

**RESEARCH ARTICLE**

**DESIGN AND SIMULATION OF METAL  
DETECTION SYSTEM**

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**Abstract**

This paper dealt with metal detectors and techniques used primitive and modern we designed the circuit of the metal detector to study the frequencies of various metals such as aluminum, gold and silver and we compared the results with the theoretical results, where it was found that the theoretical results differ from the practical results and dealt with one of the modern techniques used in detection Is a smart robot in the form of a vehicle containing a number of electronic components to assist in the detection of metals such as Arduino, motors and sensors This paper is designed to simulate and build a detector with The device was simple to install and cheaply cost. The device was successfully implemented. The device was able to detect metals in the area surrounding the sensor. The design characteristics, the performance of the device, its area of work and the accuracy of its results were discussed in this paper.

**Key Words:** *metal detectors, Arduino, motors, sensors*

## I. Introduction

This paper presents an advanced solution and a new direct approach for remote sensing GPS, RF Arduino based on the concept of metal detectors. Conventionally, Wireless-controlled robot's circuits, which have the drawbacks of limited working range, limited RF frequency range and the limited control. Use of use GPS Arduino Microcontroller and RF robotic control can overcome these limitations. It provides the advantage of robust control, working range as large as the coverage area of the service provider, no interference with other controllers . [1]

Metal detectors are used to search for metals underground Usually metal detectors give some indication of the distance; As the metal approaches, the tone in the earpiece rises or the needle moves further. The metal detector produces a magnetic field when it is above a metal object, marking the circuit in which that object is located. In this paper, we rely on the establishment of an electronic metal detection system that can be used in several fields such as mineral exploration, building security and search for lost items. These devices often consist of a portable unit with a sensor that can penetrate the ground or other objects. If the sensor is connected to a piece of metal, it will emit a signal [2]

## II. Methodology

The GPS based metal detection system using an Arduino Uno microcontroller system and an Interface Driver (UL293) to control the robot motor movements and metal detection sensor which send a single of detection to the microcontroller when detect any spot and stop on it and send the location through GPS and RF to the operator to RF with LCD which contain in the position .

## III. Microcontrollers

A Microcontroller is an integrated electronic circuit that contains an internal microprocessor, an internal programmable memory to store the control program, and another memory for data processing. It also contains input and output pins . It may also contain other tools such as an analogue-digital converter and digital - analogue converter, voltage comparators, process amplifiers, and a clock pulse generator. Counters, timers, etc.

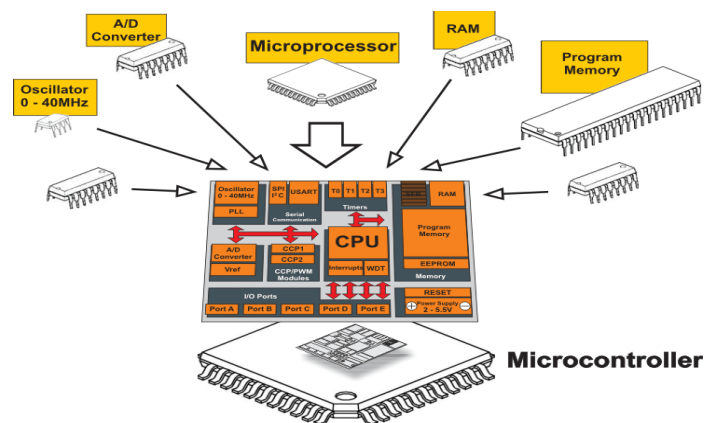


Fig1:component of microcontroller

## IV. Design of Proposed System

The metal detection system that was designed in this paper has been divided into two parts as shown below

### A. Robot circuit

circuit contains Ultrasonic sensor, Metal sensor, Driver L293, Motor, RF and GPS.

### B. Receiver circuit

This circuit contains LCD, Buzzer, Arduino and RF. Software design, BASCOM program used.

## V. Circuits Components

Firstly a signal sent to the motors to move the vehicle forward and the radars monitor whether there is an object in front of the vehicle or not , and if a metal was discovered by the sensors the car will stop and in a while it send the location coordinates to the receiver by RF (Radio Frequencies) with frequency of 450 MHZ to notice the users that there is a metal had been discovered in a specific area with location coordinates and operates the bell, after that the vehicle moved forward to search for new metal. The vehicle moves by specific map with specific steps forward then reverse the movement to the other direction with the same sequence above and so on till the entire desired area is surveyed with specific coordinates.

The transmitter circuit consists of the vehicle motors, GPS, RF radar in the front and the back in addition to the green and red LEDs , as the receiver circuit consists of RF and the Nano controller in addition to a bell and screen that displays the message.

- Robot circuit
  1. Sensors (Metal sensor, Ultrasonic sensor).
  2. Arduino UNO.
  3. RF transmutation
  4. Motor
  5. GPS.

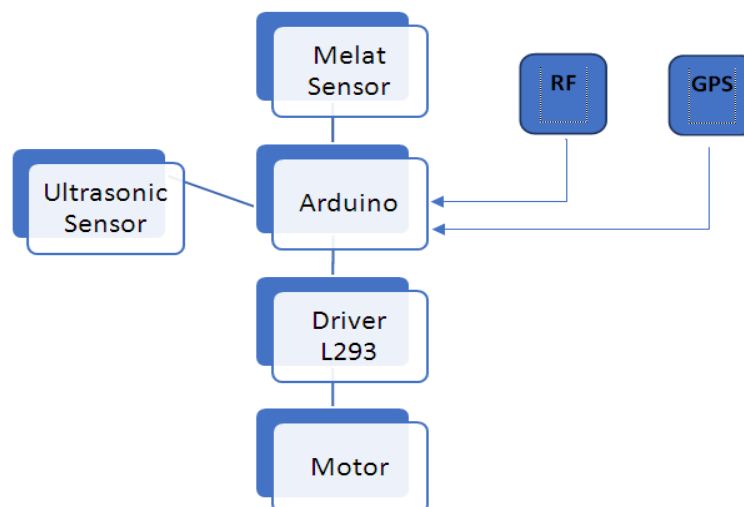


Fig2: Block Diagram of Robot circuit

- Receiver circuit
  1. LCD.
  2. Buzzer
  3. Arduino Nano
  4. RF receiver

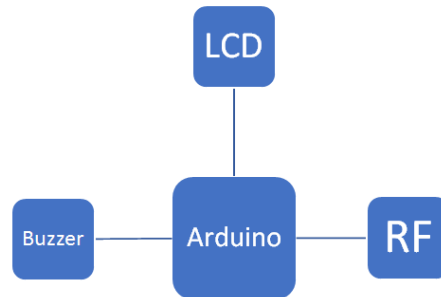


Fig 3: Block Diagram of Receiver circuit

#### A. Metal Detector

The construction method of metal detectors is based on electro magnetic induction. Metal detectors contain one or more inductor coils that are used to interact with metallic elements on the ground. The single-coil detector below is a simple type of one used in a real metal detector.[3]

A pulsing current is applied to the coil, which then induces a magnetic field shown in blue. When the magnetic field of the coil moves across metal, such as the coin in this illustration, the field induces electric currents (called eddy currents) in the coin. The eddy currents induce their own magnetic field, shown in red, which generates an opposite current in the coil, which induces a signal indicating the presence of metal.

The metal detector circuit include simple proximity sensor , LC circuit and a buzzer . the LC circuit include capacitor and inductor are connected in parallel. if the circuit detects any metal near to it, then the circuit activates the proximity sensor and its glow the LED and makes a buzzer[4]

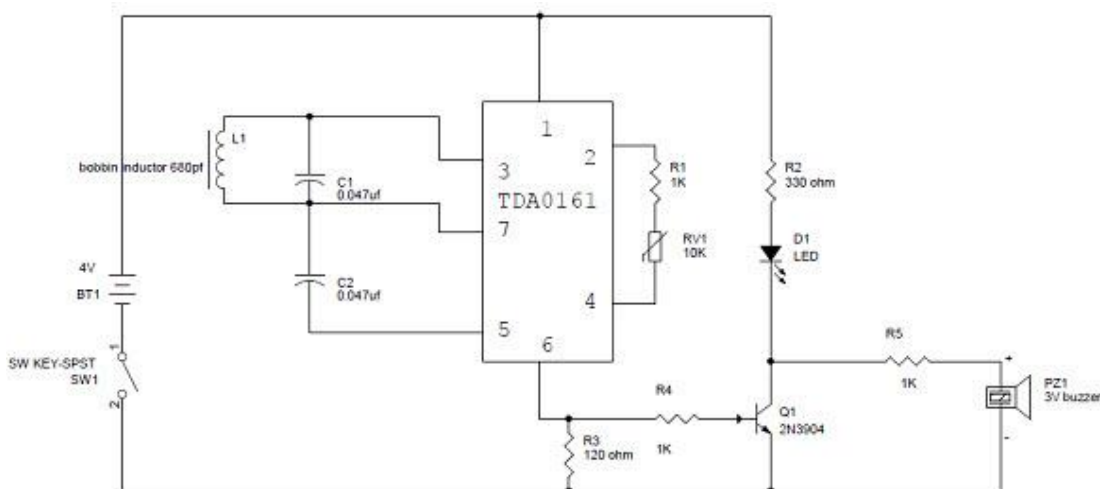


Fig4: Metal detector circuit

## B. Arduino Uno

Arduino uno is an open source platform used to build electronic projects. The Arduino consists of a physical programmable board and the Arduino IDE (Integrated Development Environment), which runs on a computer, and is used to write and read computer code to the physical board. the Arduino platform has become extremely popular with people who are just getting started in electronics, and for good reason. Unlike most programmable circuit boards, the Arduino doesn't need a separate piece of hardware (called a programmer) in order to load new code onto the board - you simply use the USB connector. In addition, the Arduino IDE uses a simplified version of C++, which makes the program easier to learn. Finally, the Arduino provides a standard form factor that breaks the functions of a micro-controller more easily into a package. the Arduino Uno is one of the most popular chips in the Arduino family, and it's a great choice for beginners.



Fig5: Arduino Uno

## C. Dc motor

A DC motor is an electric motor that converts electrical energy into kinetic energy and works only on DC systems the device is composed in its simplest form of two magnetic poles, a north pole and a south pole, separated by a certain distance, in which a coil connected to a battery or any voltage source that generates a current is placed. Thus, a permanent magnetic field will be generated as a result of the magnetic flux lines passing from the north to the south pole, knowing that the torque is directly proportional to the number of these lines passing through the coil. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. larger DC motors are used in propulsion of electric vehicles, elevator and hoists .

## D. Driver L 293

A motor driver is an electronic circuit often used to control motors in robots. Motor driver is interface between Arduino and the motors. The most common used motor driver IC's are from the L293 series such as L293D, L293NE, etc. ICs was designed to control 2 DC motors simultaneously. L293D consistof two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

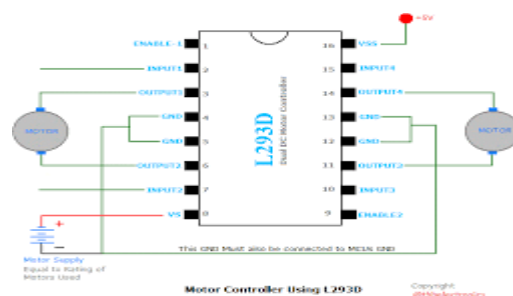


Fig6 :UL L293 IC

#### E. US (ultrasonic sensor)

Ultrasonic sensors can detect movement of targets and measure the distance to them in many automated factories and process plants. Sensors can have an on or off digital output for detecting the movement of objects, or an analog output proportional to distance. They can sense the edge of material as part of a web guiding system. Ultrasonic sensors are widely used in cars as parking sensors to aid the driver in reversing into parking spaces. They are being tested for a number of other automotive uses including ultrasonic people detection and assisting in autonomous UAV navigation..[5]



Fig7:ultrasonic sensor

#### F. GPS

The global positioning system (GPS) is a satellite navigation system, its main function is to provide accurate information about the geographical location of a particular person, and there is no doubt that the system has contributed to the development of many fields such as land trips, marine navigation and various military tasks, and the system plays a distinguished role in the areas of surveying, for this The system is considered one of the most widely used measurement tools by geodetic engineers due to its accuracy and data validity.. The GPS is made up of three part: satellites orbiting the earth; control and monitoring stations on earth; and the GPS receivers owned by user. GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. Each GPS receiver then provides three -dimensional location (latitude, longitude, and altitude) plus the time. [6]

#### G. RF

##### 1. RF Transmitter STT-433MHz

The STT-433 is perfect for remote control applications where minimal effort and more range is require , the transmitter works from a1.5-12V supply, making it perfect for battery-controlled applications and transmitter utilizes a SAW-balanced out oscillator, guaranteeing precise recurrence control for best range execution. the producing inviting SIP style bundle and minimal effort make the STT-433 suitable for high volume applications.

## 2. RF Receiver STR-433MHz

The information is gotten by the RF collector from the receiving wire pin and this information is accessible on the information pins. Two Data pins are given in the collector module. Therefore, this information can be utilized for further applications.

## VI. Result

The result of proposed system included two sections the Simulation and design and implementation of electronic circuit

### A. Simulation of Metal Detection

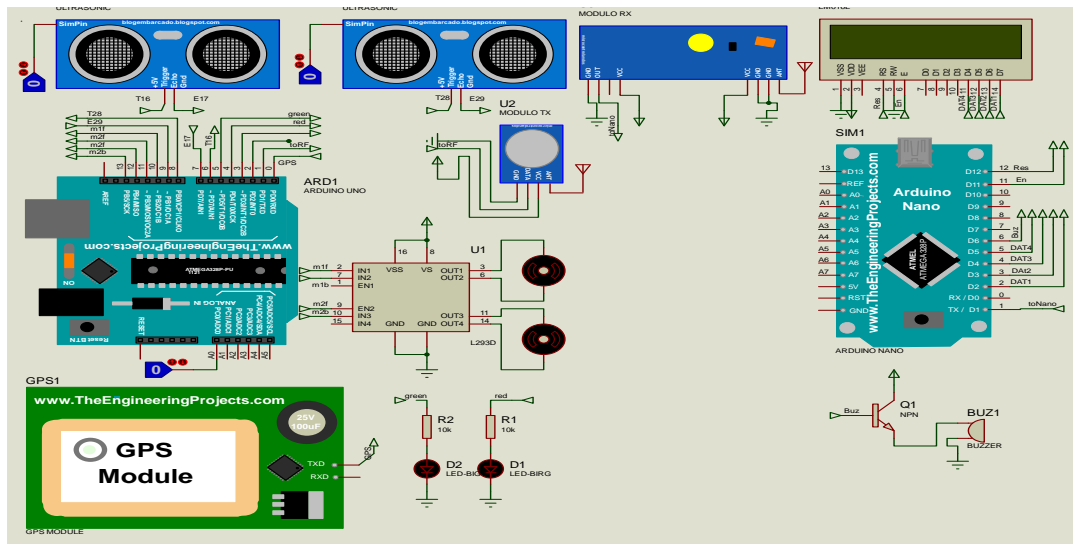


Fig 9 : Simulation of Metal Detection

### B. Design and Implementation

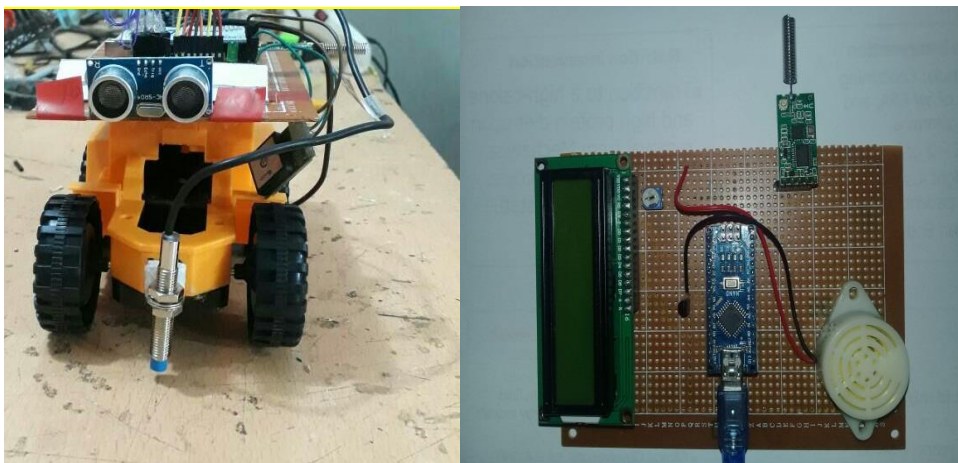


Fig 10 :Design of proposed system

Above system was implemented to detect the metal types and send information through RF antenna and controlled it using a microcontroller system called the Arduino microcontroller and sensors were used to detect object in front of the vehicle if objects were found the vehicle stopped for a while and then tried to move away from the body and then proceed to search for minerals and these sensors are sensors send ultrasonic waves to see if there is a body in front of the vehicle or not and there are sensors feel the presence of metal or not and the cheapest use of these kinds of sensors to increase the cost in these sensors and not available in some neighborhoods a device was used to locate the vehicle and place the metal which sends a message through the antenna to a screen to monitor the condition of the sensors and send a message in the presence of an object in front of the vehicle and send a message coordinates location and place of metal when the discovery of metal was used variable resistance to adjust the screen contrast and the use of transistor to amplify the sound of the bell when the metal and then send a voice signal the existence of the metal was moving the vehicle and detection of the state of operation of the system and determine the number of steps of the vehicle and walk to the front and rotation using motors but was used to protect the microcontroller from damage and All of these devices are equipped with a metal detection system as a controlled vehicle model and operates the vehicle with AC power and feeding the Arduino microcontroller and motor vehicles using a battery source.

## VII. Conclusion

The proposed system and the all components of the of the metal detection system controlled with the Arduino microcontroller, the ultrasonic sensor for the metal detector and the GPS module equipped with the prototype of the vehicle and the use of a receiver and an RF transmitter to transmit and receive signals from the vehicle system to the system operators Which can be a long distance from it and the GPS module to send the car center to the operator when the system detects any metal signals from the sensor equipped to the system and send information data to the users as well as protect the person from the risks surrounding the search and The detection of the metal using the robot in the form of a vehicle because human protection is the main task in this project has been improved and development of this project using electronic components cheap and available and easy to use and moved and booked a specific area of the vehicle to detect the metal and the operation was successful and then access to the model mission to the fullest .

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