microcontroller of the device must do some work to provide data and send the SMS to the available number. This callable GSM module calls the robot to execute commands via the serial port. At the input of the buzzer's pin, it gives a signal which allows the robot's microcontroller to be capable of "buzzing" the buzzer. Therefore, the high voltage will be fed at the input pin of the buzzer for the robot to achieve this.

Step 5: Stop

Movement and stop of the robot should be indicated by the buzzing sound and corresponding GSM message. This statement is made since a robot lacks the ability to guard its surroundings from damages and may also be a threat to other people. [12-13] The microcontroller of this robot uses the brake function by the cause of the motor's controlling signals sent by microcontroller to stop moving the robot.

RESULTS AND DISCUSSIONS

Landmines can pose a huge threat to not only the potential victims but are equally hazardous to the officials appointed for the diffusion of the landmine.

Atmega328 microcontroller serves as the 'brain' of the entire system. The proposed system as a whole can be categorized into three subsystems:

1. Mobility system
2. Tracking system
3. Surveillance system

As the name suggests, the mobility system is responsible for the swift and uninterrupted motion of the robotic vehicle. This subsystem mainly comprises of the motor driver and a couple of DC motors. The motor driver is interfaced to the Atmega328 microcontroller, and the motors are connected to the rear left and right wheels of the robotic vehicle. All these components, all together, are responsible for the motion of the robotics vehicle.

The tracking system crucially consists of the GPS module and a GSM module. After establishing a steady motion, the robotic vehicle is used to inspect the area of suspected threat. The Metal detector sensor, another part of this subsystem, once detects the presence of a landmine will trigger the GPS module and the module will send the geographical coordinates to the microcontroller which further activates the GSM module which is responsible for sending an "Alert" message to the authorities.

The surveillance system essentially uses an ESP32-CAM module. This module is a combination of an ESP microcontroller and a camera. This component can be connected to external communication devices like mobile or laptop through WIFI or Bluetooth connection. This system is responsible for the live surveillance (video streaming) of the surrounding environment which enhances the visibility of the operator.

A successful integration of all these subsystems can give rise to a system which will be able to move freely, track accurately and ensure a clear view of the surroundings. Furthermore, the safety of the civilians as well as military personnel.

Applications

1. Most essential application of Landmine detection robot is to clear the minefields and make the land safe for people to live and work.

2. Landmine detection has military applications where it will help to protect the soldiers from landmine attacks and to clear routes for military vehicles.
3. Security of sensitive areas and prevention of illegal crossing of borders can be ensured through landmine detection robots.

Future Scope

1. Developing more reliable and accurate sensors for the landmine detection robot will surely account for more accurate and feasible robots in the future. These sensors include hyperspectral imaging sensors, for better view of the surroundings and many more.
2. Landmine Detection Robots can become more autonomous, i.e., the robot can be operated without human intervention. This is essential for making the robots more efficient and for reducing the risk of death or injury of human deminers.

CONCLUSION

In conclusion, landmine discovery robots hold immense eventuality to revise the demining process. Advancements in detector technology, specifically hyperspectral imaging for enhanced environmental perception, and the development of independent capabilities promise to produce landmine discovery robots that aren't only more accurate and effective but also significantly safer for mortal deminers. Eventually, these advancements can pave the way for briskly, safer, and further cost-effective mine concurrence, eventually saving lives and contributing to a future free from the troubles of landmines.

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