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MILITARY BASED LANDMINE DETECTION ROBOTIC VEHICLE

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ABSTRACT

A landmine is an explosive device which is concealed under the soil to destroy the enemy targets such as soldier, vehicle, tanks etc. Landmines in India are mostly planted in fields, forest, wells, water resources and energy production areas. The process of removing land mines from a soil is called Demining or mine clearance. In military operations, the deminig is done with help of the devices such as mine plows and blast waves. Sometimes specially trained animals also involved in the process of mine clearance. These existing method requires a lot of time to remove the landmine and which also involves loss of many lives during the demining process. To avoid the hazard the landmine detection robot is proposed which uses a ultrasonic sensor, metal detector and GSM module as a complementary tool for landmine detection. The robot is used to detects the position of the landmine and sends its GPS position to a web server through GSM.

Keywords: GSM Module, Metal Detector, Landmine

1. INTRODUCTION

In war the buried landmines plays a vital role. The untriggered landmines are huge threats for civilans even after end of the war. Landmines not only threat for soldiers as well as civilians too. Landmines also causes huge problems to agricultural lands, water reservoirs and development of roads in the regions of the borders. Basically, the explosion of the landmine is caused by some triggering mechanisms. The landmines are triggered by using the weight of the object. The

landmines are classified into many types depending upon the weight needed to trigger the landmine. The landmines are require minimum pressure of nine kilograms which is usually buried under the soil of 10 to 40 mm. Brown et al. (2002)

Landmines are used to restrict the movements of the enemy which are done by burying the landmines in certain patterns. One of the pattern called Zigzag pattern which slows down the movement of enemy. Landmines are also used to diverge the enemy from their path and leads them in to middle of an ambush. Demining of the landmine from the affected areas which require lots of human soldiers were used their lot of manpower, time and efforts which shows in Figure 1. Animals also involves in the process of demining like specially trained which helps verify and clear the affected area. This project aims to design a robot to detect the landmines by using the GPS technology, metal detector and Arduino uno.

Figure 1

Figure 1 Landmine Detecting

1.1. CLASSFICATION OF LANDMINES

Landmines are generally classified into two categories - Anti-Vehicle and Anti-Personnel. The anti-vehicle or anti-tank mines are require lots of pressure to activate and the footstep of a person is not enough for detonate them.

The required pressure to detonate the anti-tank mines is between 348.33 pounds and 745.16 pounds i.e. (158 kilograms to 338 kilograms). Most of the tanks and other military vehicles are very heavy and enough to produce the required amount of pressure to detonate the mines. The Anti-personnel landmines are used particularly to divert or drive back foot soldiers from the war zone. These antipersonnel mines are generally get activated by pressure or by tripwire i.e., a wire stretched close to the ground or by remote detonation which is used to kill their victims. Carullo (2001)

2. BLOCK DIAGRAM

The system consists of several important components like Arduino, Metal detector, Ultrasonic Sensor, Buzzer, LCD (Liquid Crystal Display), DC motor (Direct Current Motor) are shown in Figure 2.

Figure 2

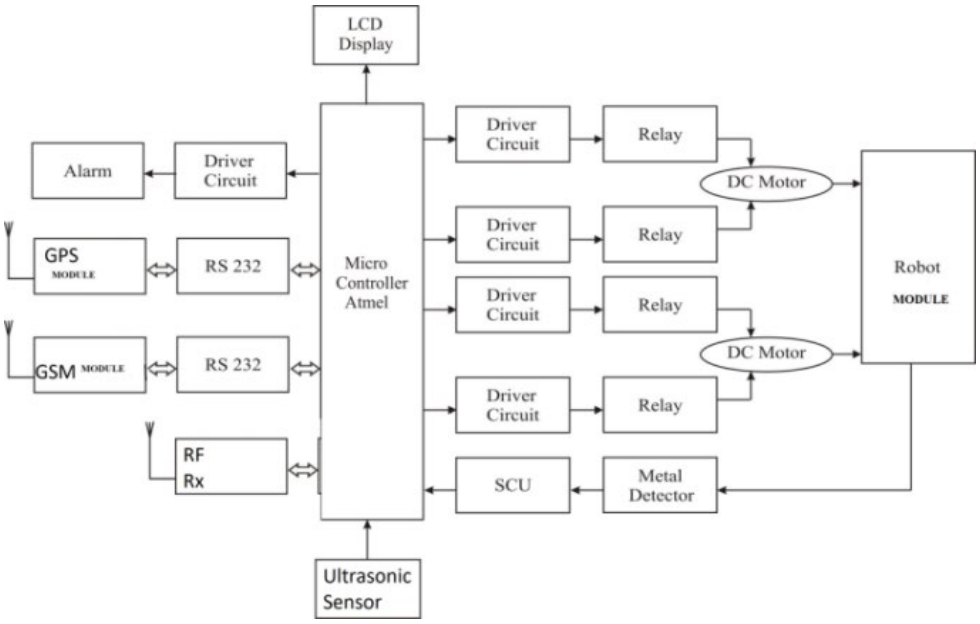

Figure 2 Block Diagram

2.1. ARDUINO

Arduino Uno is the best board to get started with electronics and coding. It is commonly used in various projects and applications, including robotics, automation, home automation, and IoT (Internet of Things) projects. Arduino Uno is a familiar ATmega328P microcontroller is shown Figure 3.

It is commonly used in various projects and applications, including robotics, automation, home automation, and IoT (Internet of Things) projects. Arduino Integrated Development Environment (IDE), which is a software platform designed to program the Arduino uno. The Intgrated Development Environment allows users to frame the program, compile, and upload code to the board easily. Christ et al. (2011)

Figure 3

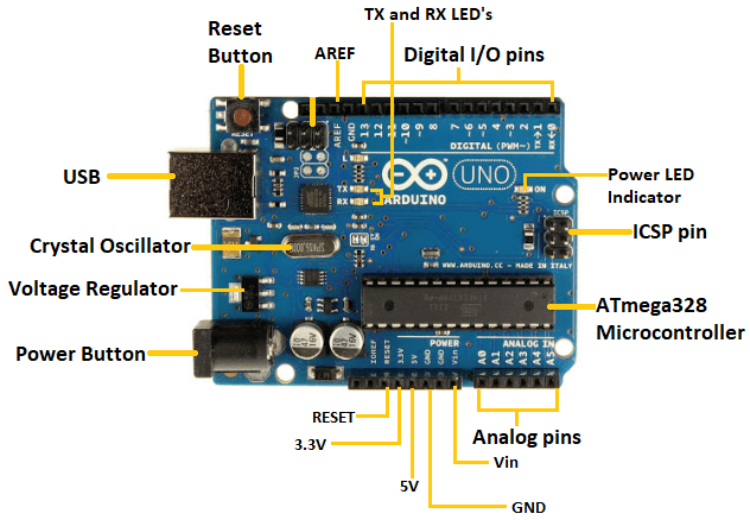

Figure 3 Arduino

2.2. LCD (LIQUID CRYSTAL DISPLAY)

LCD display (Liquid Crystal Display) is commonly used in electronic devices such as calculators, watches, digital clocks, and many other electronic devices. It consists of several layers of material that work together to display images and text. Habib (2001)

The main component of an LCD display is a layer of liquid crystals, which are placed between two polarizing filters. LCD displays are commonly used in various applications such as medical devices, automotive displays, home appliances, and more which is shown in Figure 3. They have become an essential component in modern technology and continue to be developed with higher resolutions, faster response times, and improved energy efficiency

Figure 4

Figure 4 LCD

2.3. DC (DIRECT CURRENT) MOTOR

DC motor is device which is ued to converts electrical energy into mechanical energy. It works based on the principle of Fleming's left-hand rule and consists of a rotor and a stator. The rotor is the rotating part of the motor that contains the winding or permanent magnets, while the stator is the stationary part that contains the winding or magnets. Kuo-Lan et al. (2011)

The magnetic fields of the rotor and stator interact to produce a torque that rotates the shaft of the motor. They can also be classified based on their construction and speed, such as servo motor, compound motor and stepper motors. DC motors are popular due to their simplicity, reliability, and ease of control.

2.4. METAL DETECTOR

A metal detecting sensor is a type of sensor used to detect the presence of metal objects in a variety of applications. The sensor works by producing an electromagnetic field that interacts with the metal object and produces a change in the field, which is detected by the sensor. Metal detecting sensors are used in a wide range of applications, such as security systems, industrial metal detection, and

consumer metal detectors. Metal detecting sensors are an important tool for detecting metal objects in a variety of applications, providing a non-invasive and effective way to detect metal objects, and ensuring the safety and security of people and valuable items.

Figure 5

Figure 5 Metal Detector

2.5. ULTRASONIC SENSOR

An ultrasonic sensor which uses the ultrasonic sound waves to detect the presence of objects. It works by sending out high-frequency sound waves (typically above the range of human hearing) and measuring the time it takes for the waves to bounce back after hitting an object.

The sensor can determine the distance to the object and whether it is moving or stationary by using the reflecting waves and time taken by the wave to reflect back from the target. Ultrasonic sensors is used for many applications such as measuring the distance between objects, obstacle detection, level sensing, and flow measurement. They are commonly used in robotics, automation, and automotive industries, where accurate distance sensing is critical for navigation and control

2.6. GPS MODULE

A GPS module is a device that receives signals from Global Positioning System (GPS) satellites and provides accurate location and time information to the user. The module contains a GPS receiver, which is responsible for detecting and decoding the signals from the GPS satellites, as well as a microcontroller that processes the data and provides the location and time information to other devices or applications. GPS modules are commonly used in a wide range of applications, including navigation systems for vehicles and boats, tracking systems for assets and people, and geotagging in photography. Some GPS modules also include additional features such as Bluetooth connectivity or an integrated antenna. GPS modules come in a variety of form factors, from small surface-mount components to larger standalone devices with integrated antennas. They can be interfaced with a wide range of microcontrollers and other devices using various communication protocols such as UART, SPI, or I2C.

2.7. MOTOR DRIVER (L298N)

Motor driver is essential part to drive the motor accurately. Motor driver require supply voltage and current. It is used to operate the motors in both clockwise and anticlockwise direction. L298N is works on H-bridge principle. The motor driver works on 12v which is shown in Figure 6

Figure 6

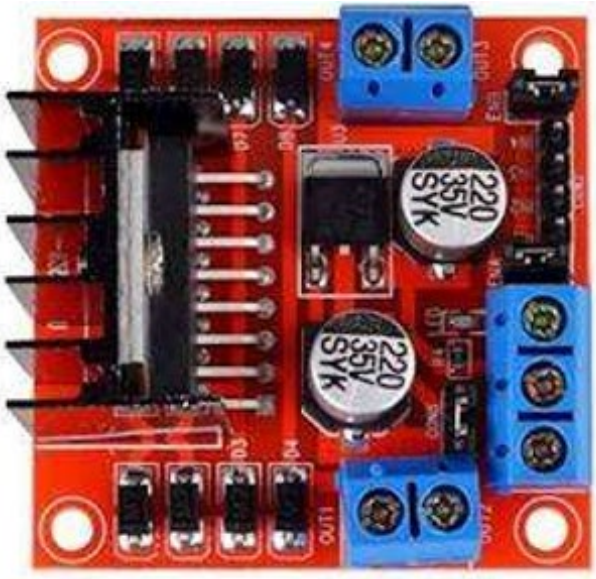

Figure 6 Motor Drive

3. MICROCONTROLLER AND GSM MODULE CONNECTION

For microcontroller and GSM module connection, There are three pins in GSM modules are Transmitter pin (Tx), Receiver pin (Rx) and Ground pin (GND). The transmitter pin of GSM module is connected with receiver pin of the microcontroller and the receiver pin of GSM module is connected with the transmitter pin of microcontroller Also Ground Pin (GND) of GSM module is connected with the ground pin of microcontroller which shown in Figure 6.

Figure 7

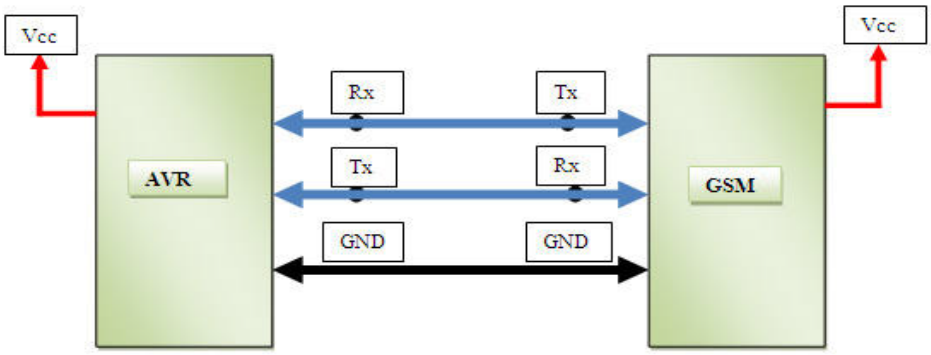

Figure 7 Microcontroller and GSM Module Connection

4. TOOLS IDENTIFIED

4.1. HARDWARE TOOLS

The hardware tools for prototype model of military based landmine detection robotic vehicle and there components are listed below.

- Arduino Uno
- L298N (motor driver)
- Servo motors
- GPS module
- LM7805 IC
- Metal detector sensor
- DC motors

4.2. SOFTWARE TOOLS

The Arduino IDE software is used for the model of military based landmine detection robotic vehicle.

5. WORKING

The robotic vehicle consists of Arduino Uno connected with the wheels of the robot for the movement of the vehicle in clockwise and anti-clockwise direction over the land. In front side of robotic vehicle metal detector is placed which can sense mine ahead of it. The robotic vehicles stop at that position when the robotic vehicle found the landmine and send the co-ordinates to the mobile phone by using the GPS module.

The latitude and longitude information of a particular location of the landmine and transfer it to the blynk app at the controlling end. The ESP8266 is proficient of either introducing an application or offloading all Wi-Fi networking functions from other application. Which gets the latitude and longitude location through online access and give it to the blynk app.

The robotic vehicle consist of two modules, which are control station is used to control the robot from remote area. The control station is consists of three integrated modules consisting of Metal detecting component, GPS data collecting component and Remote control component. These three components act as one system but the original system components act as instantaneously working autonomous systems.

6. RESULTS

- The Robot will be able to moves in all four directions: ie. Right, Left, Front, Back
- The Robot will be able to detect mine ahead of it.
- This model robot is cost effective because the structure is less complex. So it is easy to build a landmine detection robot.
- The robot gives exact co-ordinates of the landmine using GSM module.
- The final prototype of military based landmine detecting robot vehicle is shown in Figure 7.

Figure 8

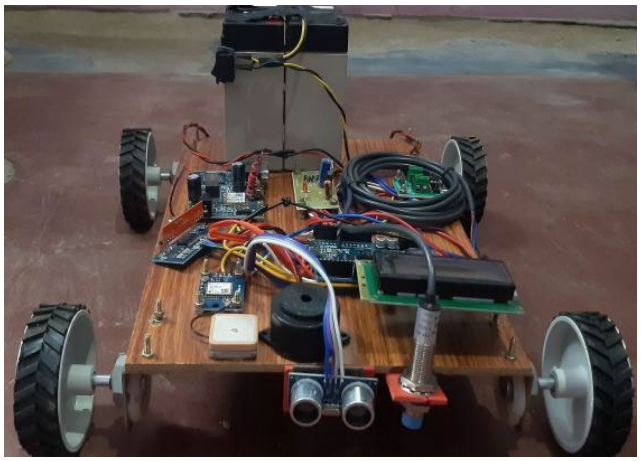

Figure 8 Prototype

7. CONCLUSION

In the current examination of the existing prototype of automatic landmine detection robot has been presented and it can be made economically. The investment on landmine detection robot is made economical in the countries because this prototype is cost effective and less complex structure. The landmine detection robot is used to detect the landmines present under uneven ground surface. Once the robot detect the landmine which the produces buzzer sound to the user. And also send the coordinates of landmine which helps to diffuse the landmine safely, without the hazard of explosion.

CONFLICT OF INTERESTS

None.

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