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Landmine Detection Robotic Vehicle

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ABSTRACT: Landmines are a significant threat to the safety and well-being of people around the world, and their detection and removal is a critical issue. In this paper, we present a landmine detection robot using Arduino, which can autonomously detect and mark the location of landmines buried in the ground. The robot is equipped with sensors that detect the presence of metallic objects and explosives, and it can navigate through different terrains. We describe the design and implementation of the robot and evaluate its performance through field experiments. The results show that the robot is capable of accurately detecting and locating landmines, making it a potentially useful tool for humanitarian and military applications.

KEYWORDS: landmine detection, robot, Arduino, sensors, explosives, obstacle detection, ultrasonic sensor, motor, Arduino UNO, Android app, camera.

I. INTRODUCTION

Landmines are an unfortunate legacy of many conflicts around the world, and their presence poses a significant threat to the safety of civilians and military personnel alike. The detection and removal of landmines is a challenging and dangerous task, requiring specialized training and equipment. In recent years, there has been growing interest in developing autonomous landmine detection robots that can reduce the risk to human life while improving the efficiency and accuracy of landmine clearance operations. In this paper, we present a landmine detection robot that uses an Arduino microcontroller and a variety of sensors to detect and locate landmines buried in the ground. The robot is designed to operate in different environments, including urban and rural areas, and is capable of detecting metallic objects and explosives commonly used in landmines. The robot is equipped with wheels that enable it to move over rough terrain, and it can be controlled remotely using a wireless connection**.** It is for sure easy to handle as well with a user-friendly GUI is developed. This project works in the environment at which the landmine has been detected and perform its stated operation. The vehicle can be operated manually using the app to take it to the location of the landmine to perform the operation. The app will be able to operate the vehicle using Bluetooth. Camera used to monitor the surrounding can help to monitor the surrounding of the vehicle. During the automated process the obstacle detection mechanism has been implemented so that it can avoid the obstacles automatically that are in its path while carrying out the operation.

II. LITERATURE REVIEW

2.1. Survey of Existing System

Bharath J, Automatic Land Mine Detection Robot Using Microcontroller. This paper describes the problems faced by the Land mines that are faced in 70 countries. The purpose of this paper is to eliminate the problems of land mine. The purpose of this paper is to design a robot prototype which is capable of detecting buried land mines and changing their locations, while enabling the operator to control the robot wirelessly from a distance. This technology interfaces the metal detector circuit in a robot to search the land mines. The metal detector circuit is interfaced with the robot and it is left on the required search area in order to detect the metallic components used in the landmines. The main advantage in this project is that we can make this robot at low cost and more efficient,

Michael YU. Rachkov, Lino Marques, Anibal T. De Almeida. The paper describes an advanced multi-sensor demining robot. The robot transport system is based on a simple structure using pneumatic drive elements. The robot has robust design and can carry demining equipment up to 3kg over rough terrains. Due to the adaptive possibilities of pedipulators to obstacles, the robot can adjust the working position of the demining sensors while searching for mines. The detection block consists of a metal detector, an infrared detector, and GPS and GSM. The robot is controlled by means of an on-board processor and by an operator remote station in an interactive mode. Experimental results of the transport, control, and detection systems of the robot are presented. The main disadvantage of the robot is weight factor due to the overloading of sensor. Seong Pal Kang, Junho Choi, Seung-Beum Suh, Sungchul Kang, Design of mine detection robot for Korean mine field. This paper presents the critical design constraints of mine detection robots for Korean minefield. As a part of a demining robot development project, the environment of Korean minefield was investigated, and the requirements for suitable robot design were determined. Most of landmines in Korean minefield were buried close to the demilitarized zone (DMZ) more than half of a century ago. The

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areas have not been urbanized at all since the Korea War, and the potential locations of the explosives by military tactics have been covered by vegetation. Therefore, at the initial stage of the demining robot system development, the target areas were investigated and the suitable design for Korean minefield terrain was determined. The design includes a track type main platform with a mine detection sensor (consists of a metal detector and a GPR at this stage). In addition, in order to maintain the effective distance between the landmine sensors and ground surface, a distance sensing technique for terrain adaptability was developed and briefly introduced in this paper. The overall design of this robot was determined by considering the speed.

III. PROPOSED SYSTEM

A. Introduction

B. Application of robotics in day-to-day life can make work of the human beings easy. Taking help of the robotics in the Landmine accidents can be very helpful to overcome the risk of human lives and also working out task on the places where human resources can't be reached. The systems developed before were either based on automatic working or manual operation. We have developed the project that uses both the methods and also some of the additional features that will benefit the efficiency of the operation. The developed robot would be used to detect landmines without human to manually navigate in landmine fields. It is a robotic vehicle that would perform the actions automatically.

C. Also, operator can monitor the site with the help camera and would able to control the operations using developed software application. Following flowchart gives the idea of the complete working of the project. Fig. Flowchart of Landmine Detection Robotic vehicle.

D. Flowchart

To explain the working of project, below is the flowchart given:

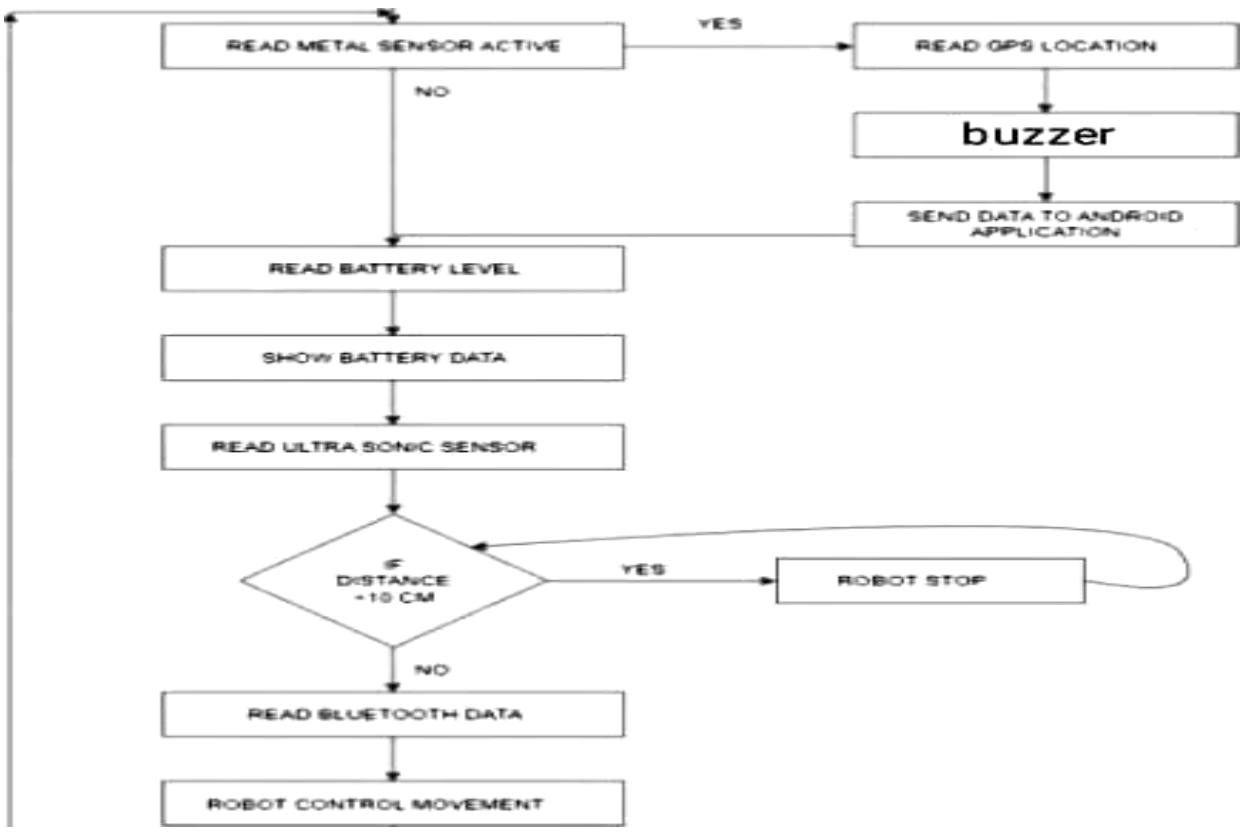

Fig. 3.1 Flowchart

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Arduino UNO

The main brain of the system that is been used in the system is Arduino UNO based on ATmega328P. It takes inputs based on what mode vehicle is been working that can be manual or auto. The inputs are processed to give appropriate output that would complete certain objective.

Software application

It has option to select manual/auto mode. When the system gets started the robot initializes itself in Manual mode. In this mode the operations such as vehicle movement in direction left, right, forward, backward and the operation of buzzer can be operated manually using software application developed for the system. Also, GUI shows the battery percentage and landmine detected alert.

GPS Module

The NEO-6M GPS module is a well-performing complete GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna, which provides a strong satellite search capability. With the power and signal indicators, you can monitor the status of the module. it is use to locate the latitude and longitude data to pin point the location on Google maps.

GSM Module

The SIM800L GSM/GPRS module is a miniature GSM modem that can be used in a variety of IoT projects. You can use this module to do almost anything a normal cell phone can do, such as sending SMS messages, making phone calls, connecting to the Internet via GPRS, and much more.

Ultrasonic sensor

There can be a situation where the vehicle can come across the obstacle. To detect these obstacle we have used ultrasonic sensor HC-SR04. The transmitter of this sensor transmits an ultrasonic signal that reflects on to the object and bounce back to receiver that would major the distance based on this time duration. Once the obstacle is detected. Comparing these two distances, it would turn the vehicle to the direction with grater distance. If the distance measured is same for both ways then it would move a bit back and then again perform the same process.

Buzzer and LED:

When the landmine or the obstacle is detected the Buzzer and LED both of 5V, is activated to notify it to user.

Metal Sensor:

A tool used to identify the presence of metal items nearby is the Sansel Stainless Steel Proximity Sensor. It is frequently used to monitor and manage numerous processes in industrial and automation applications. The Sansel Stainless Steel Proximity Sensor is described as follows: detecting Range: With a detecting distance of up to 10 mm, the sensor is able to identify metal items that are present in this area. The sensor is strong and corrosion-resistant since it is composed of premium stainless steel.

Bluetooth Module:

For the communication between software application and the system we have used Bluetooth technology as it works smoothly and is of low cost and easy to implement.

L298 motor diver module:

It is used as an interface between Arduino and DC motor. It can operate 2 DC motors at a time with speed and direction control.

DC motors:

The 12V DC motors are attached to the wheels of vehicle for the moment. DC motor is lightweight, resistant abrasion with metal material torque and tough features, durable and reliable to use it for a long time. It also has low noise, low resistance and higher efficiency.

Camera:

Though system is in manual or automatic mode, it is necessary for the surrounding in the system to be monitored continuously. Camera V380 is used in the system for monitoring surrounding. Day and night vision

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is the specialty of this camera. Also, it can be moved up down left and right to monitor the surrounding in all these directions.

IV. EXPERIMENTS AND RESULTS

Our developed landmine detection robot has been built to locate and detect landmines in a field of operation, and to assist in situations where it may be difficult or risky for humans to do so. Unlike most existing landmine detection systems that operate in either manual or automatic mode, our robot offers both modes of operation, providing users with greater flexibility and control over the detection process. The manual mode allows the user to actively control the robot's movement and sensor deployment, while the automatic mode utilizes an algorithm that allows the robot to navigate and detect landmines on its own. Users can select either mode according to the situation they need, and switch between modes using a mobile application developed specifically for the robot**.**

The robot can be controlled in manual mode using an Android application, which provides several controls to move the robot in different directions, such as moving it forward, backward, up, and down, as well as starting and stopping it. Additionally, the application allows the user to perform various operations, including activating a metal detector and ground-penetrating radar sensors, and triggering a camera to capture images of the surrounding environment. he Android application also features a battery indicator and a sensor status indicator, which display the current status of the robot's battery and sensor systems in percentage. This feature enables the user to monitor the status of the robot's power and sensor systems and take appropriate action when needed.

Overall, our landmine detection robot with its manual mode control and Android application interface provides a safe and efficient solution to the problem of landmine detection. The user can control the robot remotely and monitor its status in real-time, allowing for quick and accurate detection of landmines and safe disposal of them.

landmine detection robot is equipped with obstacle detection capabilities. In the event that an obstacle is detected, the robot's buzzer and LED are activated to notify the user. This obstacle detection feature ensures

that the robot is able to navigate around obstacles in its path, reducing the risk of damage to the robot and ensuring that it can continue to safely detect landmines. By automatically adjusting its movement in response to obstacles, our landmine detection robot offers a more efficient and effective solution to the problem of landmine detection in hazardous environments.

Camera is used to monitor the surrounding while performing the operation. The camera is independent of the mode. The camera-oriented application that is used to operate it. Also, the real- time view is captured by the camera is displayed on the app. Therefore, it becomes easy to operate the vehicle or to decide the action to perform in some immediate situation.

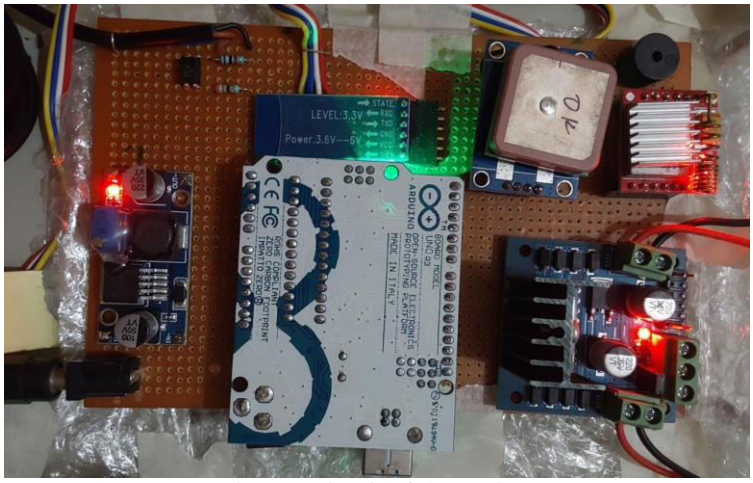

Fig. 4.1 Circuit of the Project

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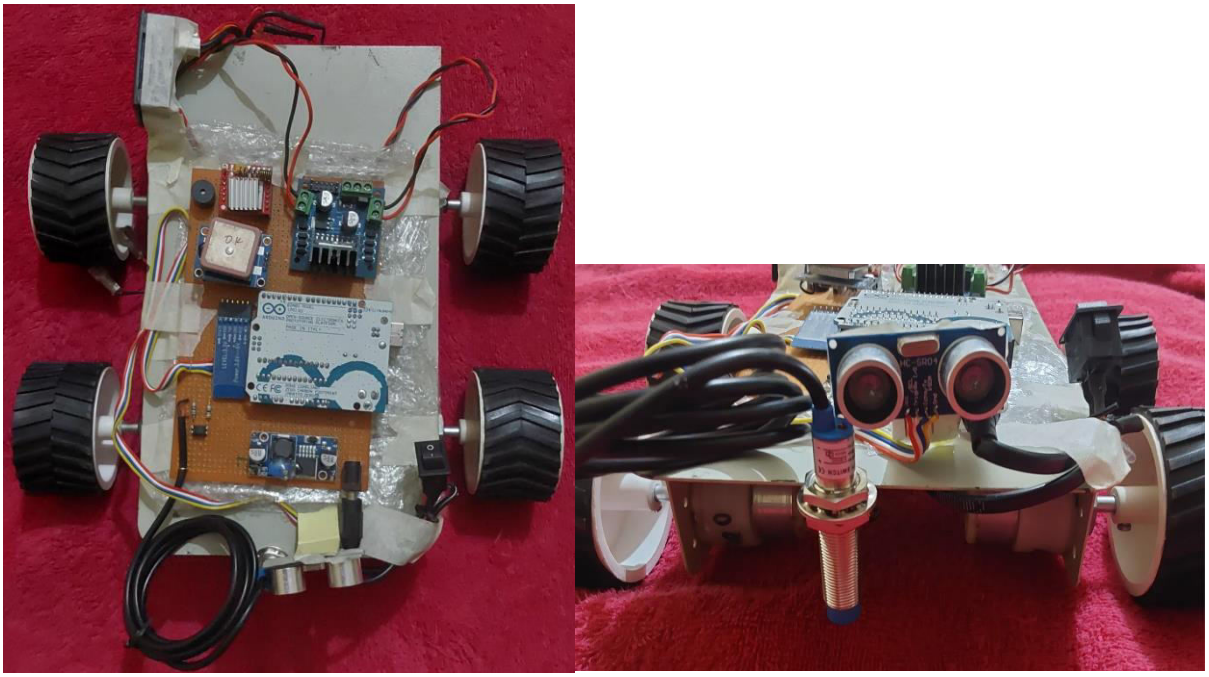

Fig.4.2Landmine Detection Robotic Vehicle

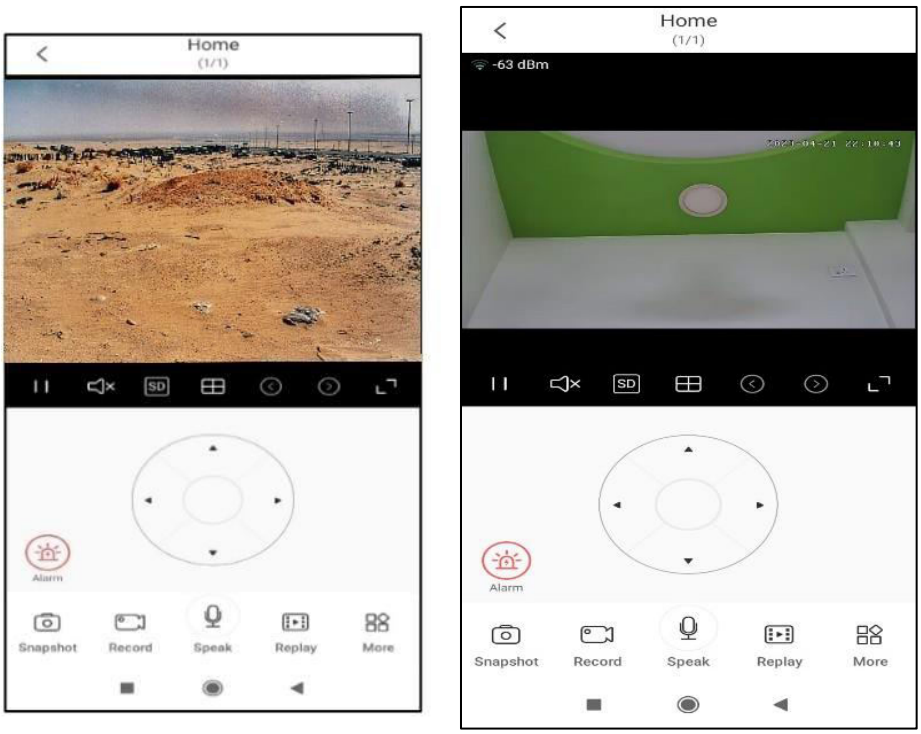

Fig. 4.3 Camera View through app

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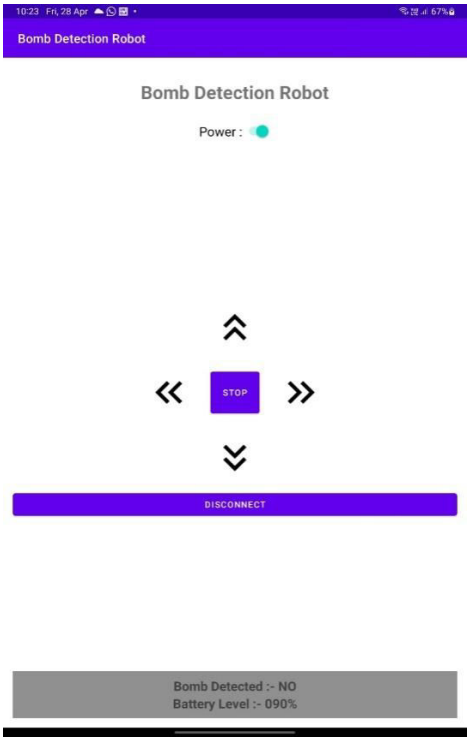

Fig.4.4. Application for the Robot

V. CONCLUSION

A significant project that has been successfully analysed and designed is the Landmine Detection Robotic Vehicle. In especially in conflict zones and border regions, the project's goal is to develop a robot that can identify landmines and act automatically when there is a possibility of a landmine event. The robot has a variety of sensors and motors that improve its ability to identify landmines. One of this robot's main benefits is its compact size and lightweight construction, which make it simple to use and move about.

The Landmine Detection Robotic Vehicle also has rechargeable batteries, which over time enable it to be more energy and financially advantageous. The robot prototype has been put through testing and shown to be incredibly effective in finding landmines, making a significant contribution to saving lives. The fact that this robot may be controlled manually or automatically is one of its most important benefits. This implies that, depending on the circumstance, the robot can be remotely directed by a human operator or can work independently. The robot is more dependable and effective since it has a backup mode in case the primary one breaks down. The Landmine Detection Robotic Vehicle has the potential to be extremely important to society, especially in landmine-affected areas. The robot's capacity to identify landmines and act independently has the potential to prevent casualties and save lives. This robot makes a significant contribution to enhancing the safety and security of residents in landmine-affected regions because to its lightweight, energy-efficient design, dual-mode control system, and other features.

The android app developed performs well to control robot according to the user need. The battery level are displayed on the app so that user will be aware of system need of power supply to monitor the system accordingly.
Camera used for monitoring the surroundings is V380 which turns in all four directions so it is easy to take decisions on controlling vehicle accordingly.

Thus, we have attempted to implement the objectives that have been assumed during the survey and also the suggestions that were taken into consideration after the discussion with the mentors were planned, designed and implemented efficiently. The advancements implemented in the system makes it outstanding than the existing systems that have been developed till now.

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VI. FUTURE SCOPE

In coming years, the field of robotics would be enhancing to the greater extend using artificial intelligence and machine learning. They can be developed in such a way that it can navigate threatful environments, detecting landmine and accordingly perform appropriate operation. Here are some of the advancements mentioned that can be used to build an intelligent Landmine Detection robot.

Autonomous navigation: Currently, most Arduino Landmine detection robots are remotely operated. However, future developments in artificial intelligence and robotics may enable these robots to operate automatically, making them more efficient and reducing the need for human intervention.

Advanced Landmine detection and suppression: Future Landmine Detection robots may incorporate more advanced Landmine detection and suppression technologies, such as laser-based detection.

Collaboration with other robots: In the future, multiple Landmine Detection robots may work together to tackle larger field and cover more ground.

Deployment in hazardous environments: Landmine Detection robots can be used in hazardous environments such as Minefield where it may not be safe for humans to enter.

Machine Learning application: The existing systems uses camera only to monitor the surrounding and take actions based on human decision. The advancement like implementing human detection using machine learning as a feature in it can help rescue the life of people stuck on the site of accident.

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