F.Y. B.Tech Students' Conference on Capstone Project 2 on 2nd and 3rd July 2022
Vishwakarma Institute of Technology, Pune, INDIA

THE SMART LANDMINE DETECTOR

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***Abstract* — Now *a day in places like Afghanistan and Iraq we know that land mines are causing serious trouble to the lives of civilians. A land mine is an explosive device that is designed to destroy enemy and hided under or on the surface of ground, especially in mine-affected countries. Landmines which used to be a safety measure during wars, play a dangerous role in civilian life, in and around the post combat regions with almost 78 countries observing an estimate of 42 human lives killed every day. To avoid the number of casualties and manual mine clearance, mobile robots can be used for detection & mapping of the mine field region. Most land mines are laid on just below the surface of ground and are activated by pressure or trip-wire. Usually most of the land mines will contain many metallic parts, which can be made use of in their detection. The mines which are embedded amid the war time may stay undetected. As the name suggests detection is done using Metal Detector and hence can be done further away from the mine carefully. A self-governing robotic system in a minefield is a popular method as it decreases the hazards in manual detection. . Such robots can be used at Warfield for the detection of landmines and also for surveillance purposes at the border area. Mine detection robot will go from the path from where the soldiers are supposed to march in near future. This is the method in which special purpose robot are used to find landmines without exploding the landmines present on surface, offering safe and efficient way of landmine detection. There are some methods for detection of land mines, such radar bullets, biological method and mechanical method. These methods are dangerous and risk is involved to life of solider. A safe method for detecting land mines is "Landmine detection robot", where we are dealing with IoT as well as GPS technique*.

Keywords *— Landmine, Internet of thing, surveillance, Minefield, Detection.*

I. INTRODUCTION

Laying mines in a war field is a safety procedure in protecting against intruders or enemies. Its purpose is simple – become a shield to slow down an invasion temporarily, direct attackers to kill zones, otherwise obstruct the enemies from defenceless areas. Mines are sensitive explosives with detonating systems which can be triggered by pressure, movement, sound, magnetism and vibration. A bomb or artillery shell blow up on approaching or hitting the target while a landmine lies hidden for it to be activated by a person, animal or a vehicle's proximity. They have been characterized into anti-personnel and anti-tank mines with further addition of anti-handling technology embedded into those mines. As the name suggests, anti-tank mines were built with the sole purpose of destroying military tanks. Hence, they are triggered by high pressure only; preventing them from exploding by small vehicles or pedestrians. Anti-personnel mines were/are designed to kill or injure soldiers so as to increase the opposition's logistical support. But these mines can still continue to maim and kill even after the fight is over. It is a small explosive device on or under the ground ready to detonate by pressure of a person's foot or person handling or through trip

wires. It is shocking to observe the sufferings caused by anti-personnel mines. According to the International Committee of the Red Cross, war surgeons tagged them the worst injuries to be treated. On stepping on a blast anti-personnel mine, the blast can often rip off the legs or else with debris of soil, metal, plastic of mine casting, grass, shoes fragments, shattered bones piercing into the body wounding deeply. On similar note, if the explosion takes while handling, then the affected ligaments are fingers, hands, abdomen, spine, face and also might leave the victims blind. The anti-personnel mines can be of the types namely – blast, fragmentation or bounding fragmentation. Fragmentation mines throw metal fragments whereas the bounding fragmentation mines are more devastating considering it jumps to a waist height and then explodes. Thus, the victims commonly suffer permanent disability, require multiple operations, extensive rehabilitations and amputations which have social, psychological and economic consequences. Not only this, but the destruction causes the land to become dry and soil to be less fertile. Obviously, landmines contribute to loss in productivity adding an adverse effect on the social and economic instability. The root problem is the landmines staying in the ground peacefully and being a hindrance for normal activity. The United Nation Mine Action Services that since 1960s more than 110 million mines have been spread across the globe and posing a threat in more than 78 countries. Approximately 15,000 to 20,000 people lose their lives by being struck by landmines and countless injured. Unarmed civilians are the primary victims of anti-personnel landmines; commonly the children, women and the elderly. To eliminate the threat of mines, the only possible solution is to remove them individually without causing any damage to the surroundings. Anti-personnel mines costs around $3 - $30 each but neutralizing them extends from $300 to $1000 per mine depending on the mine infected area. And even with experts disposing the mines; it is observed that for every 5000 mines extracted, one individual is killed and two injured by accidental explosions. An effort towards saving human lives and restoring the normal social, environmental and economic activity in these countries plays an important aspect for our thesis.

II. LITERATURE REVIEW

We proposed a land mine detection system using robotics, communication, and data analysis. system It mainly consists of a raspberry pie, a camera board, a metal detector circuit, and a GPS shield. Raspberry Pi-based motion unit for detection and data Collect and transfer to the central unit. The central unit examines the data received later. Metal detection circuit is used for metal recognition. GPS shields are used to get the exact position of a detected object. The type of detector and the resolution capacity of the camera It is considered to improve the performance of the system. S. Sasikumar, et.al. Have proposed a multi-utility based mine detection robot vehicle that uses a metal detector as an aid. Auxiliary tool for landmine detection. The system consists of a GPS, a metal detector and a microcontroller ATmega328. GPS system It detects the location of the mine and uses IOT to send it to the web server. The ATmega328P microcontroller is used to implement a metal detector with a driver circuit to coordinate all operations. The main advantage of this project is To accurately measure latitude and longitude positions using GPS modules Land mines. In addition, this prototype provides a less complex structure and reduces the cost of building a mine detection robot.

V. Abilash and J. Paul Chandra Kumar have implemented a mine detection robot controlled by arduino. The system consists of Arduino UNO microcontroller, ultrasonic sensor, buzzer, metal detector, GPS. Metal detectors, buzzers, etc. for detecting land mines Warning alert, the robot uses the Zigbee module, which is an ultrasonic sensor attached to it, to locate and Avoid obstacles. The operation of the robot is carried out by a powerful DC motor supported by an H-bridge circuit that allows the robot to move in all directions. Direction for detecting latitude and longitude, GPS sensor. The advantages of the proposed wheeled robot are cheaper, more robust and A useful tool in the military for research and surveillance purposes. J. Bharath has announced a robot design that can detect buried mines and change their position while the robot can detect them. Remote wireless control. This technique uses the metal detector circuit

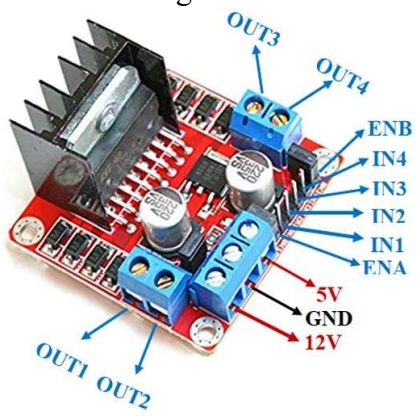
present in the robot to search for land mines. metal A detection circuit connected to the robot is left in the search area to detect the metal parts used in the manufacture of land mines. this It can detect non-uniform land mines in the basement and generate alarms for users, resulting in relocation. Mine by safely transporting mines from one location to another without the risk of explosion.

Yuvaraj Ganesh et al. Implemented a surveillance drone to detect land mines. The system consists of a quadcopter, metal Detector circuit, IR camera, RF transmitter and receiver, Ardunio Uno, GPS module and GSM module. GPS module provides location Of the mine discovered in terms of longitude and latitude. The GSM module is used to send a location to a user via SMS. wireless Communication is via the RF transmitter and receiver. Ardunio Uno, used for algorithm processing and GPS connection, GSM, metal detector, IR camera. The downside is the range of the drone and the cost of implementation. Pedro F. Santana et al. Proposed a roadmap for the application of robotics for humane demining. Portable demining kit Used to deal with remote emergencies, consisting of low cost 4-wheel steering robots with biological control Movement control. The advantage of this work is the use of cheap robots with locally available components such as bicycle wheels. Low mechanical and energetic stress due to the use of virtual components and simple sensory and computing equipment.

III. COMPONENTS

RC-CAR: A remote-controlled car (or RC car for short) is a miniature model car, bus, or truck that can be remotely controlled using a special transmitter or remote control. The term "RC" is used to mean both "remote control" and "wireless control", which includes vehicles controlled by radio, infrared, or physical cabling. (The latter is now obsolete). The general usage of "RC" today usually refers only to radio-controlled vehicles, and this article focuses only on radio-controlled vehicles. Cars are powered by various sources. Electric models are powered by small but powerful electric motors and rechargeable nickel-cadmium, nickel metal hydride, or lithium polymer cells. Four motors are connected to the four wheels which further ruled by motor driver L298N with the help of Arduino IDE . Furhter this RC car is controlled by remote , remote is made using blynk IOT application on play store .

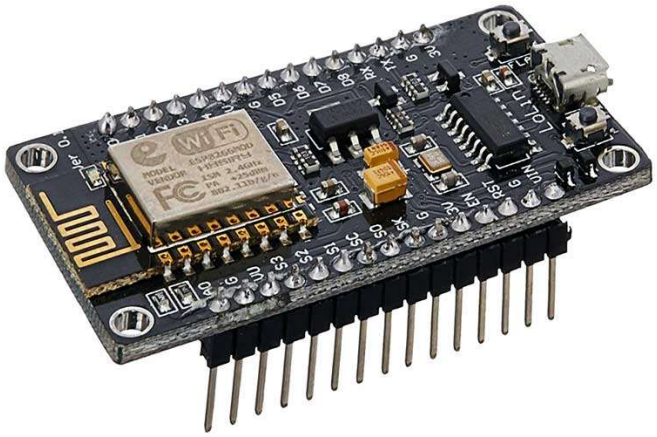
L298N-Motor Driver : The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A. The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin which can either be an input or output. This depends on the voltage used at the motors VCC.



The module have an onboard 5V regulator which is either enabled or disabled using a jumper. If the motor supply voltage is up to 12V we can enable the 5V regulator and the 5V pin can be used as output, for example for powering our Arduino board. But if the motor voltage is greater than 12V we must disconnect the jumper because those voltages will cause damage to the onboard 5V regulator. In this case the 5V pin will be used as input as we need connect it to a 5V power supply in order the IC to work properly. The Enable A and Enable B pins are used for enabling and controlling the speed of the motor. If a jumper is present on this pin, the motor will be enabled and work at maximum speed, and if we remove the jumper we can connect a PWM input
to this pin and in that way control the speed of the motor.

GPS Neo – 6m Module: GPS receivers actually work by figuring out how far they are from a number of satellites. They are pre-programmed to know where the GPS satellites are at any given time. The satellites transmit information about their position and the current time in the form of radio signals towards the Earth. These signals identify the satellites and tell the receiver where they are located. It can track up to 22 satellites on 50 channels and achieves the industry's highest level of sensitivity i.e., -161 dB tracking, while consuming only 45mA supply current. Unlike other GPS modules, it can do up to 5 location updates a second with 2.5m Horizontal position accuracy. One of the best features the chip provides is Power Save Mode (PSM). It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just **11mA** making it suitable for power sensitive applications like GPS wrist watch. The necessary data pins of NEO-6M GPS chip are broken out to 0.1″ pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 4800bps to 230400bps with default baud of 9600.

NodeMcu: The NodeMCU is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espresso if Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds. The NodeMCU offers a variety of development environments, including compatibility with the Arduino IDE (Integrated Development Environment). The NodeMCU/ESP8266 community took the IDE selection a step further by creating an Arduino add-on. If you're just getting started programming the ESP8266 or even an established developer, this is the highly recommended environment. The ESP8266 NodeMCU has total **17** GPIO pins broken out to the pin headers on both sides of the development board. These pins can be assigned to all sorts of peripheral duties, The ESP8266 NodeMCU features two buttons. One marked as RST located on the top left corner is the Reset button, used of course to reset the ESP8266 chip. The other FLASH button on the bottom left corner is the download button used while upgrading firmware.



Mine-Detection Circuit: LC circuit has inductor and capacitor connected in parallel. This circuit starts resonating when there is same frequency material near to it. The LC circuit charges capacitor and inductor alternatively. When the capacitor is charged fully, charge is applied to inductor. Inductor starts charging and when charge across the capacitor is nil, it draws charge from the inductor in reverse polarity. Then inductor charge is reduced and again the process repeats. Note inductor is a magnetic field storage device and capacitor is electric field storage device. The LC Circuit, which

consists of L1 (coil) and C1, is the main metal detector part of the circuit. With the help of this LC Circuit, which is also called as Tank Circuit or Tuned Circuit, the TDA0161 IC acts as an oscillator and oscillates at a particular frequency. When the LC circuit detects any resonating frequency from any metal which is near to it, electric field will be created which will lead to induces current in the coil and changes in the signal flow through the coil. Variable resistor is used to change the proximity sensor value equal to the LC circuit, it is better to check the value when the coil is not near any metal object. When the metal is detected, the LC circuit will have changed signal. The changed signal is given to the proximity detector (TDA 0161), which will detect the change in the signal and react accordingly. The output of the proximity sensor will less than 1mA when there is no metal detected and it will be around 10mA (usually greater than 8mA) when coil is near to the metal. When the output pin is high, the resistor R3 will provide positive voltage to transistor Q1. Q1 will be turned on and LED will glow (not shown in the circuit) and buzzer will be activated.

IV. Methodology/Experimental

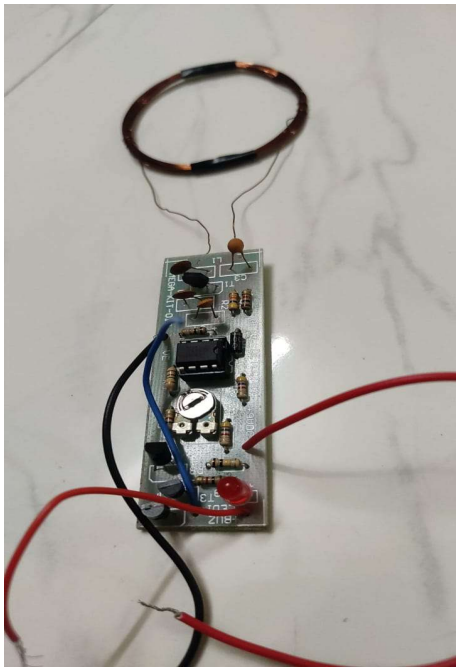
L298N motor driver: -

The L298N is a 15-pin multi-watt and Power SO20 packaged monolithic integrated circuit. This is a high voltage, high current dual full bridge driver designed for standard TTL logic levels and inductive loads such as relays, solenoids, DCs and stepper motors. Two valid inputs are provided to enable or disable the device regardless of the input signal. The emitters of the bottom transistors of each bridge are connected to each other, and the corresponding external terminals can be used to connect external sense resistors. Additional power inputs are provided so that the logic operates at lower voltages. This motor driver was connected from NodeMcu connected from the Blynk app where the wireless work vehicle was manufactured. Use the L298N motor driver to control forward, left, right and backward movements.

Metal detector: -

A metal detector is a device that detects the presence of nearby metal. Metal detectors help you find metal inclusions hidden in objects and metal objects buried underground. It often consists of a handheld device with a sensor probe that can sweep the ground and other objects. As the sensor approaches a piece of metal, it is indicated by a change in headphone tone or movement of the hands on the display. Devices usually give a certain distance. The closer the metal, the louder the headphones and the higher the needle. Another common type is the fixed "walk-through" metal detector used to detect metal weapons hidden in the human body at prison, court, and airport access points (§ Security below). See Clearance).The simplest form of metal detector consists of an oscillator that produces an alternating current through a coil that produces an alternating magnetic field. If there is a piece of conductive metal near the coil, an eddy current is induced in the metal (induction sensor), which creates its own magnetic field. Measuring the magnetic field using another coil (acting as a magnetometer) can detect changes in the magnetic field due to metal objects.

The technique used for metal detection is known as pulse induction technology, both of which are relatively powerful, unlike beat frequency



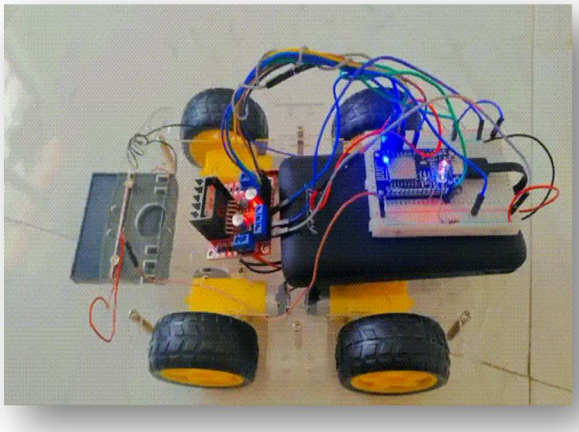
oscillators and induction scale machines that use stable low frequency alternating current. It just magnetizes the ground with something. , Instantaneous current flowing through the search coil. In the absence of metal, the electric field decayed at a constant rate and could accurately measure the time it took to decay to zero volts. However, if the metal is present when the machine ignites, a small eddy current will be induced in the metal and the detected current will decay for a longer period of time. These time lags were negligible, but improvements in electronics have made it possible to measure them accurately and identify the presence of metals at reasonable distances. These new machines had one big advantage. They are largely unaffected by mineralization, and rings and other gems can now be placed under highly mineralized black sand. With the addition of computer control and digital signal processing, the pulse guidance sensor has been further improved.

GPS module: -

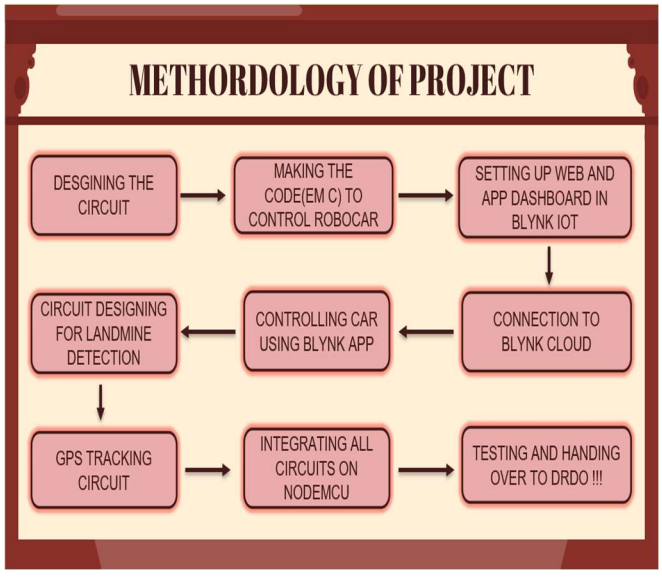
The Global Positioning System (GPS) is a satellite-based navigation system consisting of 24 satellites that orbits the earth twice every 24 hours. These satellites send 3 bits of information about the number of satellites, their position in space, and the time the information is broadcast. These signals are received by the GPS receiver, which uses this information to calculate the distance between the GPS receiver and the GPS satellites. GPS receivers can use signals from three or more satellites to triangulate ground positions (longitude and latitude) from known satellite locations. If you have four or more satellites, the GPS receiver can determine the 3D position (that is, latitude, longitude, altitude). The NEO-6M GPS module is a GPS receiver that can track about 22 satellites and identify any part of the globe. It consists of a powerful u-blox6 positioning engine. With a size of 16 x 12.2 x 2.4 mm, its compact architecture and low power consumption make it ideal for IoT projects. Overall, it's a good budget GPS receiver.

The NEO-6M GPS module has four connectors that connect to the ESP8266 Node MCU board. Connect the VCC connector to the 3.3V pin of ESP8266. Connect the TX connector (transmitter) and RX connector (receiver) of the GPS module to the GPIO pins on the board. Serial software is used to communicate between two devices. Therefore, in the program sketch, set TX to GPIO5 and RX to GPIO4. Therefore, the TX of the NEO-6M connects to GPIO4 and the RX of the NEO-6M connects to GPIO5. You can also use other GPIO pins. Also, both devices have a common reason

How this integrated system works?

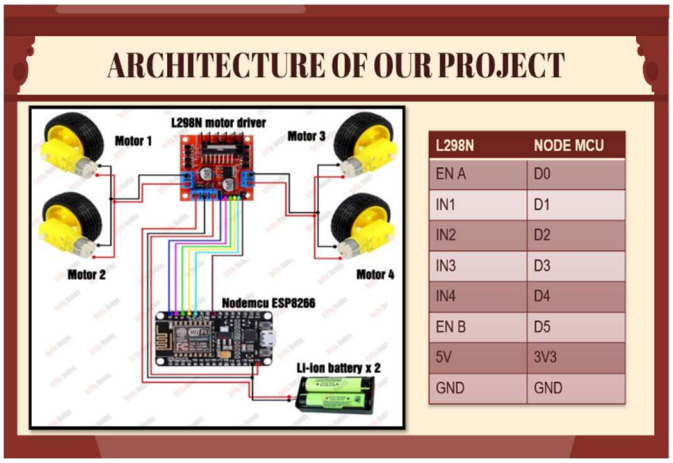


The robot vehicle consists of a node MCU (ESP8266) Connected to 4 wheels for vehicle movement Clockwise and counter clockwise across the country. In Placed in front of robot vehicle metal detector You can feel mine before when a mine is discovered the robot vehicle will stop at this



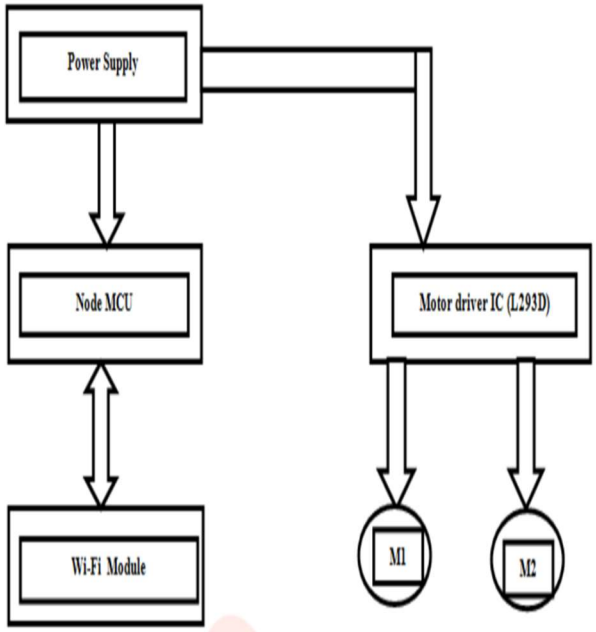
Method	Risk Profile
Greatcore GDM1 remote landmine detector	- Detection from up to 30 feet - no injury risk during detection. - Can detect landmines with low metal content, resulting in higher success.
Metal manual landmine detector	- Close proximity to landmines. - False positives of 1000 for every 1 landmine. - Low success with landmines of low metal content.
Use of animals for mine detection	- Time and investment taken to train these animals. - Indeterminate false positives. - Lacking compliance with U.N. standards for humanitarian demining.
Use of plants for landmine detection	- Still experimental with indeterminate false positives. - Issues of ecological control of a new genetically engineered specie. - Question of meeting U.N. standards for humanitarian demining.
Bacteria for landmine detection	- Certain explosive chemicals are yet undetectible. - Question of meeting U.N. standards for humanitarian demining.
Nuclear detection	- Still theoretical.
Unmanned landmine detection vehicles	- Relatively high cost operations. - Logistics of transporting and servicing these vehicles.

position and activate GPS module. GPS data is extracted online to get the latitude With longitude information for a specific location Transfer it to the blynk app on the controlling side. Or The ESP8266 Wi-Fi module is a standalone SOC and A combined TCP / IP protocol stack that can give you access Wi-Fi network. ESP8266 masters both Launch the



application or offload all Wi-Fi networks Features from other applications. Get the latitude, Longitude location information by online access Blynk app. The system consists of two main modules A control center that runs on a PC or mobile phone Remote control robot. The control station Three integrated modules of metal detectors Components, GPS data acquisition components and remote-Control component. These three components act as one The system, but the original system component an

A 12 Volt DC Power Supply has been apply to Microcontroller and Motor Driver. The Microcontroller text input and gives output to the Wi-Fi module. Here by directional arrow has been between the Microcontroller and Wi-Fi module. Motor Driver is the by directional arrow has been used between the Microcontroller and Mobile Control Internet.



autonomous system that works immediately.

V. LIMITATION

Landmine detection is fraught with difficulties. The first is that the mine underground areas vanished as a result of changes in weather conditions. The capacity to stop the effect of mines without having to see underground is the second. The final

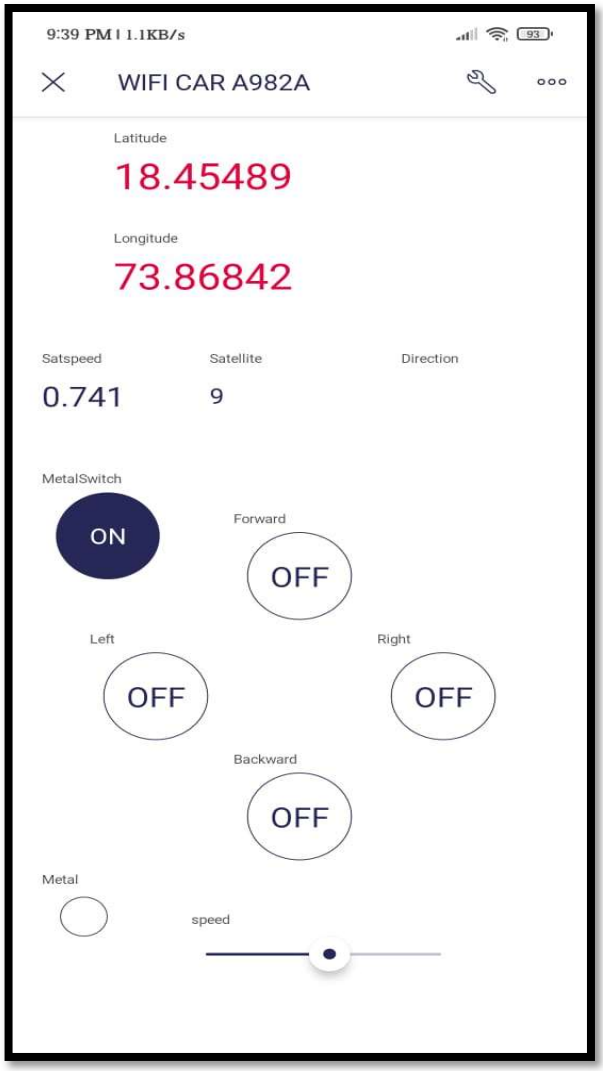
requirement is that not only is the mine present to be located, but the robot must also mark the mine's location with a 5cm radius accuracy. Because every strategy has good outcomes under constrained conditions, there is work to be done in fusing landmine detection technologies to improve its performance. A multi-sensor system based on signal and algorithm fusion should be created due to the aforementioned restrictions. Rather than relying on single-sensor technologies, mine detection research and development should focus on the design from the ground up and subsequent

development of an integrated, multisensory system that can transcend the limits of any single-sensor technology. Combining multiple types of sensors would very probably improve landmine detection performance. The procedure of detecting landmines can be done in a variety of ways. Every method has advantages and disadvantages. Detecting mines with robots is a very useful way since it gives a variety of effective sensors that can be used to identify mines. The use of robots provides a safe solution for deminers. Using a robot with a high level of intelligence

VI. Conclusion

Because the robot may utilize numerous sensors to clear landmines, the goal of this research is to detail the construction of a robot that can identify landmines. Improve existing technologies over time to improve detection rates, lower false alarm rates, and create feasible deployment scenarios. There is no single effective method for detecting land mines. Although there are numerous methods, direct results cannot be generalized. Rather of focusing on individual technologies that work independently, mine detection research and development should focus on the design of basic principles and the subsequent development of integrated multi-sensor systems that overcome the limits of single-sensor technology. Yes, there is. Combining several types of sensors will almost probably improve landmine detection performance. Finally, we must pay. Finally, sensor fusion and metal detectors should be given more consideration. All of these concerns should aid in the differentiation of meaningful data, which is crucial because a high number of false alarms increases uncertainty and limits future study. The robot employs a coverage algorithm technique in which it traverses through the mine field at least once, ensuring thorough coverage of unknown locations and assuring the detection of mines. The experimental results showed that when a robot moves in a coverage-based motion, utilising a multisensor system with decision level fusion reduces false alarms.

X . Acknowledgment



Hereby we would thank to all the faculties of our college and all the faculties of different courses that we have undergone to learn different concepts of android development and webpage development. I would also like to express my gratitude to college dignitaries for giving us such a great opportunity of developing this project. We learnt many new concepts and further by using this we will develop more useful and productive apps in future.

In this world that we are passing through, we sometimes forget to say thank you. So, before this moment slips away, there is one thing that I like to say, Thanks a million!!!

Many people have influenced the shape and content of this project and have supported us throughout

this journey. We would like to thank each and every one of them for the support and guidance which helped us in completing our dissertation.

Special thanks to Prof. Shweta kambare and Prof. Mahajan, without them, this website and app wouldn't have come into existence at all. Their support for our idea really helped us to build the concept of smart Landmine Detector.

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