Wireless Operated War Field Land Rover That Alerts On Sensing Planted Land Mines

J.Jagan Babu [1], S.Gayathri Priya[2], Vanmathi.P[3], Padmapriya.R[4], Pradeepa.S[5]

[1]Assistant Professor/ Department of ECE,R.M.D Engineering College,Tamilnadu 601206
[2]Assistant Professor/ Department of ECE,R.M.D Engineering College,Tamilnadu 601206
[3]Assistant Professor/ Department of ECE ,R.M.D Engineering College,Tamilnadu 601206
[4]UG Student/ Department of ECE, R.M.D Engineering College,Tamilnadu 601206
[5]UG Student/ Department of ECE, R.M.D Engineering College,Tamilnadu 601206
jj.ece@rmd.ac.in[1],sgp.ece@rmd.ac.in[2],pv.ece@rmd.ac.in[3]

Abstract— Land mine detection is most crucial during warefare to deploy armed vehicle drive in the enemy territory. These armed vehicle or Main battle tanks are used to followthe path of pilot tank operated manually to avoid damage/distraction of the battle tank and defence causalities of defence crews. In addition post ware fare the mines planted during war can be detected and diffused by deploying a mine detection robot, which can save civilian life to avoid human causalities. This research work proposed to have a proto type model of a land-mine detection robot (LDR), which can be operated remotely using Wi-fi. technology. The safety of humans was addressed and designed robot with special range sensors employed to avoid obstacles. Fabrication of this projectprototype was done using lightweight temperature resistantmetal. A Global Positioning System (GPS) sensor is employed, which identifies and broadcasts the present location of the robot. Path planning, obstacle detection and avoidance algorithms were used to control accurately and to navigation ofthe proposed path by avoiding obstacles. Arduino microcontroller is employed in this robot. The robot system is embedded with metal detector capable of sensing the landmine and buzzer from producing a warning alarm to the nearby personnel in that area. The locomotion of the robot is carried out by the DC motor. The robot is interfaced with the PC by deploying a ZigBee device. In this paper, a Metal Detection System with GSM technology has been presented. The system senses or detects a metallic object and sends an alert message in form of an SMS text to an embedded security GSM number for further actions

Keywords— GSM, GPS, microcontroller, metal detector, sensors,Arduino.

1. Introduction

A land mine is an explosive device concealed under or on the ground and designed to destroy the or disable enemy targets, ranging from combatants to vehicles and tanks, as they pass over or near it. Such a device is typically detonated automatically by way of pressure when a target steps on it or drives over it, although other detonation mechanisms are used. A land mine may cause damage by direct blast effect, by fragments that are thrown by the blast, or by both. The name originates from the ancient practice of military mining, where tunnels were dug under enemy fortifications or troop formations. These killing tunnels werefirst collapsed to destroy the targets located above, but they were later filled with explosives and detonated in order to cause even greater devastation. Nowadays, in common parlance, land mines generally refer to devices specifically manufactured as anti-personnel or anti-vehicle weapons.Though many types of improvised explosive devices ("IEDs") can technically be classified as land mines,the term land mine is typically reserved for manufactured devices designed to be used by recognized military services,whereas IED is used for makeshift devices assembled by paramilitary, insurgent or terrorist groups. The use of land mines is controversial because of their potential as indiscriminate weapons.

They can remain dangerous many years after a conflict have ended, harming the economy and civilians. With pressure from a number of campaign groups organised through the International Campaign to Ban Landmines, a global movement to prohibit their use led to the 1997 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of AntiPersonnel Mines and on their Destruction, also known as the Ottawa Treaty. To date, 162 nations have signed the treaty. Land mines are generally classified into two types based on the type of detonation that has to be initiated,Anti-Tank minesThey are designed to immobilize or destroy vehicles and their occupants. In U. S. military terminology destroying the vehicles is referred to as a catastrophic kill while only disabling its movement is referred to as a mobility kill. Anti-tank mines are typically larger than anti-personnel mines and require more pressure to detonate. The high trigger pressure, normally requiring 100 kilograms (220 lb) prevents them from being set off by infantry or smaller vehicles of lesser importance. More modern anti-tank mines use shaped charges to focus and increase the armour penetration of the explosives.Anti- personnel minesAnti-personnel mines are designed primarily to kill or injure people, as opposed to vehicles. They are often designed to injure rather than kill in order to increase the logistical support (evacuation, medical) burden on the opposing force. Some types of anti personnel mines can also damage the tracks or wheels of armoured vehicles. Under the Ottawa Treaty, the Parties undertake not to use, produce, stockpile or transfer anti-personnel mines and

ensure their destruction. As of early 2016, 162 countries have joined the Treaty. Thirty-six countries, including the People's Republic of China, the Russian Federation and the United States, which together may hold tens of millions of stockpiled antipersonnel mines, are not yet party to the convention.

2. Related work

There are many works on land mine detection robot, monitoring using ZigBee, robots which are available in the literature. In this chapter, surveys of related works on the above fields are discussed. The authors research on land mine detection robots,

Bharath J, Automatic Land Mine Detection Robot UsingMicrocontroller.
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 multisensordemining robot. The robot transport system is based ona simple structure using pneumatic drive elements. The robot has robust design and can carry demining equipment up to 100 kg 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 a chemical explosive sensor. 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 ofmine detection robots for Korean minefield. As a part of a demining robot development project, the environment ofKorean minefield was investigated, and the requirements forsuitable 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 areas havenot 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 atrack type main platform with a simple moving arm and 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.

3. Methodology

A land mine detection robot is needed to be designed to employ in peace support, operations and in the clearance of contaminated areas. For the safety of the operator, the robot is controlled with help of computers using the zigbee module. The robot has an ultrasonic sensor fixed to it in order to locate and avoid the obstacle. The mine can be located with help of latitude and the longitude from the gps sensor. The robot structure is made with a material that can resist blasts up to certain limit. The robot produces warning alert to the personel nearby with help of a buzzer that is mounted on the robot. The robot actuation is done with high powered DC motor supported by h bridge circuit that allowsrobot to move in any direction.

An Overall block diagram is shown in Fig 1 and 2 and the system consists of various electronic parts. The system includes the brain of the robot, Arduino UNO microcontroller, Ultrasonic sensor ,GPS sensor,GSM,

buzzer for warning alert, DC motors for actuation, ZigBee for controlling through PC, Metal detector for detection of mine. These compoments are placed on the robot and the power is supplied to these with the help of a power supply unit. PC is used for detecting the mines and the position of the mines.
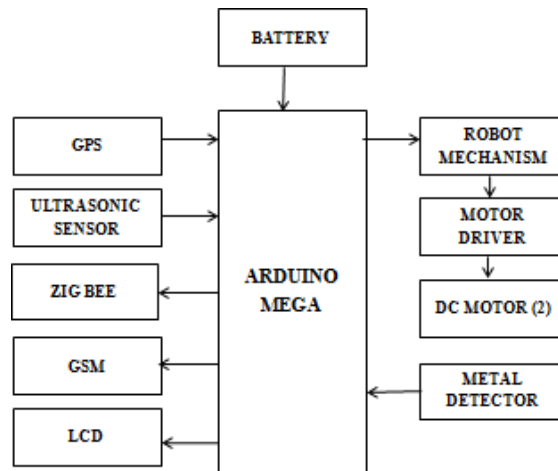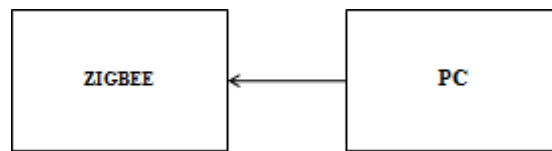

Fig 1:Block Diagram

Fig 1:Control Room Section

A.   Hardware Requirements
- Arduino Uno R3
- Battery
- DC Gear Motor
- Ultrasonic sensor
- L293d motor Driver
- Wheels
- Clamps
- Metal Detector
- GPS receiver
- GSM modem

B.   Software Requirement
- ARDUINO IDE
- Embedded C

4. Hardware implementation

A. Arduino Mega 2560

The Arduino ATmega2560 is a microcontroller board based on ATmega2560. It has 54 digital input output pins,16 analog input, 4 UARTs a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. Connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery. Arduino board works

at 5V power supply. The Mega 2560 is compatible with most shields designed for the uno and the former boards Duemilanove or Diecimila.[6]. Arduino is preferred because it has more digital and analog pins and programming is easy. The ATmega2560 has 256 KB of flash memory for storing code (of which 8 KB is used for the boot loader), 8 KB of SRAM and 4 KB of EEPROM (which can be read and written with the EEPROM library). Each of the 54 digital pins on the Mega can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead()functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions. The ArduinoMega has a resettable polyfuse that protects your computer'sUSB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.
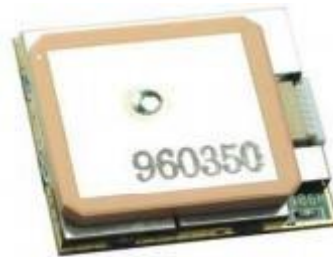

Fig 5:GPS Receiver

D. Buzzer

The PS series are high-performance buzzers that employ unimorph piezoelectric elements and are designed for easy incorporation into various circuits. They feature extremely low power consumption in comparison to electro-magnetic units. In our project we are using the buzzer type PS19 type due to the fact, It has a low frequency tone of 2khZ and piezoelectric material is coated with water and dust resistant material.

Fig 6:Buzzer

Fig 3:Arduino Mega 2560

E. DC Moto

B. Ultrasonic Sensor

Ultrasonic transducers are transducers that convert ultrasound waves to electrical signals or vice versa. These devices work on a principle similar to that of transducers used in radar and sonar systems, which evaluate attributes ofa target by interpreting the echoes from radio or sound waves, respectively. The HC-SR04 Ultrasonic Sensor is the perfect solution for any distance detection application in robotics.

Fig 4:Ultrasonic Sensor

C. GPS sensor

The GPS system provides critical positioning capabilities to military, civil, and commercial users around the world. In our project we are using the GPS sensor module EM-406A, as it is new improved GPS Module with built-in antenna andmemory back-up for OEM. This unit features low power consumption, high sensitivity. The unit is ideal for navigation systems, distance measurements, vehicle monitoring and recording, boating direction and location, together with hiking and cross country exploring.

A motor driver is a device or group of devices that serves to govern in some predetermined manner the performance ofan electric motor. In This project we are using planetry geared DC motor model RMCS-2006 as it provides the required speed for the robot to move and provides high torque at the rated speed and current.

Fig 7:DC Motor

F.   Zigbee RX

ZigBee is an IEEE 802.15.4- based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios.In our project we are using the Xbee module as it was developed to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensornetworks. The modules require minimal power and provide reliable delivery of data between devices.

Fig 8:Zigbee

G.   GSM Modem

While accessing the system, we don't replace the password verification. If password is correct, the system will capture and match fingerprint of the customer. As shown in Fig 4, if fingerprint does not match with the account registry for three times, buzzer will be made ON and a message will be delivered to customer's cell phone and bank authority. Thus,GSM MODEM to communicate with the mobile phone to which we are going to send the message is also interfaced with Arduino.

H.   Metal Detector

In this work, we mainly depend on a metal detector, becausewe need to decide the object is metallic or non-metallic. A metal detector device detects the presence of metal nearby.It takes advantage of the electric and magnetic properties of metals (Eddy currents) to detect metals. The circuit diagram of metal detector is shown below. Here the circuit is divided into three parts, an astable multivibrator, a LC circuit and a comparator circuit. In the first stage i.e., the astable multivibrator circuit (using NE 555 IC), by giving a supply to the circuit it produces a frequency (say f1) and this frequency is fixed by adjusting the variable resistor R1 and R2 which are of the value 2k Ohm and 25k Ohm respectively. It produces a square wave at the output pin (i.e.pin 3) of the IC and is adjusted to give a frequency of 0.7 MHz.

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5. Results and discussion

There are mainly two parts in this project i.e, electronics part and mechanical part. In the electronics part the simulation of all the electronics part like arduino, ultrasonic sensor, dc motors etc are done using the proteus software. The two planetary geared DC motor are connected to the output pins (9, 13), of the microcontroller board. The ultrasonic sensor is connected to the input pins (10, 11) to avoid the obstacles. The metal dector sensor are connected to the input pins (12, 13), for detecting of the mines.

The snapshots of the final robot with all the components attached is shown below in the following figures in all the views
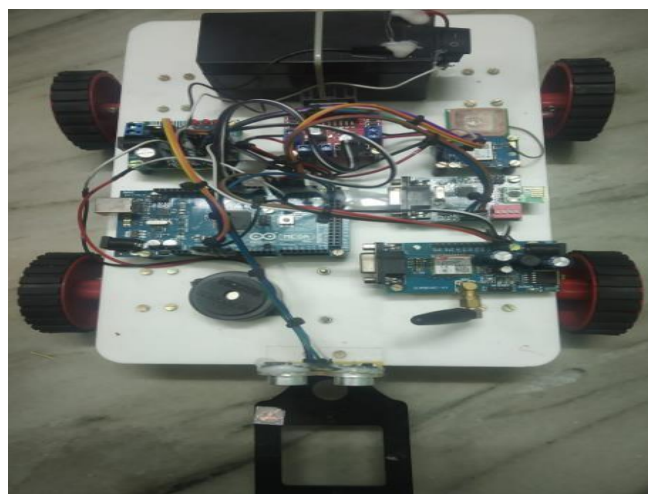

Fig 5. Experimental Setup

The result analysis of the metal detector is receiving the metal detected address to the smart phone which is

being connected through Bluetooth module. This project is very useful for mine workers to detect metal. They can operate the machine from one corner which reduces the human efforts, labor and man power cost. This is very efficient wayto do the mine works by using simple android application

6. Conclusion

This paper has described overall design for wheeled robot for land mine detection purpose and implementation. The wheeled robot is less expensive, robust and it is a helpful tool in for military for surveying and monitoring purpose. The future scope is concentrated on the improvement of the body designs by placing suspension system to over shock from the uneven surfaces. The robot is equipped with a camera for monitoring the condition of the robot. The powersystem is developed by replacing the battery with the solar panels to produce continuous power. The robot is equipped with a robotic arm for the diffusion purpose. We tested the prototype multi-sense robot and are very much used for security and military and coal mine application. With the help of this prototype, we can easily identify the objects with ultrasonic sensor insensitive and unmanned areas. The metal detector is used to identify the land mines very easily. The gas sensor which was used here to identify the toxic gases in coal mines and chemical factories etc. Therefore all these multi-sensors are together working on a wireless communication system with encoder and decoder. In future the data which was collected by the sensor are posted into the cloud, because of this continuous monitoring is possible in all sensitive zones.

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