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IoT Controlled Metal Detecting Robot

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Abstract: *The design and implementation of an IOT-controlled metal detecting robot for efficient and accurate detection of metallic objects in various environments. The robot integrates IOT technology, including sensors and wireless communication, to enable remote control and real-time monitoring. The system utilizes a combination of metal detectors and proximity sensors to identify and navigate around obstacles while detecting metal objects. Through the integration of IOT, the robot can be controlled and monitored remotely via a Smartphone or web interface, providing flexibility and convenience to users. Experimental results demonstrate the effectiveness and reliability of the proposed system in detecting and navigating through diverse environments, showcasing its potential applications in security, industrial, and archaeological fields.*

Keywords: Internet of Things

I. INTRODUCTION

Robots can be utilized to complete work in perilous zones and can be used to manage troublesome instability levels in such areas. Gradually robots are becoming dynamically vital for standard subject applications, for instance. A variety of small robotic applications are now arising where robots are utilized to complete an assortment of errands. By and large, robots are still utilized for unsafe work which is dangerous for humans. Metal detecting robot is utilized to search for metal objects covered up in the ground. Electricians also use metal detectors to scan for electrical cables hidden in walls. At airplane terminals, metal finders are utilized to scan travelers for metal protests, for example, cuts and firearms. For searching old combat zones and historical sites, hoping to find treasures, jewelry and old coins, metal detectors are frequently used. In food factories, they are used to check and verify that no metal things have fallen from industrial factories into the food unintentionally.

Different technological terms such as Telecommunication, Internet of Things (IOT), and robotics have been considered a vital part of our daily activities. Although its advances and limitations, innovative tech can be solved fundamental issues and save lives for many people for political or financial purposes. In the electronic era, speed, flexibility, and automation are major defiance that is enabling researchers to meet the challenges of the society against the quick development of the techs. Robotics has been becoming dynamically significant for several standard applications. Applications such as military, Salvage and Urban Hunt. Due to its human reduction activities in a severe environment. Effectiveness metal and landmine detections are two vital research areas that still considered more attractive to researches due to investing tech. According to Landmine and cluster monition monitor. Multi sensor robot, path planning algorithm and vehicle-mounted sensors are different strategies that used to search and detect mines.

II. LITERATURE SURVEY

While many techniques have been developed for military use, the military problems is quite distinct from that of humanitarian demining. The military is concerned mainly with minefield breaching. Rapidly clearing a route thought a minefield, leaving most of the mines in place. To achieve these ends, military systems tend to rely on high — troubled operation. This is clearly insufficient for humanitarian use as even the fear of the presence of landmines will result in land remaining uninhibited. Minefield surveys are typically classified into three levels. Level 1st surveys are designed to identify the general location of mined or suspected mines areas. A Level II surveys is designed to reduce the large areas identify in level 1st surveys. A level III survey are conducted during the actual clearance of the areas identified in

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the level II to surveys and involves the accurate recording of the areas cleared. Now, this project allows us to taking a brief literature survey from the various journals, scholars, papers, thesis on automated metal detection robot. i.e.

1. According to paper added to IEEE explore on 6 March 2017, Demining or mine clearing is the process of detecting and removing land mine from an area. Un cleared landmines represent a serious humanitarian and economic threat in over 70 countries. Its victims suffer from permanent disability if not killed and need horrific expensive care. Also Clearing mines is very dangerous work. The majority of demining work remains administered manually using metal detectors and prodders. For every 5,000 mines that are removed, one person is killed and two people are injured. Over the years there has been considerable interest within the scientific and engineering communities within the application of advanced technologies to enhance the security and efficiency of this work. In this paper a motion-planning algorithm to enable landmine detection and clearing robots to systematically scan a minefield, detect landmines and clear it's presented. The algorithm works on two steps; (1) generate the driving tracks which will be wont to scan the minefield area, and (2) connect these tracks using Dubins' path in order to get a continues and complete trajectory which may be used for the robot's navigation.

III. PROBLEM STATEMENT

The implementation of IOT-based metal detectors presents a significant challenge in the context of enhancing security, safety, and efficiency in various domains, including transportation, infrastructure, and public spaces. Traditional metal detectors have long been the go-to technology for identifying concealed metallic objects. However, they often fall short in terms of real-time data collection, remote monitoring, and integration into broader security systems. To address this issue and leverage the potential of IoT technology, the development of IoT-based metal detectors is essential. Nonetheless, several critical problems need to be addressed:

1. Detection Accuracy and False Alarms: Ensuring the accuracy of metal detection while minimizing false alarms is a complex problem. Variability in metallic object composition, size, and orientation can challenge the precision of detection systems. Balancing sensitivity with specificity is essential to avoid inconveniencing individuals and ensure reliable threat detection.
2. Data Integration and Real-time Monitoring: Integrating IOT-based metal detectors into existing security systems or creating new monitoring platforms for real- time data analysis and alerts are crucial. This requires addressing interoperability challenges, data transmission, and effective visualization to enable swift responses to detected threats.
3. Power Efficiency: IOT-based metal detectors are often expected to operate continuously in various environments, including remote and off-grid locations. Balancing power efficiency with operational requirements is essential to ensure extended device uptime and minimal maintenance.
4. Environmental Resilience: Metal detectors are often used outdoors and exposed to a range of environmental conditions, including extreme temperatures, humidity, and physical stress. Designing these devices to withstand these conditions while maintaining operational effectiveness is a complex issue.
5. Cost-effectiveness: Balancing the cost of implementing IoT-based metal detectors with their functionality and performance is vital. Achieving affordability without compromising detection capabilities is a key challenge, especially for applications with budget constraints.

The successful implementation of IOT-based metal detectors requires addressing these multifaceted challenges to deliver reliable, efficient, and secure threat detection solutions in diverse environments and applications. This project aims to develop innovative solutions that can overcome these problems and lead to a more accessible, adaptable, and effective security ecosystem, contributing to the safety and security of various public spaces and critical infrastructure.

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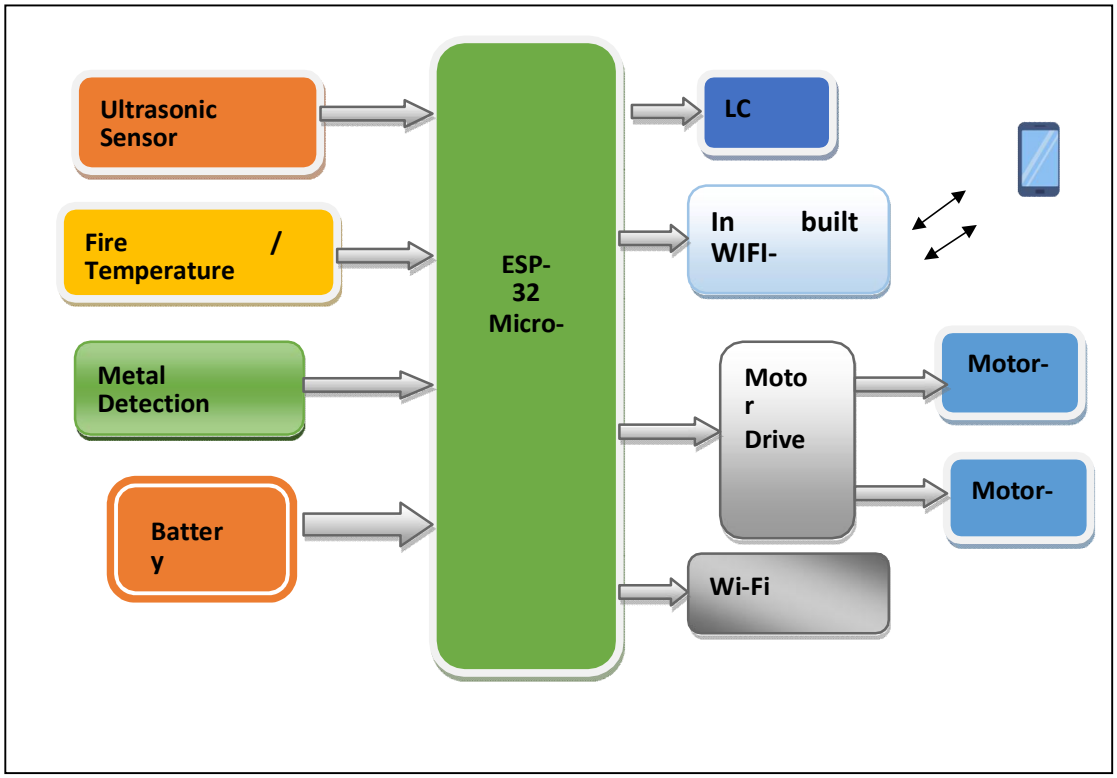
IV. METHODOLOGY BLOCK DIAGRAM



HARDWARE REQUIREMENT:

- ESP-32 Microcontroller (In built WIFI)
- 16X2 LCD display
- Ds18b20temperature sensor
- HC-SR04(Obstacle sensor - ultrasonic sensor)
- Metal Detection sensor
- L293D motor Driver IC
- DC-12v Gear Motor – 60 RPM
- ESP32- Camera Module
- Battery 12v 4.5 Ah

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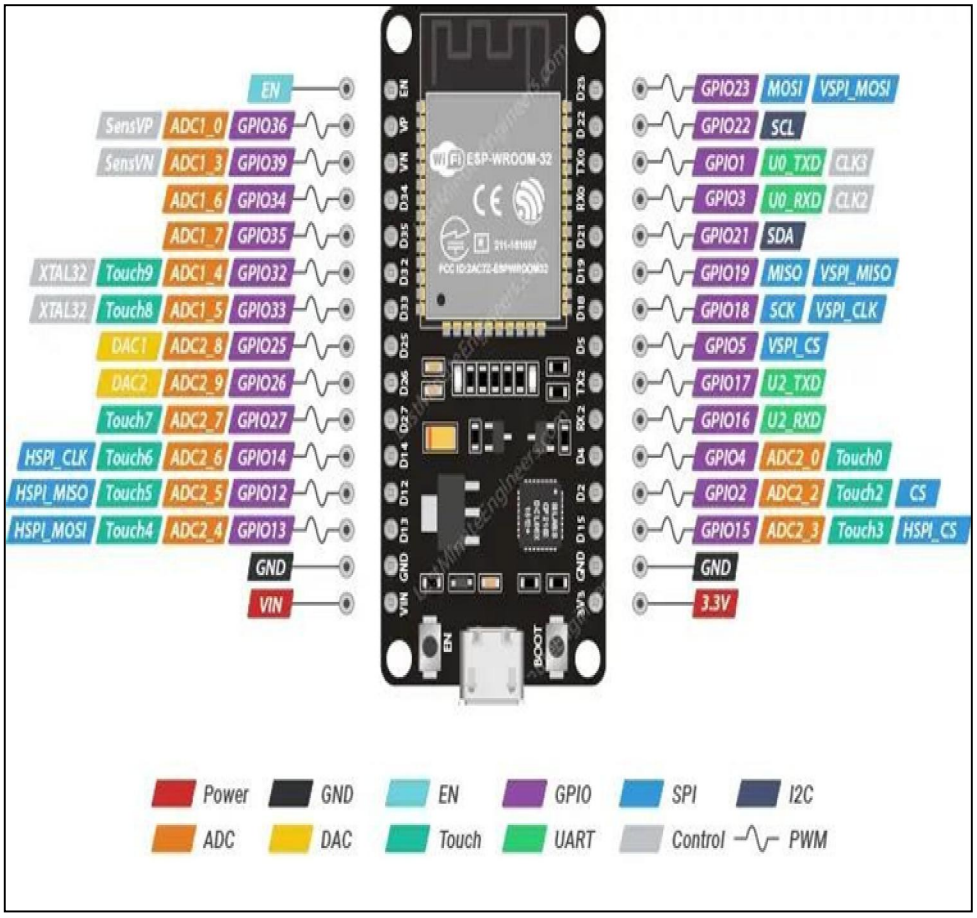
ESP-32 MUC:



Specifications – ESP32 DEVKIT V1 DOIT

The following table shows a summary of the ESP32 DEVKIT V1 DOIT board features andspecifications:

Number ofcores	2 (dual core)
Wi-Fi	2.4 GHz up to 150 Mbits/s
Bluetooth	BLE (Bluetooth Low Energy) and legacy Bluetooth
Architecture	32 bits
Clock frequency	Up to 240 MHz
RAM	512 KB
Pins	30, 36, or 38 (depending on the model)
Peripherals	Capacitive touch, ADC (analog to digital converter), DAC (digital to analog converter), I2C (Inter-Integrated Circuit), UART (universal asynchronous receiver/transmitter), CAN 2.0 (Controller Area Network), SPI (Serial PeripheralInterface), I2S (Integrated Inter-IC Sound), RMII (Reduced Media-Independent Interface), PWM (pulse width modulation), and more.
Built-inbuttons	RESET and BOOT buttons
Built-in LEDs	built-in blue LED connected to GPIO2; built-in red LED that shows the board isbeing powered
USB to UART bridge	CP2102

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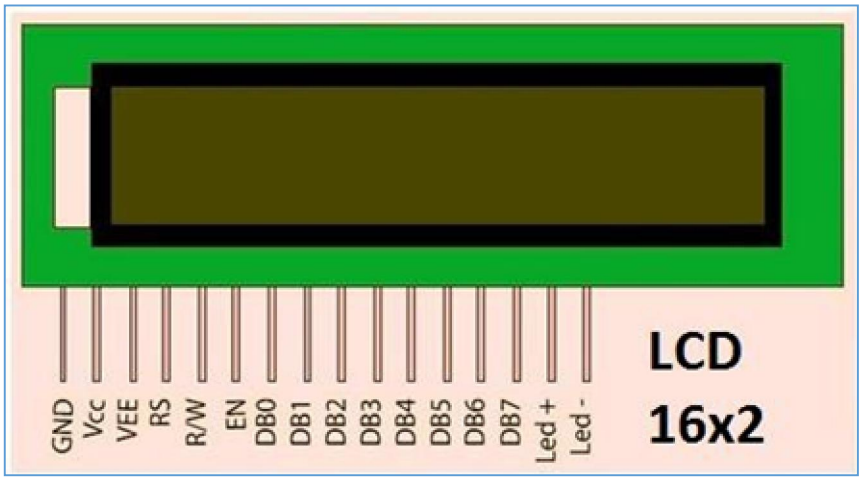
16X2 LCD display:



LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over even segments and other multi segment LEDs. The reasons being: LCDs are Economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

Ds18b20 TEMPERATURE SENSOR:

This is a 1 Meter Long Waterproof, sealed and pre-wired digital temperature sensor probe based on DS18B20 sensor. It is very handy for when you need to measure something faraway, or in wet conditions. Because they are digital, you don't get any signal degradation evenover long distance. These 1-wire digital temperature sensors are fairly precise (±0.5°C over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them. Usable with 3.0-5.0V systems. The only downside is they use theDallas 1-Wire protocol, which is somewhat complex, and requires a bunch of code to parse out the communication. When using with microcontroller put a 4.7k resistor to sensing pin, whichis required as a pullup from the DATA to VCC line.

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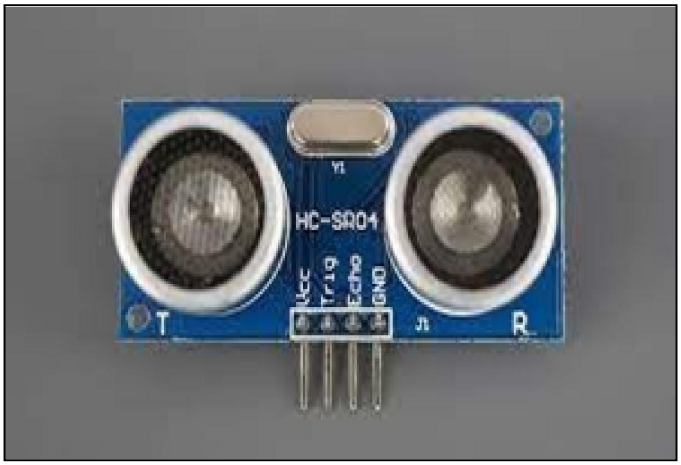
Ds18b20 SENSOR TECHNICAL SPECIFICATIONS: -
Usable temperature range: -55 to 125°C (-67°F to +257°F)
9 to 12 bit selectable resolution
Uses 1-Wire interface- requires only one digital pin for communication
Unique 64 bit ID burned into chip
Multiple sensors can share one pin
±0.5°C Accuracy from -10°C to +85°C
Temperature-limit alarm system
Query time is less than 750ms
Usable with 3.0V to 5.5V power/data

HCSR04(ULTRASONIC SENSOR):



This ultrasonic sensor module can be used for measuring distance, object sensor, motion sensors etc. High sensitive module can be used with microcontroller to integrate with motion circuits to make robotic projects and other distance, position & motion sensitive products.
The module sends eight 40Khz square wave pulses and automatically detects whether it receives the returning signal. If there is a signal returning, a high level pulse is sent on the echopin. The length of this pulse is the time it took the signal from first triggering to the return echo.

FEATURES:

- Sensor Type: Ultrasonic
- Output: Digital Sensor
- Voltage: 5VDC
- Detection distance: 2cm-400cm (0.02M - 4.0M)
- Static current: < 2mA
- Level output: high-5V
- High precision: up to 0.3cm

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METAL DETECTION SENSOR:

we can use this Metal detector non-contact metal induction detection module as a metal detector. When it approaches any metal, it makes a sound.

This is a module specifically designed to detect metal. The module operates by inducing currents in metal objects and responding when it occurs. A nice onboard buzzer signals when it detects something and an onboard potentiometer allow adjustment of sensitivity**.**

The power cables of the Metal detector non-contact metal induction detection module will need soldering on for the module to function, positive to the outside of the module and negative between the potentiometer and an electrolytic capacitor.

FEATURES:

V+ Connect to power positive
V- connect to power negative
Adjust the potentiometer, let the modules work normally.
Small and easy to use module.
It comes with a Buzzer for metal detection indication

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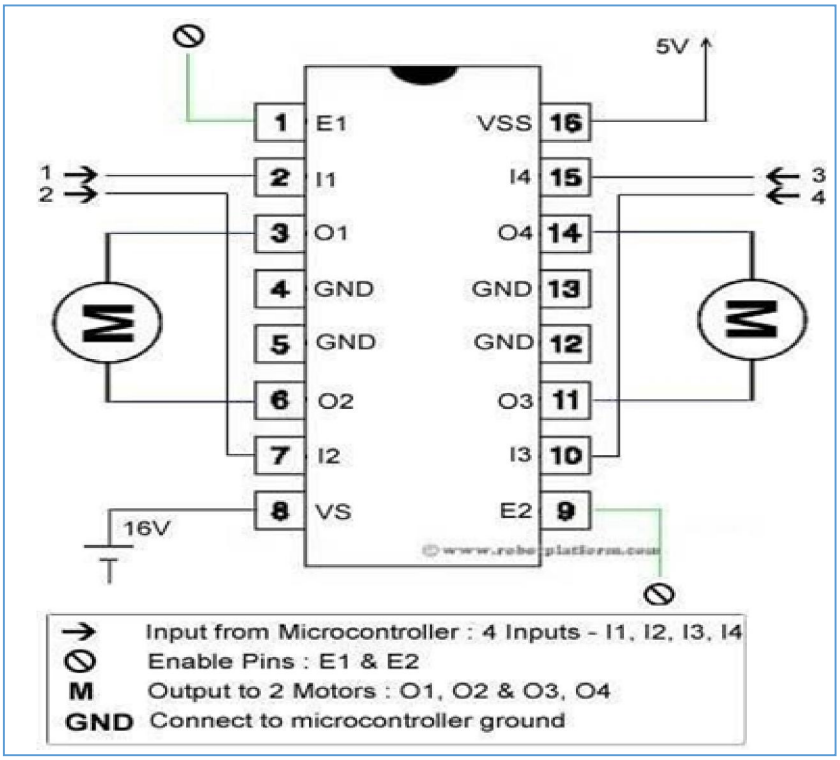
L293D MOTOR DRIVER IC: -



The L293D is most often used to drive motors, but can also be used to drive any inductive loadsuch as a relay solenoid or large switching power transistor. It is capable of driving four solenoids, four uni-directional DC motors, two bi-directional DC motors or one stepper motor. The L293D IC has a supply range of 4.5V to 36V and is capable of 1.2A peak output current per channel, so it works very well with most of our motors.

IN1	IN2	Spinning Direction
Low (0)	Low (0)	Motor OFF
High (1)	Low (0)	Forward
Low (0)	High (1)	Backward
High (1)	High (1)	Motor OFF

DC-12V GEAR MOTOR – 60 RPM:

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DC Motor – 60RPM – 12Volts geared motors are generally a simple DC motor with a gearboxattached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly. 60 RPM 12V DC geared motors widely used for robotics applications.

The most popular L298N H-bridge module with onboard voltage regulator motor driver can beused with this motor that has a voltage of between 5 and 35V DC or we can choose the most precise motor diver module from the wide range available in our Motor divers category as peryour specific requirements.

Nut and threads on the shaft to easily connect and internally threaded shaft for easily connectingit to the wheel. DC Geared motors with robust metal gearbox for heavy-duty applications, available in the wide RPM range and ideally suited for robotics and industrial applications. Very easy to use and available in standard size. Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel.

SPECIFICATIONS AND FEATURES: -

RPM: 60.
Operating Voltage: 12V DC
Gearbox: Attached Plastic (spur)Gearbox
Shaft diameter: 6mm with internal hole
Torque: 2 kg-cm
No-load current = 60 mA (Max)
Load current = 300 mA (Max).

ESP32- CAMERA MODULE:

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The ESP32-CAM is an Ai-Thinkers Original ESP32 CAM WiFi+Bluetooth with OV2640 Camera Module based on the ESP32 chip with the additional facility of using a camera. It is ideal for various IOT applications. The ESP32-CAM has a very competitive small-sized camera module that can operate independently as a minimum system. Ai-Thinker ESP32 CAMcan be widely used in various IOT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IOT applications. It is an ideal solution for IOT applications.

ESP32-CAM is packaged in DIP and can be directly plugged into the backplane for quick production. It provides customers with a highly reliable connection method and is convenient for use in various IOT hardware terminals.

FEATURES:

Ultra-small 802.11b/g/n Wi-Fi + BT/BLE SoC module
Low-power dual-core 32-bit CPU for application processors
Up to 240MHz, up to 600 DMIPS
Built-in 520 KB SRAM, external 4M PSRAM
Supports interfaces such as UART/SPI/I2C/PWM/ADC/DAC
Support OV2640 and OV7670 cameras with built-in flash
Support for images Wi-Fi upload
Support TF card
Support multiple sleep modes
Embedded Lwip and FreeRTOS
Support STA/AP/STA+AP working mode
Support Smart Config/AirKiss One-click distribution network
Support for serial local upgrade and remote firmware upgrade (FOTA)

BATTERY 12V 7.2 AH:

SPECIFICATIONS AND FEATURES: -

Maintenance free lead acid battery with Strong ABS Body. Recharge after every use.
Voltage: 12V - 1.3AH (1300mah); Initial Current: Less than 0.39A
Cycle Use: 14.4V - 15V; Standby Use: 13.5V 13.8V
Battery Size: 97 x 45 x 53 mm (L x W x H)

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SOFTWARE REQUIREMENT:

Arduino IDE
USB cable for Programming.
IOT app for operation

WORKING

This Project presents a new type of robot that uses a metal detector sensor to detect metallic object passing over the metal detector. The robotic vehicle is controlled using androidapplication for metal detection operation controlled with the help of WIFI technology. This project can be widely used because of its simplicity and ability to modify to meet changes of needs. Based on experimental studies, it was found that the mobile controlled robot can move in any direction as per the desired instruction and the beeper in the metal detector circuit beeps whenever it encounters any metallic object. The embedded hardware has been developed on ESP32 microcontroller and controlled by an Android smart phone. This controller receives thecommands from the Android phone, takes the data and controls the motors of the robot by the motor driver L293D. The robot can able to move forward, backward, left and right movements. The Smartphone is been interfaced to the device by using WIFI. A WIFI device EP32camera module was used with ESP32 MUC to receive commands from the Smartphone. A metal detector circuit was connected to the robot to detect the metal. A beep sound was made when it detected the metal. A Temperature sensor is connected to MUC to alert if any fire and avoid that path from moving further. An EPS32 camera is connected to live streaming of video which can be watched online in mobile or web page. An ultrasonic sensor is connected to MUC as an obstacle sensor if any obstacle finds while moving it stop from further motion to avoid damage to robot. All information is passed to IOT web server which can be easily viewed and controlled

V. CIRCUIT DIAGRAM AND EXPLANATION

EXPLANATION:

The robotic vehicle consists ESP32 microcontroller attached with four wheels for the movement of the vehicle over the land. When a Landmine is detected, the robotic vehicle stopsat that position and activates the buzzer and sends the live feeding image to server. The ESP32 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give anymicrocontroller access to your Wi-Fi network. The ESP32 is capable of either hosting an application or offloading all Wi-Fi networking functions from other application. Which gets live image through web camera and any obstacle through ultrasonic sensor position through online access and give it to the controller. Through wife module he positioning data from the controller is send to internet of things which stores the data in cloud. On surfing through the internet, the exact position of the landmine can be accessed and the corresponding landmine can be removed. Four motor is controlled using LM293D driver IC and LCD 16x2 display is used for displaying information received from iot server. Everything is controlled remotely through IOT using Arduino cloud IOT platform. Program is developed with embedded C usingArduino IDE 2.0 version

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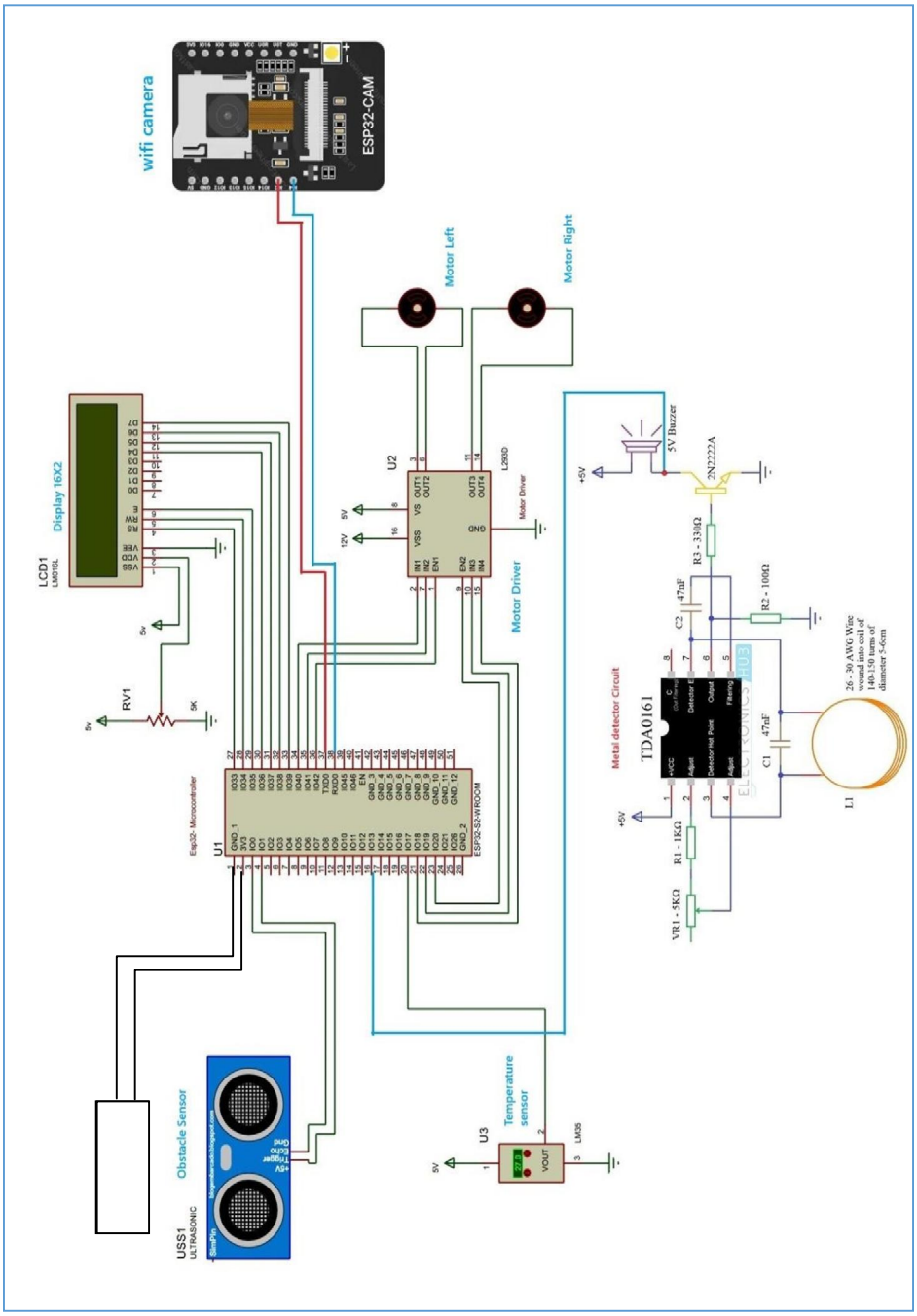

VI. SOFTWARE USED

SOFTWARE INSTALLATION

In these we will get know of the process of installation of Arduino IDE andconnecting Arduino Uno to Arduino IDE.

STEP 1

First, we must have our Arduino board (we can choose our favorite board) and a USBcable. In case we use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug), In case weuse Arduino Nano, we will need an A to Mini-B cable.

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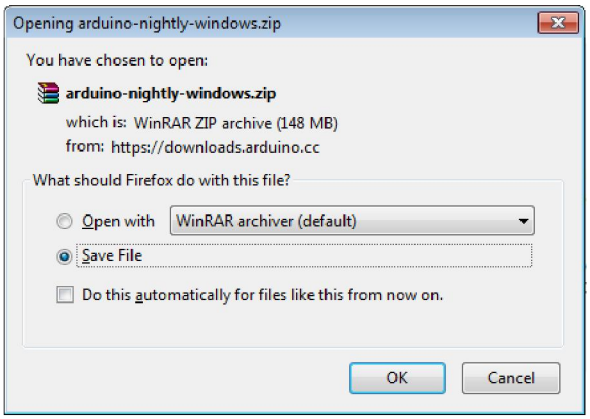
STEP 2 -Download Arduino IDE Software.

We can get different versions of Arduino IDE from the Download page on the Arduino Official website. We must select wer software, which is compatible with wer operating system(Windows, IOS, or Linux). After wer file download is complete, unzip the file.

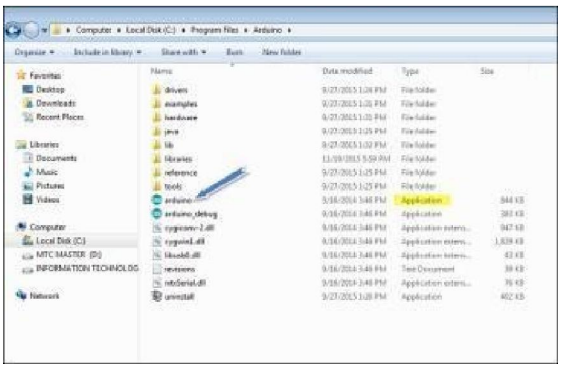


STEP 3 -Power up our board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If we are using an Arduino Diecimila, we have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic thatfits onto two of the three pins between the USB and power jacks.

Check that it is on the two pins closest to the USB port.Connect the Arduino board to wer computer using the USB cable. The green power LED (labeled PWR) should glow

STEP 4 − Launch Arduino IDE.



After our Arduino IDE software is downloaded, we need to unzip the folder. Inside thefolder, we can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

STEP 5 − Open our first project.

Once the software starts, we have two options

* Create a new project

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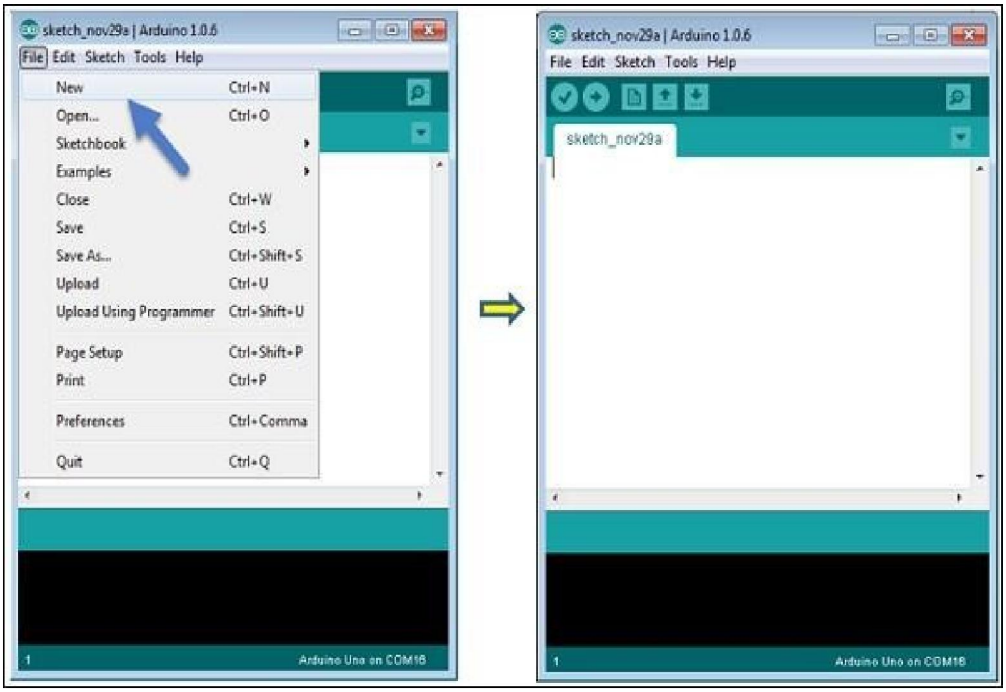
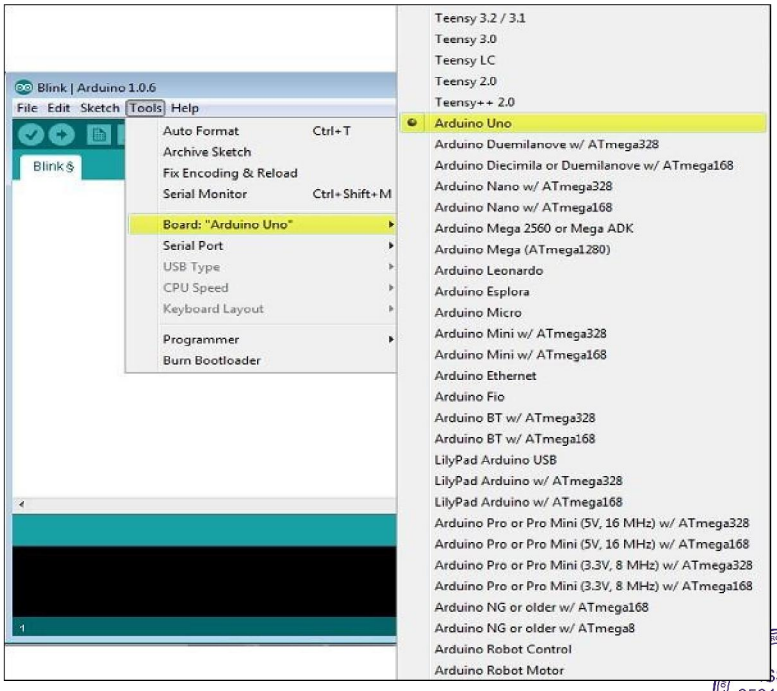


Open an existing project example.
To create a new project, select File → New.
To open an existing project example, select File → Example → Basics → Blink.
Here, we are selecting just one of the examples with the name Blink. It turns the LEDon and off with some time delay.
We can select any other example from the list.

STEP 6 − Select our Arduino board.



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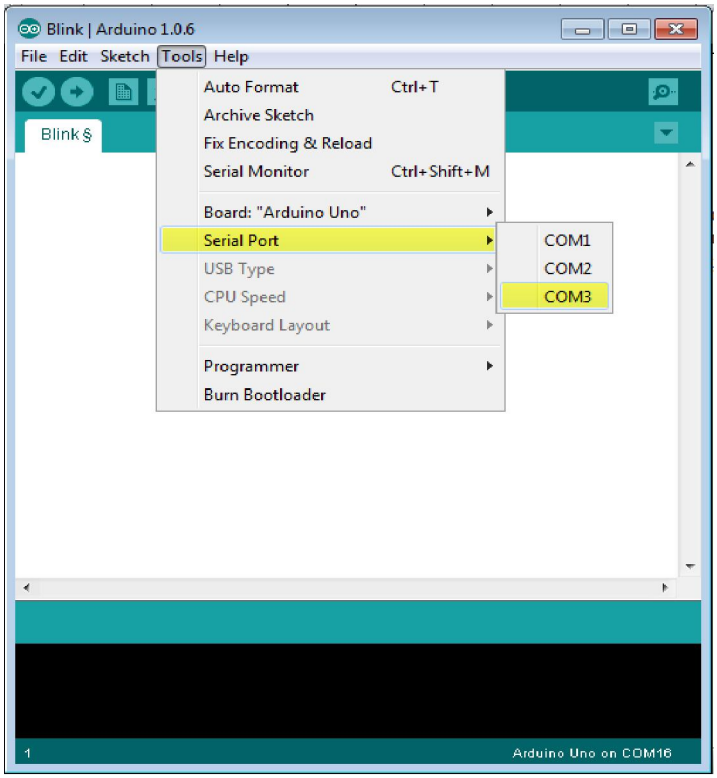
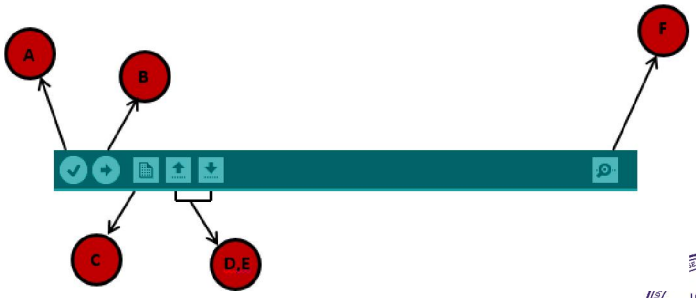
To avoid any error while uploading wer program to the board, we must select the correct Arduino board name, which matches with the board connected to wer computer.
Go to Tools → Board and select wer board.
Here, we have selected Arduino Uno board according to our tutorial, but we must select the name matching the board that we are using

STEP 7 − Select wer serial port.



Select the serial device of the Arduino board. Go to Tools → Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, we can disconnect wer Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

STEP 8 − Upload the program to wer board.
Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.



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A − Used to check if there is any compilation error.B −Used to upload a program to the Arduino board.
C − Shortcut used to create a new sketch.
D−Used to directly open one of the example sketches.E − Used to save wer sketch.
F − Serial monitor used to receive serial data from the board and send the serial data to theboard.
Now, simply click the "Upload" button in the environment. Wait a few seconds; we will seethe RX and TX LEDs on the board, flashing. If the upload is successful, the message "Doneuploading" will appear in the status bar.
Note − If we have an Arduino Mini, NG, or other board, we need to press the reset button physically on the board, immediately before clicking the upload button on the Arduino Software

ARDUINO SOFTWARE (IDE) COMPILER

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for commonfunctions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them

WRITING SKETCHES

Programs written using Arduino Software (IDE) are called sketches. These sketches are writtenin the text editor and are saved with the file extension. ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while savingand exporting and also displays errors.
The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the
Configured board and serial port. The toolbar buttons allow you to verify and upload programs,create, open, and save sketches, and open the serial monitor.
NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension. pde. It is possible to open these files with version 1.0, you will be prompted to save the sketchwith the. ino extension on save**.**

Verify
Checks your code for errors compiling it.

Upload
Compiles your code and uploads it to the configured board. See uploading below for details.
Note: If you are using an external programmer with your board, you can hold down the"shift" key on your computer when using this icon. The text will change to "Upload using Programmer"

New
Creates a new sketch.

Open
Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.
Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch latein the list, use the **File | Sketchbook** menu instead.

Save
Saves your sketch.

Serial Monitor
Opens the serial monitor.

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Additional commands are found within the five menus: **File**, **Edit**, **Sketch**, **Tools**, **Help**. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

FILE

New

Creates a new instance of the editor, with the bare minimum structure of a sketchalready in place.

Open

Allows to load a sketch file browsing through the computer drives and folders.

Open Recent

Provides a short list of the most recent sketches, ready to be opened.

Sketchbook

Shows the current sketches within the sketchbook folder structure; clicking on anyname opens the corresponding sketch in a new editor instance.

Examples

Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topicor library

Close

Closes the instance of the Arduino Software from which it is clicked.

Save

Saves the sketch with the current name. If the file hasn't been named before, a namewill be provided in a "Save as..." window.

Save as...

Allows to save the current sketch with a different name.

Page Setup

It shows the Page Setup window for printing.

Print

Sends the current sketch to the printer according to the settings defined in Page Setup.

Preferences

Opens the Preferences window where some settings of the IDE may be customized, asthe language of the IDE interface.

Quit

Closes all IDE windows. The same sketches open when Quit was chosen will beautomatically reopened the next time you start the IDE.

EDIT

Undo/Redo

Goes back of one or more steps you did while editing; when you go back, you may goforward with Redo.

Cut

Removes the selected text from the editor and places it into the clipboard.

Copy

Duplicates the selected text in the editor and places it into the clipboard.

Copy for Forum

Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax coloring.

Copy as HTML

Copies the code of your sketch to the clipboard as HTML, suitable for embedding inweb pages.

Paste

Puts the contents of the clipboard at the cursor position, in the editor

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• Select All
Selects and highlights the whole content of the editor.
• Comment/Uncomment
Puts or removes the // comment marker at the beginning of each selected line.
• Increase/Decrease Indent
Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.
• Find
Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.
• Find Next
Highlights the next occurrence - if any - of the string specified as the search item in the Find window, relative to the cursor position.
• Find Previous
Highlights the previous occurrence - if any - of the string specified as the search item in the Find window relative to the cursor position.
SKETCH
• Verify/Compile
Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.
• Upload
Compiles and loads the binary file onto the configured board through the configured Port.
• Upload Using Programmer
This will overwrite the bootloader on the board; you will need to use Tools > Burn Bootloader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so a Tools -> Burn Bootloader command must be executed.
• Export Compiled Binary
Saves a .hex file that may be kept as archive or sent to the board using other tools.
• Show Sketch Folder
Opens the current sketch folder.
• Include Library
Adds a library to your sketch by inserting #include statements at the start of your
code. For more details, see libraries below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.
• Add File...
Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side of the toolbar.
TOOLS
• Auto Format
This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.
• Archive Sketch
Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.
• Fix Encoding & Reload
Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.
• Serial Monitor
Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

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• Board

Select the board that you're using. See below for descriptions of the various boards.

• Port

This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

• Programmer

For selecting a hardware programmer when programming a board or chip and not using the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this.

• Burn Bootloader

The items in this menu allow you to burn a boot loader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new ATmega microcontroller (which normally come without a bootloader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

HELP

Here you find easy access to a number of documents that come with the Arduino Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and

other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

• Find in Reference

This is the only interactive function of the Help menu: it directly selects the relevant page in the local copy of the Reference for the function or command under the cursor.

SKETCHBOOK

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the. pde extension. You may still open. pde named files in version 1.0 and later, the software will automatically rename the extension to. ino.

Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

UPLOADING

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or

/dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5,

COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx ,

/dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

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LIBRARIES

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

THIRD-PARTY HARDWARE

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

SERIAL MONITOR

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the

Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

VII. CODE

```
// HC-SR04 - Version: 1.1.2
#include "thingProperties.h" #include <LiquidCrystal.h> #include <OneWire.h>
#include <DallasTemperature.h> #include <HCSR04.h>
#include <TaskScheduler.h> void t2Callback();
Task t2(1000, TASK_FOREVER, &t2Callback); Scheduler runner;
#define mtr1_f 15
#define mtr1_b 2
#define mtr1_en 23
#define mtr2_f 4
#define mtr2_b 16
#define mtr2_en 22
// Setting PWM properties const int freq = 30000;
const int pwmChannel = 0; const int resolution = 8;
int dutyCycle = 150;
HCSR04 hc(18, 19); //initialisation class HCSR04 (trig pin , echo pin)
const int oneWireBus = 5; OneWire oneWire(oneWireBus);
DallasTemperature sensors(&oneWire);
const int rs = 26, en = 33, d4 = 27, d5 = 14, d6 = 25, d7 = 13; LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
const int metalpin = 21; bool stopflag = 0;
int lastdata = 0; int datanow = 0; int dist = 0; float temp = 0.0;
bool metal_sense = 0;
```

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```
String motorstatus = "STOP"; void t2Callback() {
getlevel();
}
void IRAM_ATTR isr() {
if (digitalRead(metalpin) == 1) {
metal_sense = 1;
metalDet = 1;
datanow = 4; take_action();
} else { metal_sense = 0;
metalDet = 0;
}
}
void setup() { pinMode(mtr1_f, OUTPUT); pinMode(mtr1_b, OUTPUT); pinMode(mtr2_f, OUTPUT);
pinMode(mtr2_b, OUTPUT);
pinMode(mtr1_en, OUTPUT); pinMode(mtr2_en, OUTPUT); ledcSetup(pwmChannel, freq, resolution);
ledcAttachPin(mtr1_en, pwmChannel); ledcAttachPin(mtr2_en, pwmChannel); Serial.begin(115200);
pinMode(metalpin, INPUT); pinMode(oneWireBus, INPUT_PULLUP); digitalWrite(mtr1_f, HIGH);
digitalWrite(mtr1_b, HIGH);
digitalWrite(mtr2_f, HIGH); digitalWrite(mtr2_b, HIGH); lcd.begin(16, 2);
lcd.clear(); lcd.setCursor(0, 0);
lcd.print("IOT Based Metal"); lcd.setCursor(0, 1); lcd.print("Detector");
sensors.begin(); delay(1000); initProperties();
ArduinoCloud.begin(ArduinoIoTPreferredConnection); setDebugMessageLevel(0); ArduinoCloud.printDebugInfo();
runner.init(); Serial.println("Initialized scheduler"); delay(2000);
runner.addTask(t2); Serial.println("added t2"); t2.enable(); Serial.println("Enabled t2");
attachInterrupt(metalpin, isr, RISING);
}
void loop() {
ArduinoCloud.update(); getlevel();
gettemp(); lcd_display(); debugSerial(); take_action();
}
/*
Since GetButtonPress is READ_WRITE variable, onGetButtonPressChange() is executed every time a new value is
received from IoT Cloud.
*/
void onGetButtonPressChange() {
// Add your code here to act upon GetButtonPress change Serial.println("ButtonPress :" + String(getButtonPress));
datanow = getButtonPress;
take_action();
}
/*
Since SpeedSet is READ_WRITE variable, onSpeedSetChange() is executed every time a new value is received from
IoT Cloud.
*/
void onSpeedSetChange() {
// Add your code here to act upon SpeedSet change
Serial.println("Setspeed :" + String(speedSet)); dutyCycle = speedSet;
ledcWrite(pwmChannel, dutyCycle);
}
```

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```
void debugSerial() {
if (Serial.available()) {
String rx = Serial.readString(); datanow = rx.toInt();
}
}
void gettemp() { sensors.requestTemperatures();
float temperatureC = sensors.getTempCByIndex(0); float temperatureF = sensors.getTempFByIndex(0);
// Serial.print(temperatureC);
// Serial.println("ºC");
// Serial.print(temperatureF);
// Serial.println("ºF");
temp = sensors.getTempCByIndex(0); temperature = temp;
//delay(5000);
}
void lcd_display() { lcd.clear(); lcd.setCursor(0, 0); lcd.print("T:"); lcd.print(temp, 0); lcd.print(" D:"); lcd.print(dist);
lcd.print(" M:"); lcd.print(metal_sense); lcd.setCursor(0, 1);
lcd.print("Motor:"); lcd.print(motorstatus);
Serial.println("T: " + String(temp) + ", M:" + String(metalDet) + ", ob:" + String(dist)
+ ", sp:" + String(speedSet) + ", dn:" + String(datanow) + ", ls:" + String(lastdata));
}
void getlevel() { dist = hc.dist();
//rainlevel = map(rainlevel,16,4,0,100);
 //Serial.println("Fuel-Level: " + String(dist)); if (dist <= 15) {
Obstacle = 1;
if (datanow != 5) { datanow = 4;
}
}
Else { Obstacle = 0;
}
if (digitalRead(metalpin) == 1) { metal_sense = 1;
metalDet = 1; take_action();
} else { metal_sense = 0;
metalDet = 0;
}
}
void output_high(int x) { digitalWrite(x, HIGH);
}
 void output_low(int x) { digitalWrite(x, LOW);
}
void take_action() {
//Serial.println("data-now:" + String(datanow) + " lastdata:" + String(lastdata)); if (lastdata != datanow) {
lastdata = datanow; switch (lastdata) {
case 1: // motor Forward
{
output_high(mtr1_f); output_low(mtr1_b); output_high(mtr2_f); output_low(mtr2_b);
motorstatus = "FWR";
//lcd_putc("\f MOTOR: START \n FORWORD"); break;
}
case 2: // motor LEFT
```

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```
{
output_high(mtr1_f); output_low(mtr1_b); output_low(mtr2_f);
output_low(mtr2_b); motorstatus = "LEFT"; break;
//delay_ms(200);
//lcd_putc("\fMOTOR:RIGHT TRUN");
}
case 4: // motor stop
{
output_low(mtr1_f); output_low(mtr1_b); output_low(mtr2_f);
output_low(mtr2_b); motorstatus = "STOP";
//delay_ms(200);
//lcd_putc("\f MOTOR: LEFT TRUN "); break;
}
case 3: // motor right
{
output_low(mtr1_f); output_low(mtr1_b); output_high(mtr2_f); output_low(mtr2_b);
motorstatus = "RIGHT";
//lcd_putc("\f MOTOR: STOP"); break;
}
case 5: // motor backward
{
output_low(mtr1_f); output_high(mtr1_b); output_low(mtr2_f); output_high(mtr2_b); motorstatus = "REV"
//lcd_putc("\fMOTOR:BACKWOARD");
```

VII. APPLICATION:

1. Military Metal detection of land mines.
2. Detection of hidden artifacts.
3. Lost treasures finding.

VIII. ADVANTAGES

1. Remote operation of detecting land mine.
2. Low cost
3. Easy Maintenances

IX. CONCLUSION

Current work presents a metal detecting robot using radio frequency communication with wireless Video transmission and it is depicted and put into with At ESP32 MUC in embedded system field. The robot is proceeded in finicky track using switches and the beeping sounds produced. Experimental work has been The exhibited carefully. The results shows that higher effectiveness is accomplished using the embedded system. The current work is exhibited to be highly beneficial for the security intention and industrial requirements. The mine sensor undertake at a constant speed without any issues not withstanding its extension, satisfying the specification required for the mine recognition sensor. It provides the enhancement of detection rate, while reforming the operability as verified by completion of all the detection of all detection jobs as programmed. The tests established that the robot would not pretends any performance issue for setting up of the mine detection sensor

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DESIGN OF THE MODEL: