INTERNATIONAL RESEARCH JOURNAL OF ENGINEERING AND TECHNOLOGY (IRJET) E-ISSN: 2395-0056
VOLUME: 06 ISSUE: 06 | JUNE 2019 WWW.IRJET.NET P-ISSN: 2395-0072

Low-Cost DTMF Controlled Landmine Detection Rover

Rajat Mahendra Shukla[1]

[1]*UG Student, Department of Electronics Engineering, Shri Ramdeobaba College of Engineering and Management, Maharashtra, India*

Abstract - *Landmines have been a major security concern and reason for a large number of soldier casualties. While governments around the world have been working towards restricting the production and sales of these landmines, they remain a major threat to soldiers around the world. This project solely focuses on abolishing this threat making it highly useful in defense fields. The Rover proposed is controlled by DTMF (i.e. Dual Tone Multiple Frequency), this enables the user to control the rover from a large range wherever the network is available. Rover is efficiently controlled using Arduino Uno and all the modules have been interfaced for competent working. A land mine detector circuit is attached to the front end of the rover which helps in the detection of landmines present in the field. Once a land mine is detected rover stops and obtains the location of the rover using the GPS module present on the rover. This location obtained by GPS module is sent back to the user with help of a GSM module via a text message so that rover can be tracked down and that land mine can be disabled for safe passage.*

Key words: DTMF, Arduino Uno, GPS, GSM

I. INTRODUCTION

A landmine is used to destroy heavy weapons and derail the opposition Army. They are buried inside the soil and are pressure sensitive so that they can be activated when pressure is applied to them. These landmines are easy-to-make, cheap and consist of explosive materials which can cause immense damage to the receiving individuals. The Landmines are usually buried from 0.1cm to 0.4cm below the ground and require a minimum pressure of 9kg for triggering them off. There are majorly two different types of Mines like Anti-vehicle mines and Anti-personal mines. The countries have been using different methods to find and disable these illegally buried mines as they have been a source of casualties for their own citizens.

Various combinations of Mine detecting techniques have been used to detect these mines. The performance of the rover is dependent upon the results produced by the detector circuit. The rover helps by providing random movements to the user over a simple string of commands. We get 16 different input options with the use of DTMF module and each input can be programmed to perform different tasks. The purpose of this project is to design a capable rover which can detect the mines buried inside the ground. Rover should be programmed in such a way that when the landmine is detected it must stop, mark the location and send the data regarding this location to the user via a text message. This rover can be used to clear the area and get rid of these mines ensuring a safe passage for the soldiers. Rover should be able to detect almost 90% of these mines accurately and mark the location with accuracy up to 5cm. This rover should be able to operate remotely, ensuring the safety of user.

II. MODULE DESCRIPTION

A. *Arduino Uno*

First, Arduino Uno is a microcontroller board based on the ATmega328P. The board consists of 14 Digital pins, 6 Analog pins, and is programmable with the Arduino IDE via a USB Type-B cable. It can be powered by an external 9-12V battery using DC power jack port and USB cable present on board. It can be easily programmed using C or C++ language. In this project, it acts as the control unit for all the activities carried out by the rover. [1]

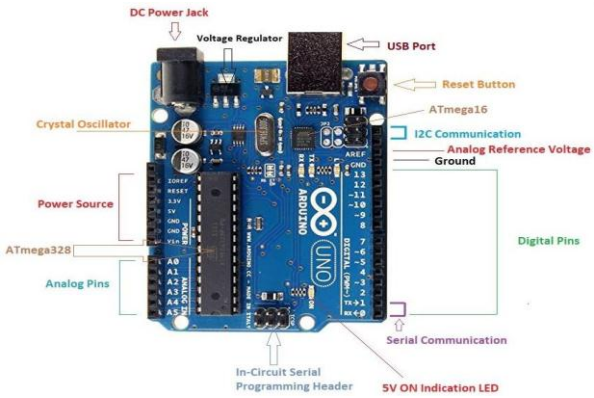

Fig 1: Arduino Uno

B. DTMF Module

This module is used to detect the dialed tones from a mobile phone. DTMF is a form of one-sided communication between the rover and the user. There are 16 different input options that can be programmed to do perform separate functions. When a key is pressed on the keyboard at the users end it generates a unique tone consisting of two audible tone frequency. For the communication to be complete system consists of a tone generator and tone decoder. The decoder module used in this project consists of the DTMF Decoder IC-MT8870DE which converts the input dial tone to 4 digital output. These digital outputs generated with the help of Decoder IC can be used to

interface with the microcontroller for application purposes.

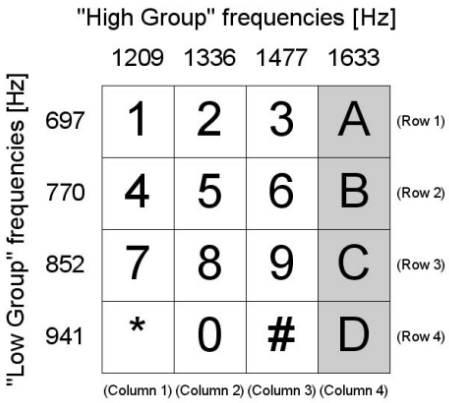

Fig2. Touch Tone DTMF Frequencies

C. GPS Module

GPS (Global Positioning System) is used to detect the Latitude and Longitude of any location on the Earth, with exact UTC (Universal Time Coordinated). This device receives the coordinates from the satellite for each and every second with time and date. GPS offers great accuracy and efficiency. In this project whenever a landmine has detected the location of this landmine is transmitted to the user via a text message.

Fig 3. GPS Module

D. GSM Module

The SIM800A modem has a SIM800A GSM chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. The SIM800A is a Quad Band GSM Module. The Voltage Supply required for the module to function from 9VDC to 12VDC with at least 2A peak current capability. The External Finger type antenna is used for transmission of the signal. The geolocation of the vehicle captured through GPS module produces a data and this data is transmitted to the user by using GSM technology via a text message [2]. The use of GSM technology makes the use of network services provided in the area making the application of this system wide spread.

Fig 4. GSM Module

E. Driver Module – L293D

L293D is a typical Motor driver that allows DC motor to drive on either direction. L293D is a 16-pin IC that can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V. [1]

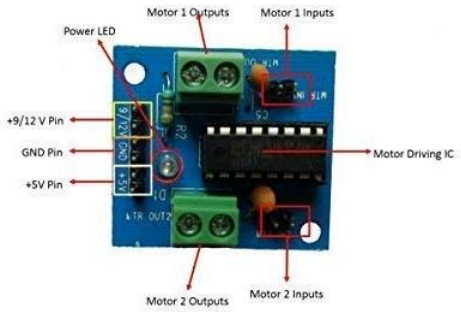

Fig 5. Motor Driver

F. Mine Detector Circuit

When a metal is bought close to the coil the inductance of coil changes. The inductance varies with the type of material which is bought near the coil if a ferromagnetic material is bought close to the coil inductance of oil changes whereas when exposed to a non-ferromagnetic material the inductance decreases. A PWM pulse wave is generated using help of microcontroller which is then provided to a LR high pass filter. The capacitor present in the circuit is charged using the spikes pulses. It requires a few pulses to charge to a point where the voltage can be read by the analog pin of microcontroller. After reading this voltage capacitor is discharged. The approximate inductance of coil is measured and the output of the circuit is observed using buzzer and LED.

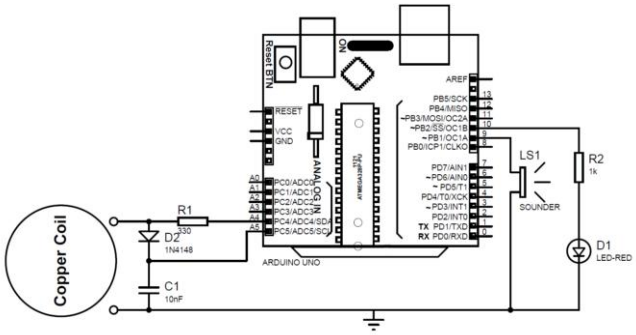

Fig 6. Landmine Detection circuit

III. SYSTEM ARCHITECTURE

The system proposed is illustrated in Fig 7. The rover consists of an Arduino Uno board, GPS module, GSM module, DC Motors, DTMF decoder & landmine detection circuit. The Arduino present on the rover is the control unit and performs a very important function of interfacing and acts like a coordinator between different modules. We are using the DTMF function of the mobile phones. The user has to place a call for their ?Remote mobile? phone to the ?Driver mobile? phone placed inside the rover. Once the call is accepted by the driver mobile phone, the rover can be driver seamlessly by giving commands from Remote mobile phone at the users end. Different keys have been assigned function which have been pre-programmed in the software code using Arduino IDE, this is done by addition of Arduino DTMF library .

Microcontroller present in the Arduino board is used to generate a square wave which is provided to the capacitor present in the Mine detection circuit. The capacitor is charged by the rising pulses, it takes a few pulses to charge it to a value where the voltage can be read by microcontroller. This voltage is read by microcontroller using the ACD unit present in it. Once the voltage is read it is discharged by making the capacitor pin as output and setting it to low. This process is repeated as the whole process is taking about 200 microseconds to complete, an average value is obtained. In this way the inductance of coil can be measured to the nearest approximation. These obtained results are illustrated with the help of LED and Buzzer present in the circuit.

Whenever a landmine is detected the rover stops overriding any other command and with the help of GPS module present on board the location of this detected landmine is given back to the user. The GPS receiver obtains the data as the entire NMEA format text. Only the latitude and longitude coordinates are taken from it; using the Arduino TinyGPS library and then the GSM module sends SMS to the number specified in the code.

The rover needs a capable power source which can last long and provide for all the different modules at the same time without fail. The search of landmines can lead to hours of usage before stumbling upon a successful result. This obtained location can be tracked down using the GPS tracker which are present at the users disposal. It is an effective and efficient way of detecting mine and diffusing them for a safe passage. The operation of driving the rover and receiving the text message containing the location of landmines can be done via one single Remote mobile present at the users disposal.

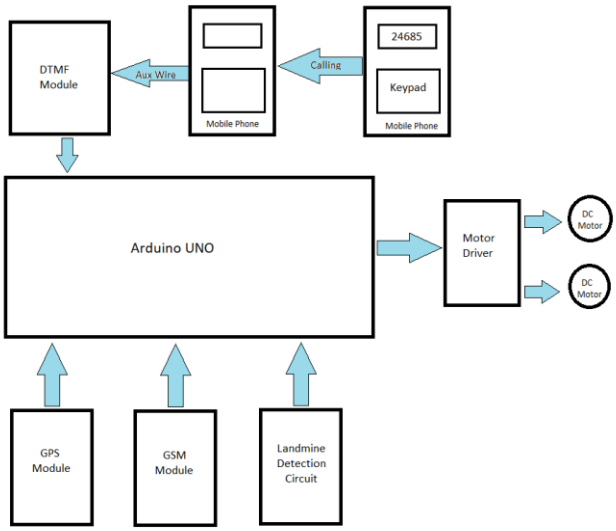

Fig 7. System Design

IV. SOFTWARE IMPLEMENTATION AND WORKING

The Software implementation of the rover includes coding of Microcontroller using Arduino IDE according to which the motor driver moves the motors. The direction in which the motors move directed by the DTMF present onboard of the rover. GPS module present in the rover obtains the data regarding the landmine and the data about longitude and latitude is obtained using the TinyGPS library this location obtained is sent via a text message using the GSM module present on the rover. Arduino IDE provides a user friendly yet powerful environment for programming. It is used for compilation and uploading code to the Arduino UNO board using the USB cable.

We first included all the libraries are required to program the rover. For the DTMF decoder module to be operational we have to include the DTMF library which helps in decoding the input frequency to the digital output. TinyGPS is an Arduino library used for parsing NEMA data streams which are actually obtained by the GPS module. This library is used as it actually provides a compact and easy-to-use method for extracting latitude and longitude measurements of the landmine. We have also used SoftwareSerial library which has been used to enable serial communication on other digital pins of the Arduino board as it uses software to replicate the functionality.

For GPS data of the detected mine and other information received from the GPS module through GSM network, the SIM800A module connected with Arduino Uno microcontroller is used. AT command instructions are used to control the modem. The SIM card present in the GSM module is checked by using AT commands. Then we check the response of the network response system and checks GPS status and acquires the information about the landmine. The function SendMessage() is used to send the SMS to carry this out we should set the GSM module to text mode first which is again carried out using AT commands. To achieve this we use the mySerial.println() function mySerial.println writes data to software serial port and this is recognized by GSM module. After setting the GSM module to Text mode, we input the mobile number of the user which is achieved with AT command □AT+CMGS=\□+91xxxxxxxxxx\□\r□. The message is received by the user on the same mobile phone which is used to control the rover using DTMF keypad inputs. [7]

Working of System:

Step 1: Place this rover on the field which has to be surveyed.

Step 2: Place a call from Remote Mobile to Driver Mobile an accept.

Step 3: Rover will wait for the command to move from user. Landmine detection part of rover starts scanning the field.

Step 4: Check the below condition for each scan.

if (Metal sensor will detect any object)

Go to Step 5 and continue.

else

Keep moving until Landmine is detected.

Go to Step 3.

Step 5: STOP.

Step 6: Get the NMEA data from GPS Module.

Step 7: Send this data to the operator using GSM module via a text message to Remote mobile.

Step 8: End

The rover can be tracked to the transmitted GPS location. This landmine can be diffused and safe passage can be secured. [8]

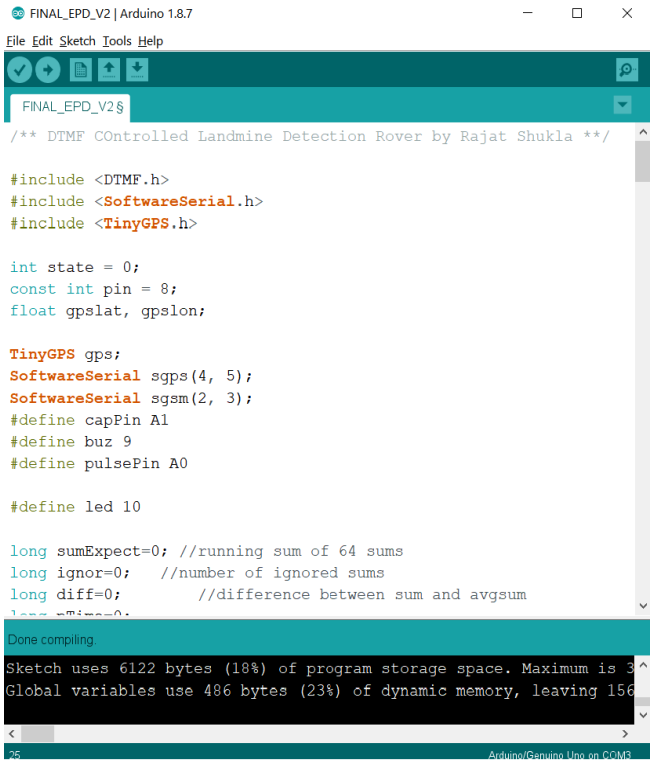

Fig 8. Arduino IDE Sketch of Coding Proposed System

V. SIMULATION AND RESULTS

The design of the proposed rover is landmine detecting rover which is capable of detecting landmines and give its location to the operator via a text message using the GSM module present on board of the rover. The rover can move in four directions and there is one button which can be used to stop the movement of the rover. After making and accepting the call on the Remote mobile, Rover can be moved forward via key 2 and it can be reversed using key 8. User can use key 4 facilitates a left turn whereas the right turn is enable by key 6. Key 5 is used to stop the rover from moving and stopping at one place. Combining all the different modules present we were able to get a final circuit of the working prototype of the rover. This circuit is shown in Fig 9.

The rover proposed has been tested rigorously by varying the length of the buried landmine from 1 to 5 cm below the soil. These results were recorded and we found that the rover was capable of detecting mines almost 95 percent of times. The rovers chassis is built and protected in such a way that it is protected from any kind of environment a small power band of 800mAh is attached inside the rover so that it can run for long period of time without running out of power. The power bank can be recharged and the rover is good to go again.

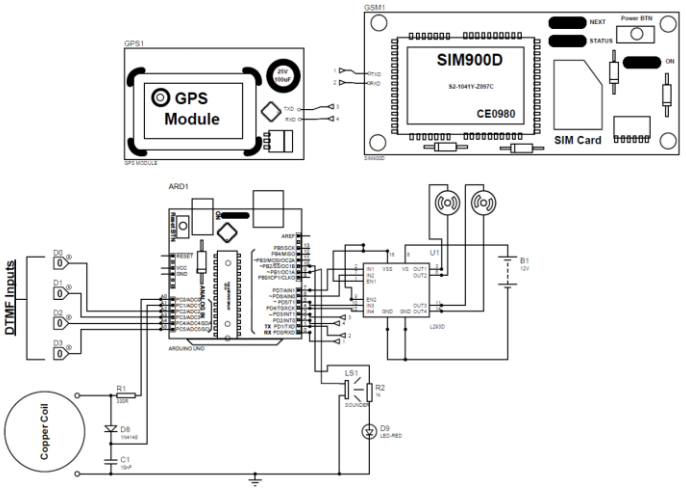

Fig 9. Final Simulation Circuit

Fig 10 shows a working prototype of the proposed rover. The landmine detector circuit like the rover is operated by the Arduino Uno board. Mine detector coil is actually to the front part of the rover which facilitates the detection part of the circuit. This coil can be attached at any length from the rover and is extendable.

Fig 10. Prototype of the Rover

VI. CONCLUSIONS

Landmine detection and clearance is a mundane task and Human involvement in such activities can prove to be exhausting and source of great danger. Landmines have been reason of hundreds of injuries and deaths from various sites around the world. The search methods employed to disable these methods are expensive and prove to be ineffective. The cost required to carry out these search is alarmingly high. We have used a keypad mobile phone by Nokia as the Driver mobile phone which is attached to the DTMF module as they provide the best possible results.

This project focuses on a cheap landmine detection techniques. The rover proposed is very light weight and has no chance of activating the landmine by accident. It can be controlled and tracked wirelessly making it perfect to go to remote places easily. The rover detects these landmines and location is sent back to the user through a text message.

VII. FUTURE ENHANCEMENT

Future work includes addition of a camera modules which are capable of transmitting live video feed to the user over the internet. This makes navigation of rover much easier. The rover can also be made autonomous so that it can navigate the area under test thoroughly without human direction. It should be equipped with all obstacle detection and collision prevention code.

REFERENCES

[1] T. Palaniappan ,V.Devaguru, Vidya P Janaki and Dr.R.Suresh Babu, "DTMF BASED MINE DETECTION ROVER", International Journal of Advanced Research Trends in Engineering and Technology (IJARTET), Vol. 5, Special Issue 13, March 2018

[2] June Myint Mo Khin and Dr. Nyein Nyein Oo, "Real-Time Vehicle Tracking System Using Arduino, GPS, GSM and Web-Based Technologies", International Journal of Science and Engineering Applications, Volume 7Issue 11,433-436, 2018

[3] Achut Manandhar, Peter A. Torrione, Leslie M. Collins and Kenneth D. Morton, "Multiple-Instance Hidden Markov Model for GPR-BasedLandmine Detection," IEEE transactions on Geosciences and remote sensing, vol. 53, no. 4, pp. 1737-1745, April 2015

[4] K.S. Ruchitha, Soumya Anand, Anurima Das and Rajasree P.M, "Design and Development of Landmine Detecting Robot", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 4, April 2016

[5] Kenzo Nonami, Seiji Masunaga and Daniel Waterman Mine Detection Robot and Related Technologies for Humanitarian Demining", Japan, 2008.

[6] https://www.ijert.org/automatic-vehicle-identification-at-tollgates-and-theft-detection-of-vehicles

[7] https://mechatrofice.com/arduino/send-gps-location-via-sms

[8] Kishan Malaviya, Mihir Vyas and Ashish Vara, "Autonomous Landmine Detecting and Mapping Robot", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue 2, February 2015

[9] https://www.arduino.cc/en/Reference/SoftwareSerial

BIOGRAPHY

Rajat Mahendra Shukla, currently pursuing BE in Electronics at Shri Ramdeobaba College Of Engineering and Management. Inclined towards Embedded Systems, Internet of Things and Artificial Intelligence.