

LANDMINE DETECTION SYSTEM USING ARM PROCESSOR

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I. ABSTRACT

The land mine crisis is globally alarming since there are presently 500 millions unexploded, buried mines in about 70 countries. Governments are looking into this situation seriously since land mines are claiming the limb and lives of civilians every day. The purpose of this project is to design a robot 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 started from the brain storming phase together with the research phase and then proceeded 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 and experiment the concepts that had been developed.

II. INTRODUCTION

The aim of this project is to design Landmine detection, if any on the position of land surface; it detects and alerts the respective department using notification transmitter section. It also locates the mine position of land surface transmitter section on display and indication. In this project system can scan a rectangular area efficiently and scan it for landmines. For this, the system makes use of metal detector for detecting these mines. Once the system detects the mine, it stops the robotic vehicle at the location where the mine is being hidden. After which system makes use of wireless communication indicating the position of the mine that is hidden in the land. Here the ARM controller is used to process data sent by the metal detection system and stop whenever it is detected. Here we have ARM cortex board as controller that drives motorized vehicle accordingly so that robotic vehicle scans the entire rectangular area.

This project contains multiple sensors for detecting the landmines. A land mine detection robot is needed to employ in peace support operations and in the clearance of contaminated areas. Also the robot shall be able to detect 50-90% of landmines (Anti-Personnel

Mines) and mark the locations of the mines within a tolerance of 5cm and it is able to send the location to the operator via GSM. For the safety of the operator, the designed robot must be able to operate remotely. Moreover, it must be equipped with wireless data transmitting capabilities. Landmines are easy-to-make, cheap and effective weapons that can be deployed easily over large areas to prevent enemy movements. Mines are often laid in groups, called mine fields, and are designed to prevent the enemy from passing through a certain area, or sometimes to force an enemy through a particular area. While more than 350 varieties of mines exist, they can be broken into two categories, namely, anti-personnel mines and anti-tank mines. Anti-personnel mines are designed to kill or injure enemy combatants. They are usually buried 10mm to 40mm beneath the soil and it requires about 9 kg minimum pressures to detonate them. The face diameter of most of the anti-personal mines ranges from 5.6cm to 13.3 cm. Hence to prevent from these mines we designed this system which is light weighted and will detect the mine.

Every country is preparing for a strong army to prevent them from terrorists, the soldier undergoes a particular period of training in the camp and finally they will be shifted to the most dangerous place of where terrorist area camp, even to protect the borderline between the two countries. The landmine is the most dangerous weapon that is invented when the World War happened. It plays a very important role in the period of war and most of the soldiers have lost their life or body parts due to their inability to detect them.

The objective of the robots is to search for landmines using their landmine detection sensors. When an object of interest is detected on a robot's sensor, finally, the data collected from the object of interest by the robots has to be fused so that the object can be classified as a landmine or no landmine.

The main objectives behind this project are follows:

- Improve Knowledge of robotics as well as electronic circuit design and construction.
- Construction a robot which capable of detecting a landmine.
- To maintain the safety of our military.
- To search for landmines using their landmine detection sensors.

III. LITERATURE SURVEY

A land mine is a type of self-contained explosive device which is placed onto or into the ground, exploding when triggered by a vehicle, a person, or an animal. The name originates from the practice of sapping, where tunnels were dug under opposing forces or fortifications and filled with explosives.

1)Rasaq Bello, Literature Review on Landmines and Detection Methods. This paper has a review on landmines and detection methods, various types of landmine is explained in details such as Anti-personnel, Anti-tank, Common anti-personnel. Various landmine detection techniques mentioned in this paper are:

Back Scattered X-Ray Radiography: In this method detection of landmines is done using backscattered x-rays with the help of collimated x-ray beam and uncollimated detectors. This system works under various weather conditions.

a) Penetrating Radiation: This method is useful for material characterization of explosive materials but in case of landmine detection is requires the access to two opposite sides of an object, which is difficult to obtain in case of landmines.

b) Ultrasound Techniques: Properties of an ultrasonic pulse which can propagate through the material are measured through which the mechanical characteristics of the material are measured.

c) Acoustic Technique: It's a non-destructive testing method using flaw detection and material characterization, principle area of which is landmine detection.

d) Thermography: thermal signature of the soil is altered by the presence of shallowly buried objects is the main principle behind this method. Since landmines are shallowly buried objects this method is a topic of great interest in past few years.

e) Ground Penetrating Radars: Short Pulse, wide band low energy radars are used to probe into the earth, but this

method has a problem that the dielectric discontinues at the places other than the mine [1].

2) Waqar Farooq, Nehal Butt, Sameed Shukat, Nouman Ali Baig, Sheikh Muhammad Ahmed, Wirelessly Controlled Mine Detection Robot. This paper demonstrates the problem and effects of landmines in defence fields. The robot is equipped with special wheels controlled by H-Bridge module, allowing it to move in all possible directions. The robot is equipped with special range sensors that help in avoiding the obstacles in the field by specifically detecting the position of obstacles. A special type of prototype made of lightweight temperature resistant metal is used to carry all objects. A wireless camera is added to the robot, which captures and broadcasts the present location of the robot [2].

3) Jebasingh Kirubakaran.S.J, Anish kumar jha, Dheeraj kumar, Sadambi Poornachandran Prakash, Mine Detecting Robot with Multi Sensors Controlled Using HC-12 Module. This paper demonstrates a mine detecting robot guided by HC-12 module that allows it to scan the testing area within 1.8km and metal detector is used as mine detecting sensor placed in front of the vehicle, while GPS is used to provide the exact location of the infected area. The embedded system is based on Arduino technologies and guided by an HC -12 Module [3].

4) Bharath J, Automatic Land Mine Detection Robot Using Microcontroller. This paper demonstrates the landmine detection robot. In this he 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 [4].

5) Michael YU. Rachkov, Lino Marques, Anibal T. De Almeida, Multi-Sensing Demining Robot. The paper describes an advanced multisensory demining robot. The robot transport system is based on a 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. [5].

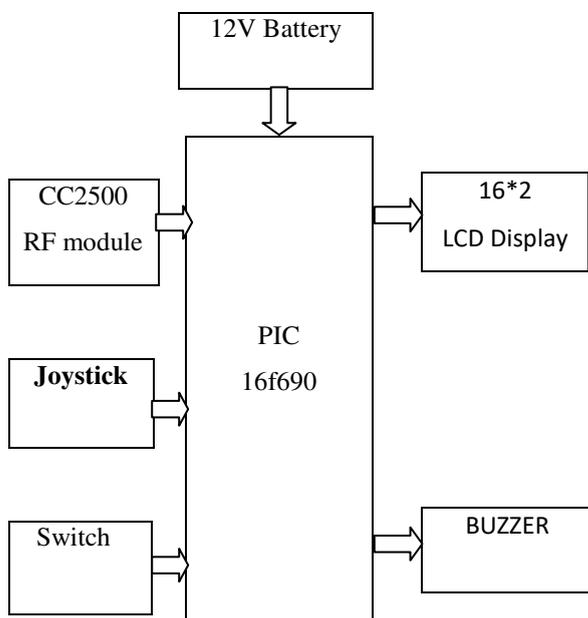
IV. System Diagram

The operation of metal detectors is based upon the principles of electromagnetic induction. The single-coil detector is the one used in a real metal detector. A pulsing current is applied to the coil, which then induces a magnetic field. When the magnetic field of the coil moves across metal, such as the coil. DC motors are used to physically drive the application as per the requirement provided in software. The dc motor works on 12v.

Here we are developing an Android APP through which the user can set the Automatic mode or the Manual mode. In manual mode the App GUI will display 4 buttons through which the user can control the vehicle.

The block diagram of the hardware implementation of the entire system is as shown in the Figure1. ARM 7 is a microcontroller capable of performing various functionalities.

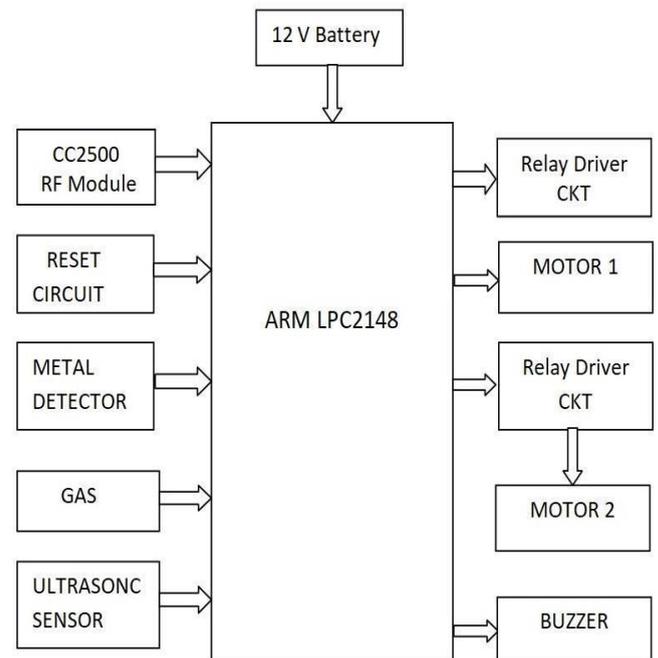
i) Transmitter section for landmine detection system



- 12V Battery is used as a power source which will be given to the transmitter section
- A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

- A buzzer or beeper is an audio signal device, Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.
- CC2500 RF Module is a trans receiver module which provides easy to use RF communication at 2.4 Ghz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source.
- PIC16F690 20-pin Flash-based PIC microcontroller that comes with high-performance RISC CPU and mainly used in automation and embedded systems.

ii) Receiver section for landmine detection system



- Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

- The operation of metal detectors is based upon the principles of electromagnetic induction. The single-coil detector is the one used in a real metal detector.
- The Gas Sensor module is useful for gas leakage detection. It is suitable for detecting H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible.
- A Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF
- The various functionalities of the components are given below: The various functionalities of ARM 7 (LPC 2148) Up to 45 of 5v tolerant fast general purpose I/o pins in a tiny LQFP64 package. Up to 21 external interrupt pins are available.

V. RESULT

With the help of this landmine detection system we can ensure the safety of our soldiers. The detection of landmine can be done remotely with the help of this system. So the life casualties can be avoided easily. Detection and destroying of mines where they are, is better than forming maps of found mines and then defusing them. The Built guarantees complete coverage of unknown areas for ensuring the detected mines existence

VI. ADVANTAGES

- The Robot can operate automatic as well as in manual mode
- The mode switching is done very fast without any delay.
- Robust system, which can be used in almost all types of terrain and weather.
- Low power requirement, as it consumes less power and hence gives more battery backups.
- GPR used in this systems has accurate measurement and can also locate even a small target.

VII. Features

- High Safety.
- Low power consumption.
- High efficiency.
- Versatile mounting on PCB or panel.
- More Protection
- Reliable and rugged.

VIII. Applications

- **Military application :**
These robots can be used as detection of landmines in war and also in naxal prone areas.
- **Co-operative application:**
These robots can be used as metal detection .
- **Domestic application :**
These can also be used at home for the domestic purpose like Treasure detector.

IX. CONCLUSION AND FUTURE SCOPE

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 power system 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.

X. Reference

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