# Multi Utility Landmine Detecting Robotic Vehicle

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***Abstract-*** *Landmines in India are lethal artefacts mostly abandoned in rural areas and along the borders. Landmines are weapons or explosives which are buried under the soil that are activated by pressure, and may kill or cause harm when stepped upon it, and also cause long term physiological effects. Landmines provide major challenges to agriculture, infrastructure and road development in post-conflict regions. In order to demine the affected areas, human soldiers were used which involves lot of manpower, time and efforts. This existing method involves lot of errors and even loss of lives in some situations. Hence a robot based method is proposed which uses metal detector as a complementary tool for landmine detection. It detects the position of the landmine and sends its GPS position to a web server through IOT. A metal detector with driver circuit is implemented using ATmega328P microcontroller to regulate the complete operation.*

***Keywords***- AT mega 328P microcontroller, Wi-Fi module, GPS (Global Positioning System), Metal detector and robot.

## I. INTRODUCTION

Landmines are weapons or explosives that are buried under the soil that are activated by pressure, and may kill or cause harm when stepped upon it, and makes agricultural land unusable with the restriction of access to water. Landmines pose a serious threat to soldiers and civilians worldwide and also provide major problems to agricultural lands, water reservoirs and road development in border regions. The landmines are usually buried 10-40mm below the soil and requires about minimum pressure of 9Kg to detonate them. The face diameter of these AP mines ranges from 5.6 to 13.3cm. Landmines are broadly categorized into two types of landmines Anti-Personnel and Anti-Tank landmines. Anti-personnel landmines are used to injure a person since it contains fewer amounts of explosives which get activated when pressure is applied on it while soviet PFM also known as butterfly mine due to its shape, attract children who thinksit as a toy. The most common method is electromagnetic induction (EMI) based sensors can detect metal mines at a low cost; this method has been explored, and uses the electromagnetic characteristics of the mines or the mine casing.The use of electromagnetic sensor in the existing systems is extended to incorporate GSM method, prevails the limitation of restricted frequency and working area as the GSM provided a worldwide range with no interference with other controller. Several techniques such as GPS, infrared imaging, acoustic method, ultrasound technique, gamma rays method, thermography methods are used for metal detection. This project aims at designing a landmine detecting robot that uses GPS technology and is controlled by the ATmege 328p microcontroller.

## II. LITERATURE SURVEY

Kishan Malaviya, et. al[1] the paper titled as" Autonomous Landmine Detection and Robotic Vehicle" which is capable of detecting buried land mines and marking their locations, while enabling the operator to control the robot wirelessly from a distance. The project was start from the brain storming phase together with the research phase and then preceded into the conceptualization or designing phase. The ideas and concepts from the theoretical stages are shaped into the physical hardware components by fabrication of a prototype and then software programs are integrated into the system so as to test end experiment the concepts that had been developed.

Bharath J,et.al[2] the paper titled as" Automatic Landmine Detection and Sweeper Robot using Microcontroller "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.

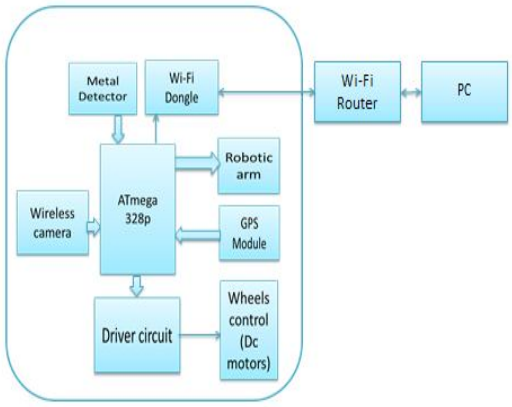
Abilash V, et.al [3] the paper titled as "Ardunio Controlled Landmine Detection Robot" developed a proto type model of a land-mine detection robot (LDR), which can be operated remotely using Wi-Fi Technology. The safety of humans was addressed and designed robot with special range sensors employed to avoid obstacles. Fabrication of this project prototype was done using lightweight temperature

resistant metal. 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 of the 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. Robot can identify the position of the landmines which is designed using the Proteus 8 TM software and the embedded programming using Arduino software.

## III. RELATED TECHNOLOGY

Mine detection systems have typically been developed by first identifying a sensor technology, then testing on particular manmade test beds, then deploying the sensor on a vehicle or man portable device. Despite much effort, current systems still exhibit gaps between existing and desired capability, e.g., in terms of rate of advance, detection rate, and false alarm rate within demonstration test beds. A design of a holonomic mobile robot for rough terrain that can replace the human role in the demining applications. The terrain navigation used by the mobile robots is attained by a novel embodied reactive obstacle avoidance method. Highly compliant legged and wheeled platforms have been developed accomplishing lowcost all-terrain robots. Digital signal processing algorithms have been applied for landmine detection using the payload sensors. A GPS and sonar based area mapping and navigation scheme for a mobile robot. A mapping is achieved between the GPS space and the world coordinates of the mobilerobot which enables us to generate direct motion commands for it. This mapping enables the robot to navigate among different GPS locations within the mapped area. The GPS data is extracted online to get the latitude and longitude information of a particular location. In the training phase, a 2-D axis transformation is used to relate local robot frame with the robot world coordinates and then the actual world coordinates are mapped from the GPS data using a RBFN (radial basis function network) based Neural Network. In the second phase, direct GPS data is used to get the mapping into the world coordinates of mobile robot using the trained network and the motion commands are generated accordingly. Metal detectors are considered as the most reliable sensors for mine detection work. However, landminedetection performance of the metal detectors is highlydependent on the distance between the sensor heads andthe buried landmines

**BLOCK DIAGRAM**




## III. PROPOSED SYSTEM

The robotic vehicle consists of ATmega 328p microcontroller attached with four wheels for the movement of the vehicle over the land. When a Landmine is detected the robotic vehicle stops at that position and activates the GPS module. The GPS data is extracted online to get the latitude and longitude information of a particular location. The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from other application. which gets the latitude and longitude position through online access and give it to the controller. Through wife modulethe positioning datafrom the controller is send to internet of things which stores the data in cloud. On surfing through the internet, the latitude and longitude position of the landmine can be accessed and the corresponding landmine can be removed. At the same time this robot can be used for surveillance purpose. The controller send the video data from wireless camera to the cloud. Operator can monitor invasions in borders at anywhere in world.

### ATmega328p

The high performance Microchip pico power 8-bit AVR RISC based microcontroller combines 32 KB ISP flash memory with read-write capabilities, 1024B EEPROM, 2KB SRAM , 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable watchdog USART,A byte –oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, and

five software selected power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1MIPS per MHz, balancing power consumption and processing speed.

**Metal Detector**

A metal detector is an electronic instrument which detects the presence of metal nearby. Metal detectors basic operation depends on Ampere's and Faraday's laws. It works on the principle of transmitting a magnetic field and analysing a return signal from the target and environment. The transmitted magnetic field varies in time. This transmitted magnetic field creates electric current to flow in metal targets. These electric currents are called eddy currents, the eddy currents causes an alternating voltage signal at the receive coil. Depending on the alternating voltage signal at the receive coil, we can decide whether the metal target is detected or not.

**Wi-Fi Dongle**

A USB Wi-Fi adapter or dongle plugs into one of your desktop or laptop's universal serial bus (USB) ports, allowing you to connect to a wireless network in the home, office, or a public place. You can use this connection to access shared files, devices, and documents, or to connect to the Internet. This is a handy alternative for those using computers that do not have integrated network adapters. A USB device is often less expensive than a replacement network card. Adapters tend to be bulkier than dongles, but more powerful. However, dongles fit in the pocket, so are more portable. These devices resemble memory sticks.

**GPS Module**

GPS receivers use a constellation of satellites and ground stations to compute position and time almost anywhere on earth.At any given time, there are at least 24 active satellites orbiting over 12,000 miles above earth. The positions of the satellites are constructed in a way that the sky above your location will always contain at most 12 satellites. The primary purpose of the 12 visible satellites is to transmit information back to earth over radio frequency (ranging from 1.1 to 1.5 GHz). With this information and some math, a ground based receiver or GPS module can calculate its position and time.

The data sent down to earth from each satellite contains a few different pieces of information that allows your GPS receiver to accurately calculate its position and time. An important piece of equipment on each GPS satellite is an extremely accurate atomic clock. The time on the atomic clock is sent down to earth along with the satellite's orbital position and arrival times at different points in the sky. In other words, the GPS module receives a timestamp from each of the visible satellites, along with data on where in the sky each one is located (among other pieces of data). From this information, the GPS receiver now knows the distance to each satellite in view. If the GPS receiver's antenna can see at least 4 satellites, it can accurately calculate its position and time.

## IV. HARDWARE CONFIGURATION

**Acrylic Sheets and Spacers**

Acrylic sheet is used to construct the body of the robot. This material has unique physical properties and performance characteristics. Acrylic sheets are less in weight and highly durable. It is also an excellent insulator, so that the electronics and electrical parts of the robot are safe in terms of electrical hazards. A spacer is a type of hardware, which is used to maintain space between two sheets in our robot. Spacer is used to maintain our robot stable on operation and we are using 3 mm bronze spacer and 150 mm aluminum spacer in our project.

**DC Motors**

Here, 100 rotations per minute (RPM) Centre Shaft Economy Series DC Motor are used and it is high in quality as well as low cost DC geared motor. The motor is DC type 12 Volt motor and gives 100 rotations per minute in 12 volts.

**Wheels**

Width of the tire: 20 mm. Diameter of the tire: 70 mm. Diameter of the Shaft hole: 6 mm.

**Relays**

By using relays we can control DC motor direction of rotation. So, by using series of relays we can control robot movement

**Colpitts Oscillator**

Colpitts oscillator with induction coil act as a metal detector circuit in the robot's mine detection part. By using an inductor coil, we can detect presence of metal. When metal is kept near an inductor due to mutual inductance there will be change in frequency of oscillation.One of the advantages of this circuit is its simplicity; it needs only a single inductor. As a metal object is brought close to the inductor, the amplitude

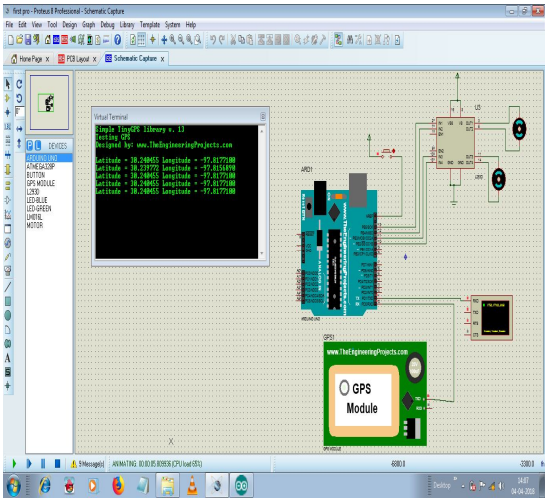
of the voltage across the tank circuit gradually begins to drop. Here, the feedback factor for the Colpitts is typically 0.1 to 0.5, or 10 to 50%. If the series combination of C1 and C2 creates the effective capacitance of the (inductance is L and Capacitance is C) LC tank circuit with one inductance, then the frequency of oscillation derived from the equation.

$$F_0 = \frac{1}{2\pi\sqrt{L\frac{(C1*C2)}{C1}+C2}}$$

Colpitts oscillator response to the signal from the detector coil based on mutual inductance. The signal frequency from the detector coil varies based on the contact with metal surface to activate the Colpitts oscillator to send voltage to the alarm unit.

## V. SOFTWARE CONFIGURATION

### A. Stimulation Results




## V. CONCLUSION

This prototype provides less complex structure and reduces the cost to build a landmine detection robot. Accurately it measures the latitude and longitude positioning using the GPS module hence it is easy to point out the position of the landmine. The greatest advantage is that this robot offers safety for the soldiers on war field.

## FUTURE DEVELOPMENT

In case of plastic landmine detection, the detector can be replaced by ground penetrating radar or other detection mechanism.

Wheels size should be increased to upload the landmine from the actual mine fields. We can install shock absorbers and adjusters to the wheel unit, so that it can run on any rough terrain surface.

A suspension system based on the bogie mechanism was adopted in order to overcome rough terrains. The flexible design of the robot enables it to move in any direction at any instant without changing the orientation of the body.

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