



Autonomous Defense Robot in Metal Detecting and Chemical Sensing using Internet of Things

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ABSTRACT: Nowadays, robots play a major role in all human activities like house maintenance, aerospace, factories, lifting of heavy equipment, etc.. It will also help to do the risky jobs which cannot do by humans such as mining. The main aim of this project is to extend the use of robots in national defense system. In that case, the part of detecting explosives made of either metal or chemical is very important. This project is to implement the robots for metal detection for national security. It consists of metal detecting unit, chemical sensors (which is used to detect chemical composition), line following (IR) sensor (for path following and obstacle detection) and GSM components. These are all controlled and monitored by Internet of Things (IOT). The Arduino is the main controlling element of the robotic vehicle.

KEYWORDS: Defense robots, IOT, IR sensor, GSM, Arduino, metal detection.

I. INTRODUCTION

In this competitive world the nation's fate was changed because of the terrorism and the war between two countries becoming frequent. The method of war between countries also improved apart from fighting of soldiers of two countries such as bio war, bomb traps in borders may catch many lives of both soldiers and ordinary people. In addition to this, terrorist of opponent country and anti-social elements will make bomb blast in public places like malls, theatres, markets, temples, etc., could kill a lot of people.

For example, in 2008 a series of attacks took place in Mumbai, carried out 12 coordinated shooting and bombing attacks lasting four days across the city. It began on 26 November 2008 and lasted on 29 November 2008. This incident killed 164 people and injured at least 308. The attacks happened at 8 places include South Mumbai, Chhatrapati Shivaji terminus, Oberoi-trident, Taj palace, Leopold cafe, Cama hospital, Nariman house, Metro cinema and Lane behind Times of India building and St. Xavier college.

During those cases, the bombs are detected by the bomb squad. In such condition the squad people may also get died due to the wrong operation or shortage of time. However, loss of lives will remain a burden to the country. To prevent this accidental loss of life, the metal detecting robots can be used in such domains. Therefore, we can implement these metal detecting robots in national bomb squad service and also in military defense system. Elimination of terrorism in every nation is a very tedious process. It could not be done with one movement of defense system. Since it has lots of loss of lives, some immediate and technological activities should be taken for anti-terrorism. In technological wise this can be overcome with the help of engineers by improving the equipment used in military defense system. This is because nowadays every nation's army face is changing towards the developed technology for ease in identifying and defending of terrorist activity. Robots play an important role in recent technology development. In this emerging technology it could be used fruitfully in the defense system with this the efficiency can be improved.

The main aim of this project is to design and demonstrate the metal detecting robots to determine the location of explosives in the terrorist targeting areas. Most of the bombs used to explode are either metal made or chemical made. Thus the robots are to be made with the capability of detecting metal and the chemical substances.



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For this, the robot has to be equipped with metal detector and chemical sensors. After detecting the explosives, the complete details includes types of bomb, its weight, capacity etc., will be send to the higher officials of the defense service or bomb squad with the help of GSM inserted in the robot using IOT technology. IOT refers to the use of smart and connected electronic devices to enable greater efficiency and productivity in our daily lives. It is a system of connected physical objects or entities that are access able through internet, each object is obtained with an IP address and it has the ability to collect and transfer data over a network without manual assistance.

IOT is considered as smart technology, using this many devices are interconnected. IOT can help an organization to reduce the cost through improved process efficiency and connectivity. The direction and path of the robot can be controlled and maintained by line following (IR) sensors. This is provided to prevent the diversion of robots from its target path. It also has another advantage that it can be used for other purpose in the camp during its ideal time. It provides high internet security with good cryptographic technics. Lots of data can be transferred through the network so more investment is necessary. Devices can represent themselves in the network that they can be controlled from anywhere. Internet of Things is the leading technology in current generation of wireless communication.

II.RELATED WORKS

In mine clearance robots, fast neutron generation technique, penetrating RADAR (GPR), metal detector and infrared imaging are used for anti-personal mines [1]. The robot with Bluetooth and camera as a controlling system, it is possible to send videos and pictures as same as IOT technology but it has the limitation in the controlling distance [2]. The eight direction metal detection robots provides accurate metal detection and can be easily movable in uneven surface but the electromagnetic wave intensity is very poor so it can able be detect closer objects [3]. The robots made by using AT89552 micro controller unit and the control is done with the help of gestures which is captured through camera of high quality but noise creation will happen also, high efficient filter circuit is used [4].

III.PROPOSED WORK

Whenever humans find difficulty in doing any works then it leads the path of invention. Robotics is an emerging branch which focuses on reducing the efforts of human. In this project a robotic vehicle is designed and demonstrated for improving the national security. The major components used are arduino uno (ATmega3), metal detecting unit, chemical sensors, GSM sim 900A, IR sensor (transmitter-receiver), motor control unit L293d and 12V motor.

Arduino UNO board is the main controlling unit of the robotic vehicle, it is programmed based on our application either using assembly language or C-programme. Arduino 1.7 software is used for the programming environment.

Infrared (IR) sensor unit consist of transmitter and receiver, which transmitter an IR signal in the direction of motion and receives back from the surface of the object. By analysing that signal that obstacle can be detected.

Global System for Mobile communication (GSM) is inserted in the main body of the vehicle and is controlled by arduino. The motor control unit is used to control the robotic wheels. A power supply unit is employed, that delivers power to the entire circuit board. DC motor is used for the locomotion purpose. High torque motor is selected.

The vehicle is equipped with metal detecting sensor, which helps to detect the metals which are hidden under the ground with the help of metal detecting unit. A chemical sensor is also implemented to detect the presence of chemicals in any form under the ground as well as in the atmospheric surroundings.

The robot should have the capability of differentiate the ordinary minerals or chemicals present in the soil with the explosives hidden by the terrorists. For this differentiating capacity it has be provide with necessary programs or coding and the basic details of the chemicals.

Other than the cases expect from the forest areas or borders, the bomb traps in the living areas is a bit difficult with the metal detector. Because generally in these areas metals other than explosives can be found in all places. So similar to the chemical detector, the metal detector must be able to specify the metal explosive with the help of programming that feed to it earlier.

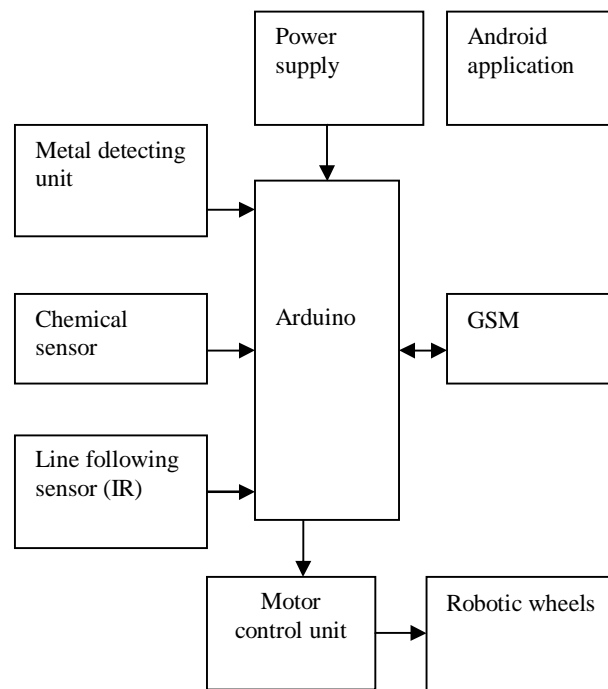


Fig.1 Block diagram representation of proposed system

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- i. Automatic
- ii. Manual

Arduino uno controller is used in the board with that it can be programmed based on our choice and switching off modes is possible. In automatic mode, the robotic vehicle continuously monitored the field and updates for each and



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every interval of time. In manual control the operator can control the operations or movement of the robot either using remote control or through android application.

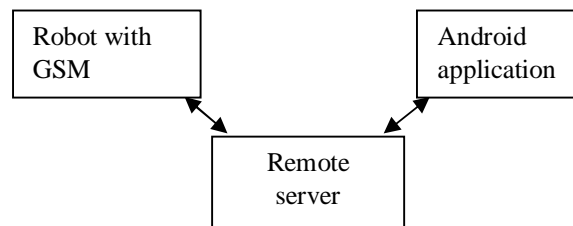


Fig. 2 Information passing flow

Whenever the metal or chemical explosive is detected it gives an alarm and also sends the relevant information to the higher official using Internet of Things (IOT). An android application is developed to control the robot vehicle from the side of higher officer. High encryption keys are used for the security purpose.

A. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, and a reset button. It contains everything needed to support the microcontroller. Operating voltage is 5 V, It has 32KB flash memory, 2 KB SRAM, 1KB SRAM. The ATmega328 provides UART TTL (5V) serial communication, An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The Arduino Uno can be programmed with the Arduino software. It has a resettable poly-fuse that protects your computer's USB ports from shorts and overcurrent.

B. GSM SIM 900A

Global System for Mobile communication, GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine SIM900A, digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band. The Modem is with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip. The baud rate is configurable from 9600-115200. The Modem is having internal TCP/IP stack to enable you to connect with internet. It is suitable for SMS, Voice as well as DATA transfer application in mobile to mobile interface. The on-board Regulated Power supply in GSM allows you to connect wide range unregulated power supply.

C. IR sensor

In this Arduino UNO based project line follower robot we have used IR Transmitter and IR receiver module, also called photo diodes, which is placed at front side of the robot. They are used for sending and receiving light. IR transmits infrared lights. When infrared rays fall on white surface, it reflected back and received by photo diodes which generates some voltage changes. When IR light falls on a black surface, light is absorbed by the black surface and no rays are reflected back. Thus photo diode does not receive any light.

D. Metal detecting sensor

The metal detector working is based on electromagnetic field. When the electromagnetic field is transmitted from the search coil into the earth. Metals in the electromagnetic field will become strengthened and resend an electromagnetic of their own. The metal detector consists of a search coil which receives the retransmitted field and alarms the user by generating a response of the metal. Mine lab metal detectors are accomplished by discriminating between dissimilar types of targets and can be to ignore unwanted metal objects.



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E. Chemical sensor

The MQ series of gas sensors is used; it has a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. The output is an analog signal, can be read with an analog input of the Arduino. The MQ-2 Gas Sensor module is useful for gas leakage detecting in home and industry. It can detect chemicals like LPG, i-butane, propane, methane, alcohol, hydrogen and smoke.

F. Motor control unit

L293d IC is used in this project, it works on the concept of H-bridge. H-bridge circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. VCC is the voltage that needs for its internal operation.

G. DC Motors

Two DC motors are used, which is controlled by motor driver circuit L293d. It has 120 rpm and 12V. Two wheels is used with the motor for the locomotion of the robotic vehicle.

IV. MODELLING AND RESULTS

The kit is supplied with two power source; 9V supply is given to GSM and arduino board. GSM module consists of a SIM card. When proper power supply is provided led blinks. Here line following robot is developed, a lined surface is provided, IR sensor is used to follow the path. Place a metal anywhere in the surroundings, the metal detecting unit placed in the robot detects the metal and pass the information to GSM module, the information is updated in our android application. The android application is updated automatically, same is for chemical MQ2 sensor is responsible to detect the chemical component.



Fig. 3 Robotic vehicle top view image

In the figure 6, the kit diagram is shown. The top view shows the main components of the robotic vehicle. The interconnection of components is done using patch wires.



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Fig. 4 Front view of the robotic vehicle

In this figure 7, the front view of the kit is shown,. At front of the vehicle the metal detecting sensor and MQ2 sensor is fixed.

V. CONCLUSION

The main goal of this project is to design a robotic vehicle which can sense metals near to it on its track, and this robot is controlled by an android application. This project comprises of a metal detector circuit which is interfaced to the control unit that produces a buzzer sound to the user when a metal object is close to it. A microcontroller is used for the desire operation. The project is successfully detects the metal and chemical, It can be mainly used in defense applications. It consist of metal detecting unit, chemical sensor, IR for line following. Whenever the metal or chemical explosive is detected it gives an alarm and also sends the relevant information to the higher official using Internet of Things (IOT). An android application is developed to control the robot vehicle from the side of higher officer. High encryption keys are used for the security purpose. After detecting the location information is also send through this application. So the officers can be find it out as early as possible mean while the robot checks for another area.

VI.FUTURE WORK

New technologies emerging daily, Multitasking robot with web of things could be implemented, and more components can be included. It is can use to improve our national security.

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