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Solar Operated Robotic Vehicle For Metal Detection

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Abstract : The design and development of mobile operated solar-powered metal detector robot is a robot to autonomously operate and detect the archaeological remains. The study of archaeology involves the finding of historical remains by excavation. The remains are mostly metallic in nature can be detected easily with the help of metal detector. The robotic vehicle is capable of detecting metals ahead on its path. Operation of robotic vehicle can be achieved by any smart phone. The GPS (global positioning system) is use for sending the location coordinates i.e., longitude and latitude of the location where the archaeological metallic remains are detected to the mobile attached to it. The development of application for controlling the robotic vehicle is capable of viewing and sharing the results i.e., location coordinates to any communication network. The solar panel mounted on robotic vehicle provides a power output to charge the battery and hence improve performance. The overall efficiency and performance of the archaeological research system is increase by such a robotic vehicle.

Keywords- Arduino UNO, L298D motor driver IC, GPS module L 80, solar panel, HC 05 Bluetooth module, Buzzer, Metal detector sensor.

I. INTRODUCTION

The discipline of archaeology studies human cultures and past. It helps to prove the authenticity of written records. Archaeological remains are required to study archaeology. Metal detectors are one of the most commonly used instruments required to find the archaeological remains.

Our project aims to find such metallic remains using metal detector which is mounted on the robotic vehicle which is controlled by Arduino microcontroller. As soon as the metallic objects detected the vehicle turn on the buzzer. The robotic vehicle is also capable of sharing the location coordinates of the place where the metallic remains have found using GPS module. The Bluetooth module HC 05 is used to established communication between Arduino UNO and mobile phone. L293D motor driver IC is used to controlled the direction of motors. We developed the custom application for sending the commands to microcontroller and also to receive and sharing the location coordinates. The vehicle utilizes the solar energy to charge the battery

and improve its efficiency. This robotic vehicle is also capable of detecting the metallic pipeline, electrical lines underneath the land.

II. OBJECTIVES

1. To detect the metallic objects and turn on the buzzer and share the location of that place to the connected mobile via GPS technology.
2. To develop the application which can controlled the robotic vehicle movement and to view and shared the location coordinates to any communication network.
3. To utilise the renewable solar energy to charge the battery.
4. To decreases the efforts of archaeologist to find out metallic archaeological remains.

III. Methodology

- The Arduino uno board one of the most commonly used board for various electronic projects is used in our project to interface the GPS module, L293D motor driver IC, metal detector sensor, buzzer, Bluetooth module.
- The block diagram shown below gives the interfacing of different component with Arduino uno.
- The 12V battery supplies the power to the Arduino board as well as to the GPS module for their operations.
- The solar panel charge the battery simultaneously to provide the energy efficiency to the system.
- The Bluetooth module is interface with the Arduino to give command to the Arduino board from the mobile via Group 39 Bluetooth interface application.
- The L293D motor driver IC is interface with Arduino and controlled the motors operation and ultimately controlled the direction of vehicle.
- The GPS module is interface with the Arduino which sends the location coordinates of the place where the metal is detected to the mobile.
- The group 39 Bluetooth interface application can control the robotic vehicle movement and also view, share and delete the results i.e., location coordinates as per requirement.
- The buzzer is also integrated to the Arduino which alerts the onsite people about metal detection

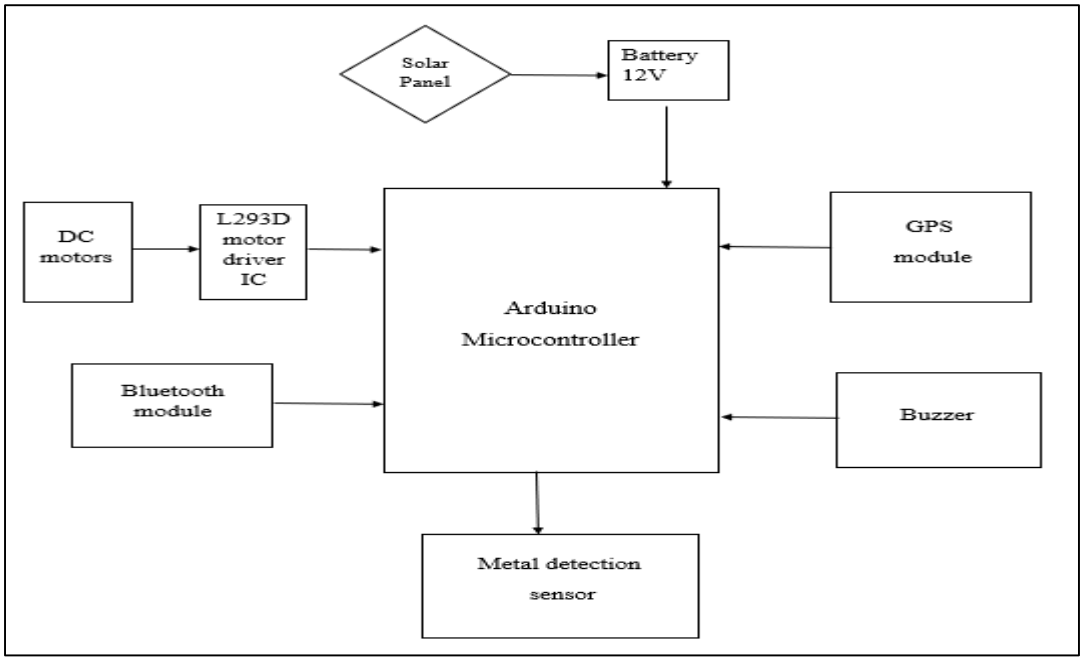

Fig. No. 1 Block Diagram of Project

IV. Components

1. Arduino

Arduino is an open source hardware and software platform designed for creating and prototyping interactive electronic projects. It consists of a microcontroller board with various input and output pins that can be connected to sensors, actuators, and other components.

Arduino boards are programmable using the Arduino programming language, which is based on C/C++.It provides an easy to use and beginner-friendly way to develop project, allowing users to control and monitor a wide range of devices and systems.

2. L293D Motor Driver IC

Motor Driver IC commonly used in robotics and automation projects. It is designed to control and drive small DC motors or stepper motors. The IC provides a convenient way to interface motors with microcontrollers or other digital circuits.

To control the motors, the L293D requires input signals from a microcontroller or other control circuitry. These signals determine the motor direction (forward or reverse) and enable or disable motor outputs.

3. Metal detector sensor

A metal detector proximity sensor is a device that is used to detect the presence or proximity of metal objects. It works by emitting an electromagnetic field and measuring changes in that field when objects come into its range. When a metal object is detected, the sensor triggers an alert or signal to indicate the presence of metal.

4. GPS Module

A GPS module, is a compact electronic device that receives signals from multiple satellites in orbit around the Earth to determine the device's precise location. The module works by actively receiving signals from at least four GPS satellites simultaneously. This module can determine its exact latitude, longitude.

5. Bluetooth Module

A Bluetooth module is a small electronic device that enables wireless communication between electronic devices. This device can be used for connect & control other electronic circuits. It uses Bluetooth technology to establish a short range connection and allows devices such as smartphones, computers, IOT devices to exchange data and control signals without the need for physical cables or internet connectivity.

V. Drafted model

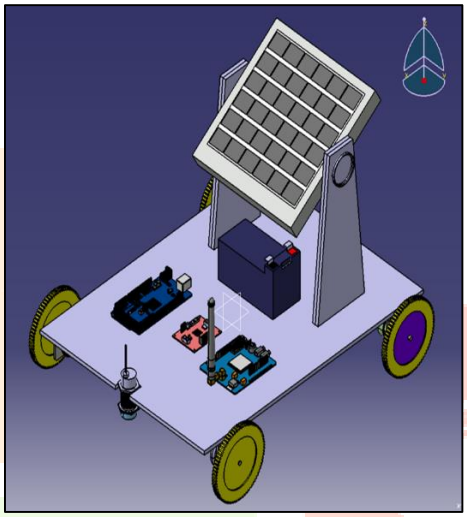

Fig. No. 2 Drafted Model

V. Programming for Arduino uno microcontroller

- Arduino sketch written in C++ that combines several functionalities: controlling motors, detecting the presence of a metal object, and retrieving GPS coordinates using the TinyGPS++ library.
- The setup() function initializes the necessary pins for motor control (m1, m11, m2, m21), metal detection (Pin), and an output pin for a buzzer (Buzz). It also initializes the SoftwareSerial library to communicate with a GPS module.
- In the loop() function, it first calls the Metal() function, which checks the state of the metal sensor. If an object is detected, it prints "Object Detected" to the serial monitor and stops the motors. It then activates the buzzer and calls the Gps() function to retrieve GPS coordinates.
- The loop() function also checks for commands received through the Serial communication. Depending on the received state (values '1' to '5'), it sets the motor pins accordingly to control the motors.
- The Metal() function reads the state of the metal sensor (Pin). If a metal object is detected, it prints a message to the serial monitor, stops the motors, activates the buzzer, and calls the Gps() function to retrieve GPS coordinates.

- The Gps() function reads data from the GPS module via the gpsSerial. Once a valid GPS data is encoded, it retrieves the latitude and longitude information from the TinyGPS++ library and prints it to the serial monitor.
- Overall, this code combines motor control, metal detection, and GPS functionality, allowing the Arduino to detect metal objects, activate an alarm, and retrieve GPS coordinates when triggered.
- Link for the code of Arduino:

https://github.com/aransubhe11/SORVMD/blob/main/Code%20for%20Arduino

VI. Development of application for robotic vehicle

- Group39 Bluetooth Interface, an Android app developed as part of our project to explore the capabilities of Bluetooth technology. This app, built using Android Studio, serves as a practical demonstration of Bluetooth communication and control. Group 39 Bluetooth Interface features a clean and interactive user interface designed specifically for this project. It offers five customizable buttons that can be mapped to different values, allowing users to simulate actions such as left, right, forward, reverse, and stop. This functionality provides a hands-on experience in controlling external devices or systems using Bluetooth connectivity. User can also see the visible devices in their list and connect to the device that they want.
- The app includes a display area that showcases user actions and information received from the Bluetooth sensor connected to a microcontroller. This feature enhances the learning experience by visually presenting the interactions between the app and the connected devices. Users can observe the real-time feedback and gain insights into the data being transmitted. For ease of use, Bluetooth Interface Android provides a delete button to clear the display area, facilitating a fresh start for experimentation. Additionally, a share button is available, enabling users to easily share the logs and information with others via various media platforms like email, WhatsApp, or Telegram. This promotes collaboration and the exchange of findings among project members.
- Group 39 Bluetooth Interface aims to empower students and project enthusiasts with practical knowledge of Bluetooth communication and control. By offering a hands-on approach and an intuitive interface, this app facilitates a deeper understanding of the underlying concepts. It serves as a valuable tool for learning, experimenting, and showcasing the potential of Bluetooth technology in various applications. This application also can be used to control other robots of such a category.

- Link for the code of application: https://github.com/sawantrajendra/Group-39-Bluetooth-Interface

VII. RESULT:

- We have successfully controlled the movement of robotic vehicle using the developed application.
- When the metal is detected by the robotic vehicle its buzzer gets turn on and gives the indication in terms of sound.
- The exact location coordinates i.e., latitude and longitude are also shown on the application view space as shown in figure
- The resulting data can be shared on any communication network as per the specific requirements or preferences shown in figure below.
- The solar panel mounted on robotic vehicle provides a power output to charge the battery and hence improve performance.
- By using good archaeological metal detectors such as Minelab Equinox 800, Fisher F75, Garrett AT Pro one can detect the deep archaeological metallic remains and also distinguish between their sizes and material.

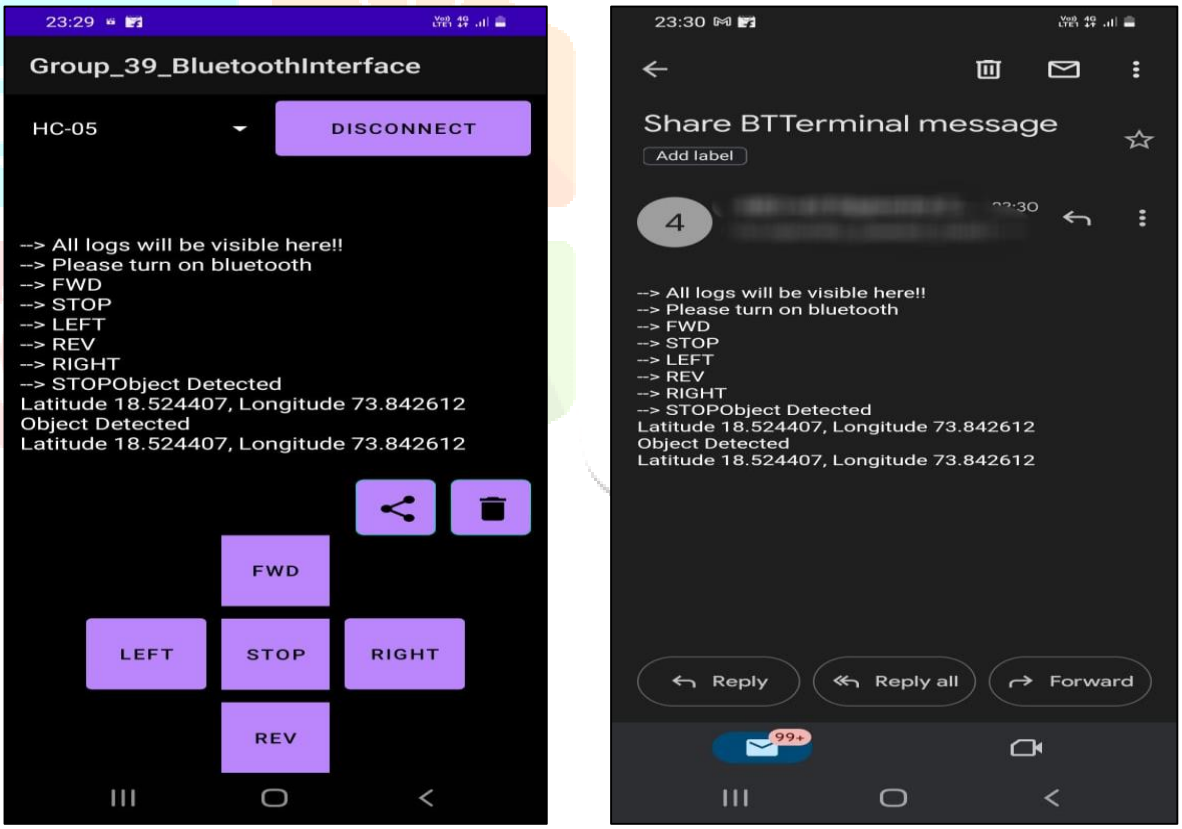

Fig. No. 3 Vehicle Operating & Sharing Location Co-ordinates by Mobile App

Result Table:

Sr. No	Material	Latitude	Longitude
1)	Iron nails	18.524424	73.842805
2)	Copper wire	18.524321	73.842800
3)	Metal coin	18.522696	73.825647
4)	Gold ring	18.522607	73.825456
5)	Metal key	18.534725	73.828387
6)	Iron nails	18.534653	73.828312
7)	Safety pin	18.577819	73.813425
8)	Iron nail	18.577698	73.813365
9)	Metal key	18.525257	73.846399
10)	Copper wire	18.525316	73.846360

ACTUAL MODEL:

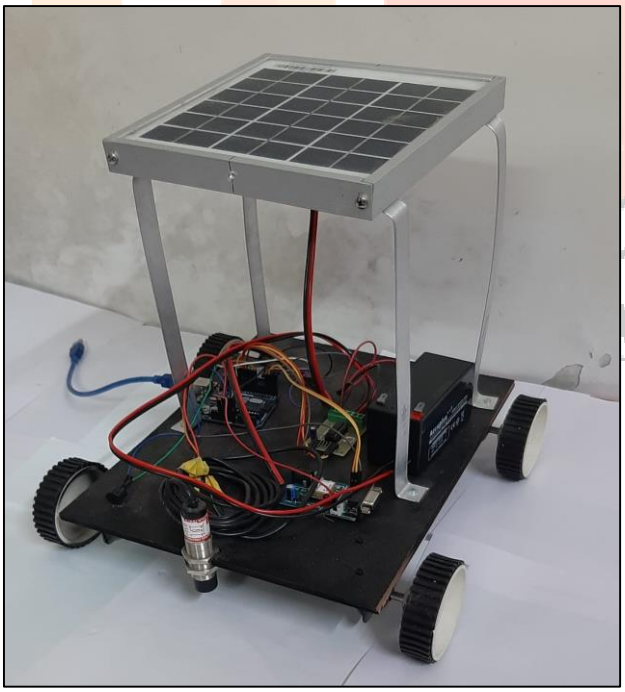

Fig. No. 4 Actual Prototype

VIII. CONCLUSION:

In this research, solar operated robotic vehicle for metal detection system is fabricated which enhances the performance of archaeologist to find out the metallic remains. As soon as the metal detected buzzer produces sound as an indication of detection of metallic object. The main goal, which has been achieved, was to collect the location coordinates, send this coordinate to any communication network and also to store this data for future requirement. The developed application (group 39 Bluetooth interface) is successfully controlled the movement of robotic vehicle and also receive, delete and shared the data related to GPS coordinates. By adopting certain advance metal detector sensor, we can distinguish between some of the metallic material, their sizes etc. The implementation of solar charging is effective as it improved the energy efficiency by using the renewable source of energy.

This robotic vehicle decreases the efforts of archaeologist to find out metallic archaeological remains. Metallic pipeline detection, other metallic objects detections is possible by this robotic vehicle.

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