A Major Project Report

On

DEFENCE ROBOT FOR LANDMINE AND FIRE DETECTION

Submitted in partial fulfilment of the

Requirements for the award of the degree of

Bachelor of Technology

In

Computer Science and Engineering

By

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(Formerly CVSR College of Engineering)

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CERTIFICATE

This is to certify that the project entitled **"Defense Robot for LandMine and Fire detection"** being submitted by **Anisha Arya** bearing the Hall Ticket number **17H61A0501** and **B V Jhansi Saketa** bearing the Hall Ticket number **17H61A0504** and **A Sarika** bearing the Hall Ticket number **17H61A0543** in partial fulfilment of the requirements for the award of the degree of the **Bachelor of Technology** in **Computer Science and Engineering** to **Anurag Group of Institutions (Formerly CVSR College of Engineering)** is a record of bonafide work carried out by them under my guidance and supervision from April 2021 to July 2021.

The results presented in this project have been verified and found to be satisfactory. The results embodied in this project report have not been submitted to any other University for the award of any other degree or diploma.

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ACKNOWLEDGEMENT

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DECLARATION

We hereby declare that the project work entitled "**Defense Robot for LandMine and Fire detection**" submitted to the **Anurag Group of Institutions (Formerly CVSR College of Engineering)** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology (B.Tech)** in Computer Science and Engineering is a record of an original work done by us under the guidance of **Mr M Ravi Kishore, Assistant Professor** and this project work has not been submitted to any other university for the award of any other degree or diploma.

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Date:

ABSTRACT

Land mine detection is most crucial during warfare to deploy armed vehicle drive in the enemy territory. These armed vehicle or Main battle tanks are used to follow the path of pilot tanks operated manually to avoid damage/distraction of the battle tank and defence casualties of defence crews. In addition post warfare the mines planted during war can be detected and diffused by deploying a mine detection robot, which can save civilian life to avoid human casualties.

In our proposed system, the robot can be controlled by an application from a safe distance. The landmine and fire are detected in the targeted area. The landmine can be detected using the metal sensor and the fire can be detected using the fire sensor. The robot can be controlled and taken to a place where the humans can't reach and detect the fire and landmine.

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1. INTRODUCTION

1.1 Motivation

Landmines are a serious threat facing many civilians in countries across the globe. Despite being designed for military use with guidelines mandating the clear marking of minefields, and a requirement for removal post-conflict, many landmines remain buried Often non-state parties such as terrorist groups place mines indiscriminately and without recording locations, without regard for international law. Their indiscriminate nature and long service life means that they remain a potent threat to anything or anyone unfortunate enough to detonate the mine. Every year thousands of people die or are permanently disabled by landmines. In addition to the severe injury or death that may face the person who sets off the landmine, survivors place additional burdens on their communities as they are often left crippled, requiring lifelong assistance from their community.

Given their serious risk to human life and livelihood, landmine detection, marking, and cleanup has long been an important subject for human aid efforts. This has led to the development of safe and effective methods but most use tools that are expensive, costly to operate, and require skilled technicians. However, more affordable time-tested methods are what often get employed in the areas most affected where funds are limited and skilled personnel are short on hand. These methods tend to place humans at risk and require extensive training and caution to be effective.

The largest impact of landmine use in the last century has not been as a turning point in any major battles, but in the effect of minefields left behind when the war ends. While an armistice may cause an end to the battles some minefields are left behind. These minefields can remain active for decades. In 2015 landmines injured or killed 6,461 people in 61 different countries according to the United Nations. 79% of these casualties came from civilians. Survivors of landmine detonation often lose limbs, which can ruin the quality of life for the victim permanently. Crippled survivors are often unable to work, facing a bleak future. In impoverished areas where proper medical care is often unavailable people who have lost limbs face many further physical and mental health issues resulting from their injuries. Even immediate survivors of a direct explosion from a landmine may end up dying as a result of their injuries.

1.2 Problem Definition

Landmines are used as a tactical weapon in time of war. This is a self-contained explosive device which is placed onto or into the ground, designed to explode when triggered by a vehicle, a person or an animal. Landmines are usually used to restrict enemy movements and to secure disputed borders. Unfortunately, the effect of landmines lasted much longer than the conflict, affecting not only the army forces but mostly the civilian population after the conflict ended.

Among all types of landmines antipersonnel landmines produce the largest problem because they are specially designed to kill or main people.

1.3 Objective of the Project

In our proposed system, there are mainly 4 objectives

1. **To detect landmines and sense fire**

   In the proposed system, the landmine and fire are detected in the targeted area. The landmine can be detected using the metal sensor and the fire can be detected using the fire sensor. The robot can be controlled and taken to a place where the humans can't reach and detect the fire and landmine.

2. **To control the robot using the web application**

   The proposed system can be used for human safety. It can be controlled by a web application. The rover can be operated from a safe distance. The proposed Defence robot can be used in metal and fire detection so the robot instead of humans can be put to detect a dangerous item.

3. **Ensuring the demining operators safely**

   The detected results can be displayed in the web application. The team can call the rescue team for demining operations after looking at the detected results in the application.

4. **To design a low-cost defence robot for Landmine and Fire detection**

   The proposed system is an affordable and efficient defence robot for landmine detection and fire sensing.

2. LITERATURE SURVEY

[1] In mine clearance robots, fast neutron generation technique, penetrating RADAR (GPR), metal detector and infrared imaging is used for anti-personnel mines. The robot with Bluetooth and camera as a controlling system, it is possible to send videos and pictures the same as IOT technology but it has the limitation in the controlling distance .

[2] The eight direction metal detection robots provide accurate metal detection and can be easily movable in uneven surfaces but the electromagnetic wave intensity is very poor so it can be detected closer objects. The robots are made by using AT89552 microcontroller units and the control is done with the help of gestures which is captured through cameras of high quality but noise creation will also happen, high efficient filter circuits are used .

[3] Wirelessly Controlled Mines Detection Robot a Metal detector is used which detects the metal 20cm underneath the ground and displays the consequences of mine detection on the LCD (liquid crystal display) and Interfacing of sonar interface is also done. But the motors are required to give out a considerable amount of current to drive the wheels, and their preciseness has errors. In Arduino Military Spying and Bomb Detecting Robots they are merging two applications, spying and bomb detection. Just by using a RF module enabled, the user can control the robot from anywhere but No proper authorization.

[4] In Distance Controlled Rescue and Security Mobile robot, the robot is controlled through a wireless communication system, which is known as DTMF system. If any obstacle is observed by the robot it will change its direction or it will stop but there is No proper guidance or accuracy. In Wireless bomb disposal robot the system is design to develop wireless bomb disposal robot which will help in the defence of our nation from terrorist, suicide bombers and other such activities but the design of the robot is costly.

3. ANALYSIS

3.1 Existing System

A) Landmine detection system using Arduino UNO- Detection and removal of landmines is an important worldwide concern. A huge number of landmines have been deployed over the last twenty years and demining will take several more decades,even if no more mines were deployed in future.In this project , the defense robot is capable of detecting a buried mine,marking the exact location of the buried mine,and controlling itself from stepping over it and detonating the mine. The detection of the buried mine is done by using metal detectors since most landmines contain metal components.

B) Wirelessly controlled mines detection robot - In this a metal detector is used which detects the metal 20cm underneath the ground and displays the consequences of mine detection on the LCD (liquid crystal display) and interfacing of solar interface is also done. But the motors are required to give a considerable amount of current to drive the wheels , and their preciseness has errors.

C) Basic fire alarms:
Most alarm systems provide information to emergency responders on the location of the fire, speeding the process of fire control.To be useful, detectors must be coupled with alarms. Alarm systems provide notice to at least the building occupants and usually transmit a signal to a staffed monitoring station either on or off site. In some cases, alarms may go directly to the fire department, although in most locations this is no longer the typical approach.The system inputs consist of fire detection devices and system monitoring devices that activate the control panel and the outputs are responsible for occupant notification and control functions associated with life safety.

3.2 Proposed System

Whenever humans find difficulty in doing any work then it leads the path of invention. Robotics is an emerging branch which focuses on reducing the efforts of humans. In this project a robotic vehicle is designed and demonstrated for improving national security.

Arduino UNO board is the main controlling unit of the robotic vehicle, ESP 8266 will provide the internet to our project. The web application will help the user to control the rover and the rover can be placed in the targeted location.

A power supply unit is employed that delivers power to the entire circuit board. The DC motor is used for the locomotion purpose. High torque motor is selected. The vehicle is equipped with a metal detecting sensor, which helps to detect the metals which are hidden under the ground with the help of metal detecting units. A fire sensor is also implemented to detect the fire when no human can't reach the target area.

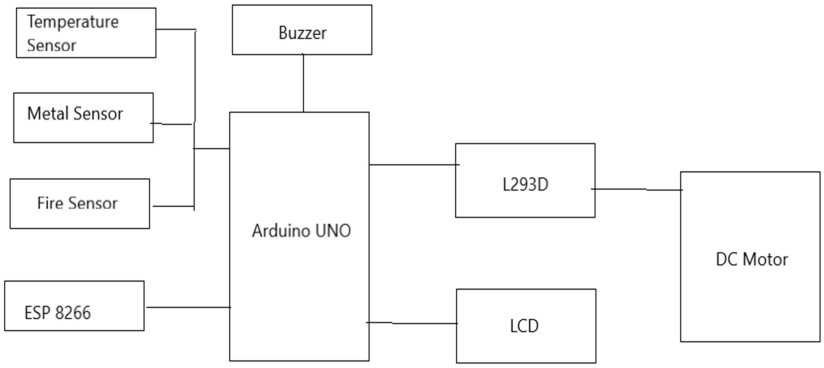


Figure 1 Block Diagram of the Proposed System

3.3 Software Requirements Specification

3.3.1 Purpose

National security is of prime importance in today's weapon-studded world and therefore the need to consider safety of the army personnel and people living in war prone areas becomes very vital. A Landmine is basically an explosive device hidden underground by the enemy and explodes when any personal or vehicle steps or drives over it. The Pressure created by the personnel or the vehicle on the ground below which the mine is laid acts as the detonator for the mine explosion. The damage caused by the Landmine explosion is fatal and hence detecting landmines becomes necessary before the army personnel or vehicle accidentally steps over it. The major challenge is detecting these landmines without causing any explosion and diffusing them once they

are detected. The process of detecting landmines is technically termed as minesweeping and the process of removing or defusing the mines is known as demining or mine clearance. Minesweeping was earlier done using trained animals like dogs and rats but modern methods include metal detectors and various tools attached to the vehicles. But any manual intervention of a human is always dangerous. Robots are used for various applications in industrial areas . The Robot performs various activities and is becoming more advanced. That's the reason nowadays Landmine Detection Robotic Vehicles and unmanned robots are used to detect landmines. Robots are always reliable in terms of perfection in detection and no human life is endangered in the process. An automatic robot, which is capable of detecting buried landmines and taking from their locations, while enabling the operator to control the robot wirelessly from a distance. The detection of the buried mine is done by using metal detectors since most landmines contain metal components. The system allows the operator to stay at a safe distance by enabling him to control the robot wirelessly or remotely

3.3.2 Scope

New technologies emerging daily, Multitasking robots with web of things could be implemented, and more components can be included. It can be used to improve our national security.

3.3.3 Overall Description

The proposed system can be used for replacing the human involvement in detecting the landmine. This will reduce the danger caused to humans while searching for landmines. Sometimes, humans lose their lives while detecting landmines. The rover can be controlled from the safest distance. The system can also be used for detecting fire where humans can't reach. The proposed system is cost effective and efficient to detect the landmine and fire

4. DESIGN

4.1 CLASS DIAGRAM

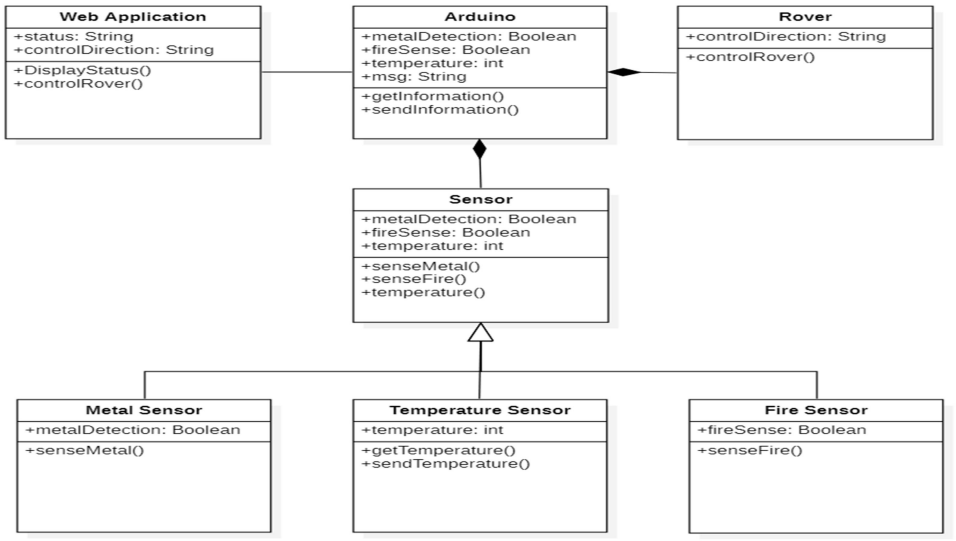


Figure 2 Class Diagram

Class diagrams are the main building blocks of every object-oriented method. The class diagram can be used to show the classes, relationships, interface, association, and collaboration. UML is standardized in class diagrams. Since classes are the building block of an application that is based on OOPs, so as the class diagram has appropriate structure to represent the classes, inheritance, relationships, and everything that OOPs have in its context. It describes various kinds of objects and the static relationship in between them.

The above figure 2 shows the class diagram of our project. The above class diagram has 7 different classes. They are: Web Application, Arduino, Rover, Sensor, Metal Sensor, Temperature Sensor and Fire Sensor. The Sensor class shares a generalization relationship with the three classes.

4.2 USE CASE DIAGRAM

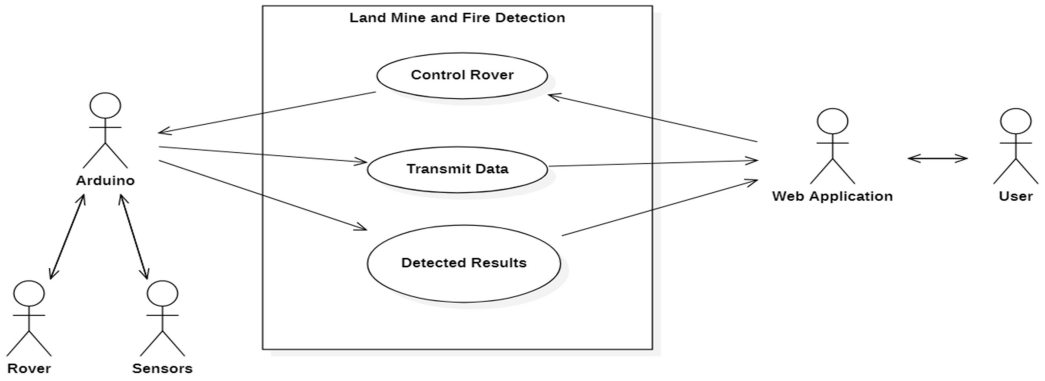


Figure 3 Use Case Diagram

Use case diagram is the primary form of system/software requirements for a new software program underdeveloped. Use cases specify the expected behavior (what), and not the exact method of making it happen (how). Use cases once specified can be denoted both textual and visual representation (i.e. use case diagram). A key concept of use case modeling is that it helps us design a system from the end user's perspective. It is an effective technique for communicating system behavior in the user's terms by specifying all externally visible system behavior.

The above figure 3 represents the Use Case Diagram of our project. The Use Case Diagram has actors like User, Web Application, Arduino, Rover and Sensor.

4.3 SEQUENCE DIAGRAM

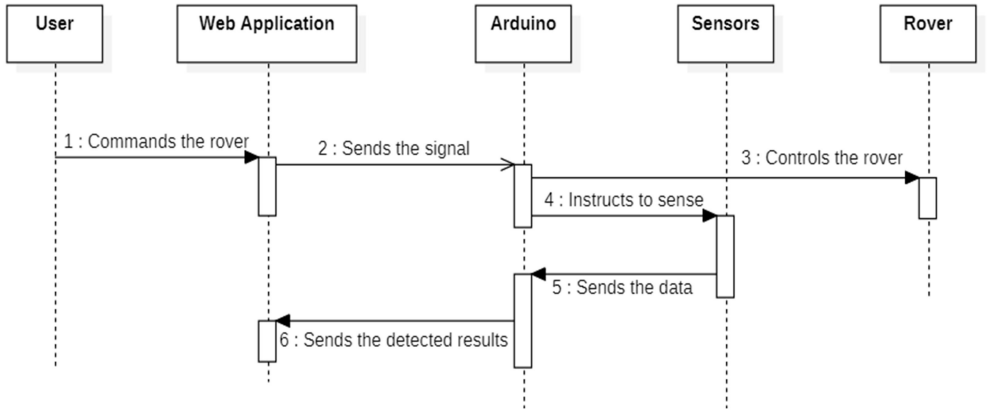


Figure 4 Sequence Diagram

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function. These diagrams are widely used by businessmen and software developers to document and understand requirements for new and existing systems.

The above figure 4 represents the Sequence Diagram of our project. In the above Sequence Diagram, first the user commands the rover in the web application. The Arduino sends the signal and controls the rover. There will be continuous sensing and the detected results will be sent to the web application.

4.4 ACTIVITY DIAGRAM

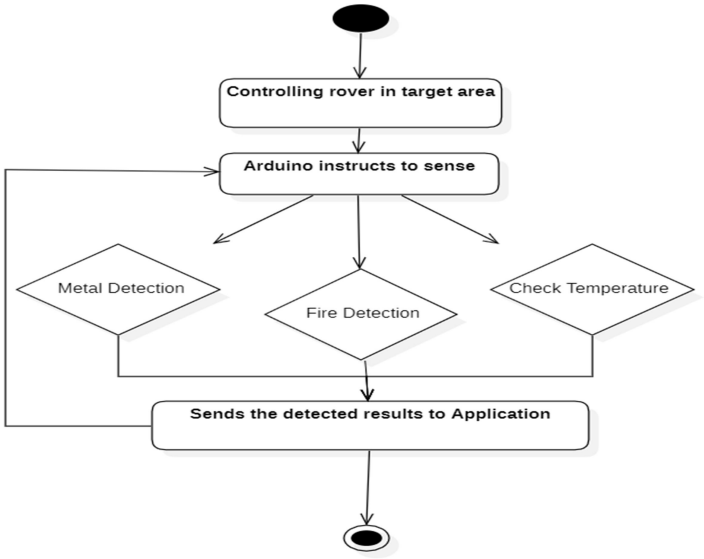


Figure 5 Activity Diagram

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system.

The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent.

Activity diagrams deal with all types of flow control by using different elements such as fork, join, etc. The basic purpose of activity diagrams is similar to the other four diagrams. It captures the dynamic behavior of the system. Other four diagrams are used to show the message flow from one object to another but the activity diagram is used to show message flow from one activity to another.

Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part.

The above figure represents the Activity Diagram of our project. In the above Activity Diagram, first the rover will be controlled and will be placed in the target area. The Arduino will continuously sense and send the detected results to the web application.

5. IMPLEMENTATION

5.1 Modules

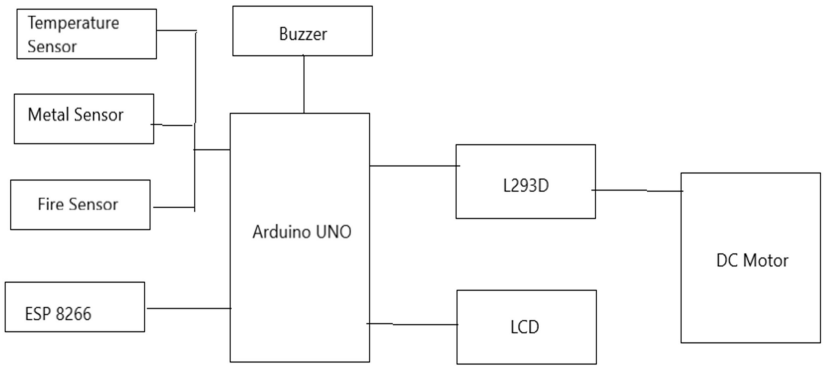


Figure 6 Project Architecture

In this project we are using various sensors like metal sensor, fire sensor and temperature sensor to do the important sensing work. Our model helps us to know the presences of landmines and fire. This model is very helpful for the military and fire department as its compact size and easy control helps us in sending the robot to remote places and checking the area before sending humans there. It can help us avoid serious accidents and can save the chance of any kind of disaster. The Fire and metal sensor when moved around the area keeps continuously sensing and gives the results to the application which helps the user know the status of the area and understand the situation beforehand and take the necessary steps and avoid major accidents.

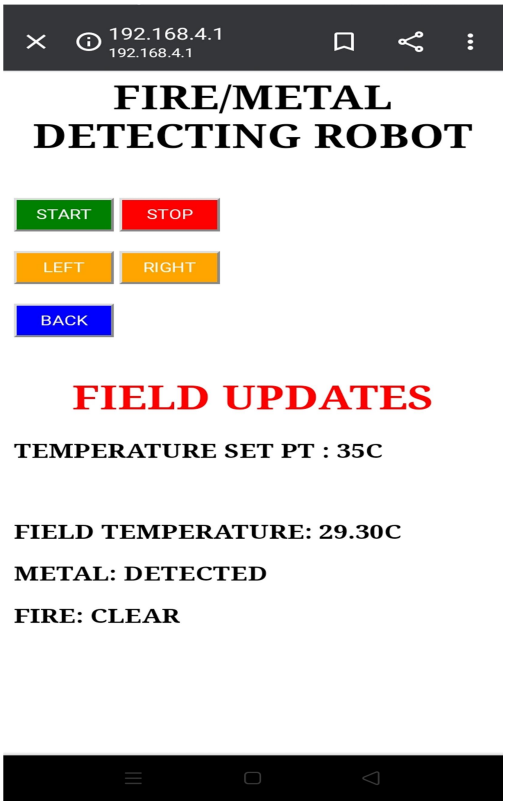


Figure 7 Web Application

The Mobile Application works by giving us control over the robot's moments and sensing of the area and it keeps giving the results on the display to give a better understanding of the situation.

When the robot is moving on the land and after continuous detection if it finds no trace of any landmines or fire then it shows clear status for both on our application.

When the robot is moving on land and after continuous detection if it finds no trace of any fire but a landmine is detected then it shows clear status for fire and detected status for Landmine on our application.

When the robot is moving on land and after continuous detection if it finds no trace of any landmine but a fire is detected then it shows clear status for Landmine and detected status for fire on our application.

When the robot is moving on land and after continuous detection if it finds trace of both fire and landmine then it shows detected status for both fire and Landmine on our application.

5.2 Module Description

Arduino UNO

Arduino Uno is a microcontroller board based on an 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists of other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in arduino programming. Each pin operates at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analogWrite() function.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, it's off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using an AREF pin with analog Reference() function.

- Analog pin 4 (SDA) and pin 5 (SCA) are also used for TWI communication using the Wire library.
- Arduino Uno has a couple of other pins as explained below:

- AREF: Used to provide reference voltage for analog inputs with analogReference() function.
- Reset Pin: Making this pin LOW, resets the microcontroller.

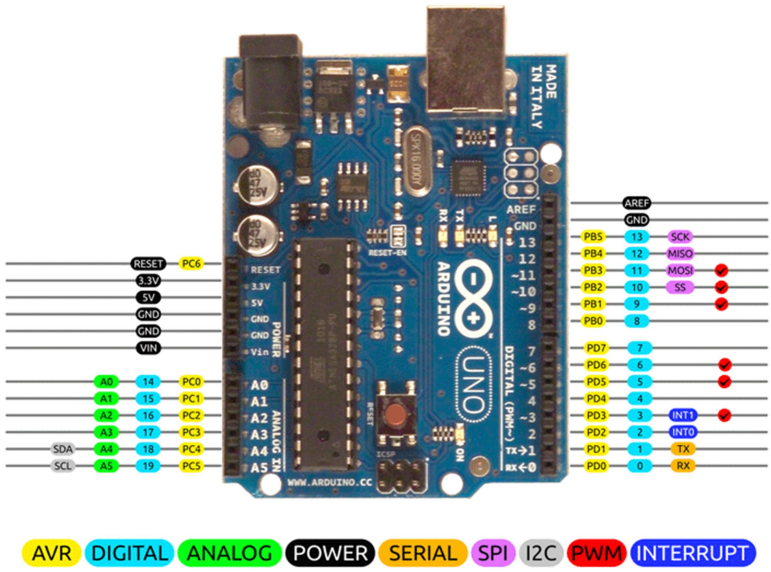


Figure 8 Arduino UNO

Pin Description

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator.

		Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.

SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage

Arduino Uno Technical Specifications

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)

DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

ESP 8266

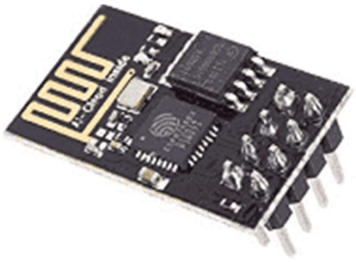


Figure 9 ESP 8266

The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability, produced by Espressif Systems in Shanghai, China.

This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted.The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, the chip, and the software on it, as well as to translate the Chinese documentation.

The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing the building of single-chip devices capable of connecting to Wi-Fi.

Power Supply

All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply.

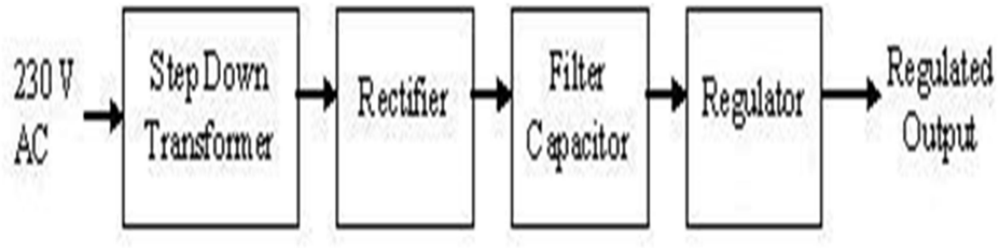


Figure 10 basic block diagram of a fixed regulated power supply

Figure 10 shows the basic block diagram of a fixed regulated power supply. Let us go through each block.

TRANSFORMER

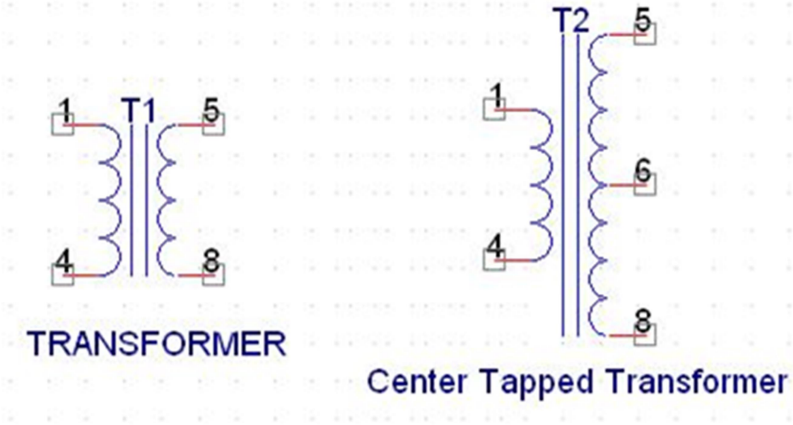


Figure 11 TRANSFORMER

A transformer consists of two coils also called “WINDINGS” namely PRIMARY & SECONDARY. They are linked together through inductively coupled electrical conductors also called CORE. A changing current in the primary causes a change in the Magnetic Field in the core & this in turn induces an alternating voltage in the secondary coil. If load is applied to the secondary then an alternating current will

flow through the load. If we consider an ideal condition then all the energy from the primary circuit will be transferred to the secondary circuit through the magnetic field.

$$P_{primary} = P_{secondary}$$

So

$$I_p V_p = I_s V_s$$

The secondary voltage of the transformer depends on the number of turns in the Primary as well as i the secondary.

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Rectifier

A rectifier is a device that converts an AC signal into a DC signal. For rectification purposes we use a diode, a diode is a device that allows current to pass only in one direction i.e. when the anode of the diode is positive with respect to the cathode also called as forward biased condition & blocks current in the reversed biased condition.

Rectifier can be classified as follows:

1) Half Wave rectifier.

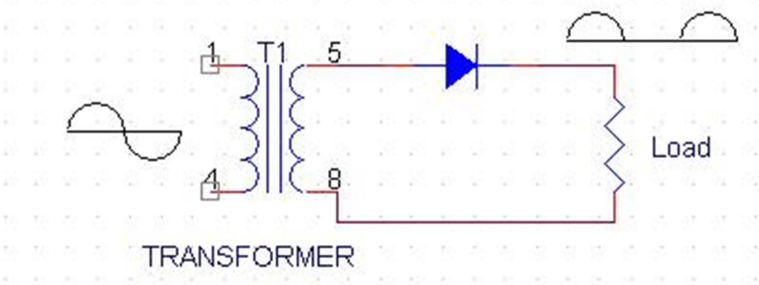


Figure 12 Half Wave rectifier

This is the simplest type of rectifier as you can see in the diagram a half wave rectifier consists of only one diode. When an AC signal is applied to it during the positive half cycle the diode is forward biased & current flows through it. But during the negative half cycle diode is reverse biased & no current flows through it. Since only one half of the input reaches the output, it is very inefficient to be used in power supplies.

2) Full wave rectifier.

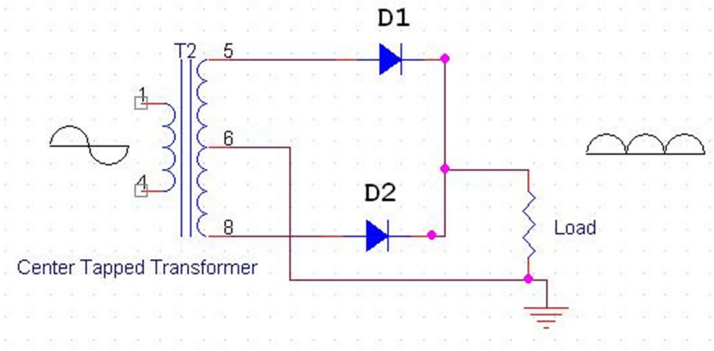


Figure 13 Full wave rectifier

Half wave rectifier is quite simple but it is very inefficient, for greater efficiency we would like to use both the half cycles of the AC signal. This can be achieved by using a center tapped transformer i.e. we would have to double the size of secondary winding & provide connection to the center. So during the positive half cycle diode D1 conducts & D2 is in reverse biased condition. During the negative half cycle diode D2 conducts & D1 is reverse biased. Thus we get both the half cycles across the load. One of the disadvantages of Full Wave Rectifier design is the necessity of using a center tapped transformer, thus increasing the size & cost of the circuit. This can be avoided by using the Full Wave Bridge Rectifier.

3) Bridge

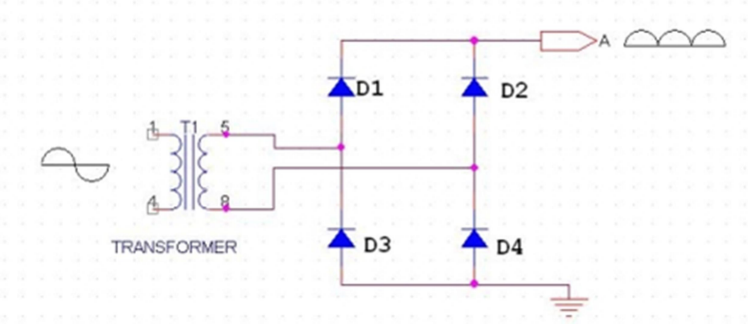


Figure 14 Bridge

As the name suggests it converts the full wave i.e. both the positive & the negative half cycle into DC thus it is much more efficient than Half Wave Rectifier & that too without using a center tapped transformer thus much more cost effective than Full Wave Rectifier.

Full Bridge Wave Rectifier consists of four diodes namely D1, D2, D3 and D4. During the positive half cycle diodes D1 & D4 conduct whereas in the negative half cycle

diodes D2 & D3 conduct thus the diodes keep switching the transformer connections so we get positive half cycles in the output.

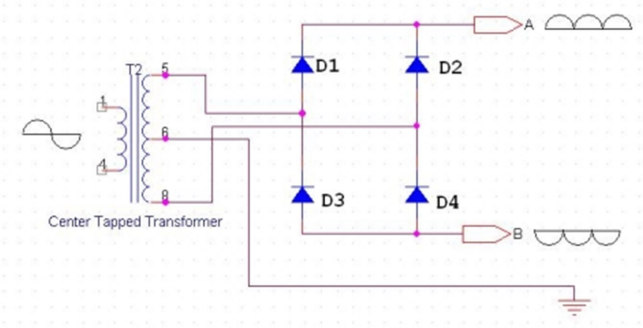


Figure 15 Bridge Circuit

If we use a center tapped transformer for a bridge rectifier we can get both positive & negative half cycles which can thus be used for generating fixed positive & fixed negative voltages.

Filter Capacitor

Even though half wave & full wave rectifiers give DC output, none of them provides a constant output voltage. For this we require to smoothen the waveform received from the rectifier. This can be done by using a capacitor at the output of the rectifier; this capacitor is also called as “FILTER CAPACITOR” or “SMOOTHING CAPACITOR” or “RESERVOIR CAPACITOR”. Even after using this capacitor a small amount of ripple will remain.We place the Filter Capacitor at the output of the rectifier the capacitor will charge to the peak voltage during each half cycle then will discharge its stored energy slowly through the load while the rectified voltage drops to zero, thus trying to keep the voltage as constant as possible.

If we go on increasing the value of the filter capacitor then the Ripple will decrease. But the the costing will increase. The value of the Filter capacitor depends on the current consumed by th circuit, the frequency of the waveform & the accepted ripple.

$$C = \frac{V_r F}{I}$$

Where,

Vr= accepted ripple voltage.(should not be more than 10% of the voltage)

I= current consumed by the circuit in Amperes.

F= frequency of the waveform. A half wave rectifier has only one peak

Whereas a full wave rectifier has Two peaks in one cycle so F=100hz.

VOLTAGE REGULATOR

A Voltage regulator is a device which converts varying input voltage into a constant regulated output voltage. Voltage regulator can be of two types

1) Linear Voltage Regulator

Also called as Resistive Voltage regulator because they dissipate the excessive voltage resistivity as heat.

2) Switching Regulators.

They regulate the output voltage by switching the Current ON/OFF very rapidly. Since their output is either ON or OFF it dissipates very low power thus achieving higher efficiency as compared to linear voltage regulators. But they are more complex & generate high noise due to their switching action. For low levels of output power switching regulators tend to be costly but for higher output wattage they are much cheaper than linear regulators.

The most commonly available Linear Positive Voltage Regulators are the 78XX series where the XX indicates the output voltage. And 79XX series is for Negative Voltage Regulators.

After filtering the rectifier output the signal is given to a voltage regulator. The maximum input voltage that can be applied at the input is 35V.Normally there is a 2-3 Volts drop across the regulator so the input voltage should be at least 2-3 Volts higher than the output voltage. If the input voltage gets below the Vmin of the regulator due to the ripple voltage or due to any other reason the voltage regulator will not be able to produce the correct regulated voltage.

DC Gear Motors

A unit which creates mechanical energy from electrical energy and which transmits mechanical energy through the gearbox at a reduced speed. A gearhead and

motor combination to reduce the speed of the motor to obtain the desired speed or torque.

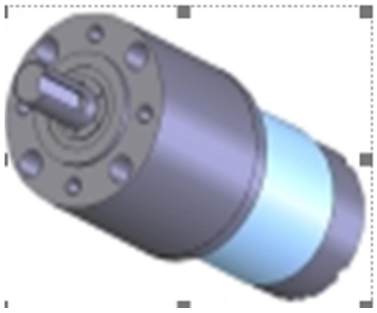


Figure 16 DC Gear Motors

Gearmotors of all types and sizes including single / multiphase, universal, servo, induction and synchronous types. DC gearmotors are configured in many types and sizes, including brushless and servo. A DC gearmotor consists of a rotor and a permanent magnetic field stator and an integral gearbox or gearhead. The magnetic field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque applications. A DC servomotor has an output shaft that can be positioned by sending a coded signal to the motor. As the input to the motor changes, the angular position of the output shaft changes as well. Servo Motors are generally small and powerful for their size, and easy to control. Common types of DC servomotors include brushless or gearmotor types. Stepper motors are a class of motors that provide incremental motion, or steps, in response to pulses of current that alternately change the polarity of the stator poles; step motors do not require feedback and are sometimes used in "Open Loop," or no-feedback applications.

Important performance specifications to consider when searching for gearmotors include shaft speed, continuous torque, continuous current, and continuous output power. The terminal voltage is the design DC motor voltage. The continuous torque is the output torque capability of the motor under constant running conditions. Continuous current is the maximum rated current that can be supplied to the motor windings without overheating. Continuous output power is the mechanical power provided by the motor output.

Important DC motor specifications to consider include terminal voltage, motor construction and commutation. The terminal voltage is the design DC motor voltage. Motor construction choices include permanent magnet, shunt wound, series wound, compound wound, disc armature, and coreless or slotless. Commutation choices include brush or brushless.

Important gearing specifications to consider for gearmotors and gearheads include the gearing arrangement, gearbox ratio, and gearbox efficiency. Gearing arrangement choices for gearmotors or gearheads include spur, planetary, harmonic, worm, and bevel. Gearbox ratio is the ratio of input speed to output speed. A ratio greater than one, therefore, indicates speed reduction, while a ratio less than one indicates speed increase. Efficiency is the percentage of power or torque that is transferred through the gearbox. Losses occur due to factors such as friction and slippage inside the gearbox.

Feedback choices for gearmotors include integral encoder, integral resolver, and integral tachometer. Other important parameters to consider when specifying gearmotors include shaft orientation or type and number of shafts, design units, motor shape, diameter or width, housing length, NEMA frame size, enclosure options and special or extreme environment construction. Common features include multi-speed, reversible, integral driver electronics, integral brake, integral clutch, and brake and clutch combination.

L293d-Driver Circuit

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

Description/ordering information (continued)

1.On the L293, external high-speed output clamp diodes should be used for inductive transient suppression.

2.A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation.

3.The L293and L293D are characterized for operation from 0C to 70C.

Pin Diagram:

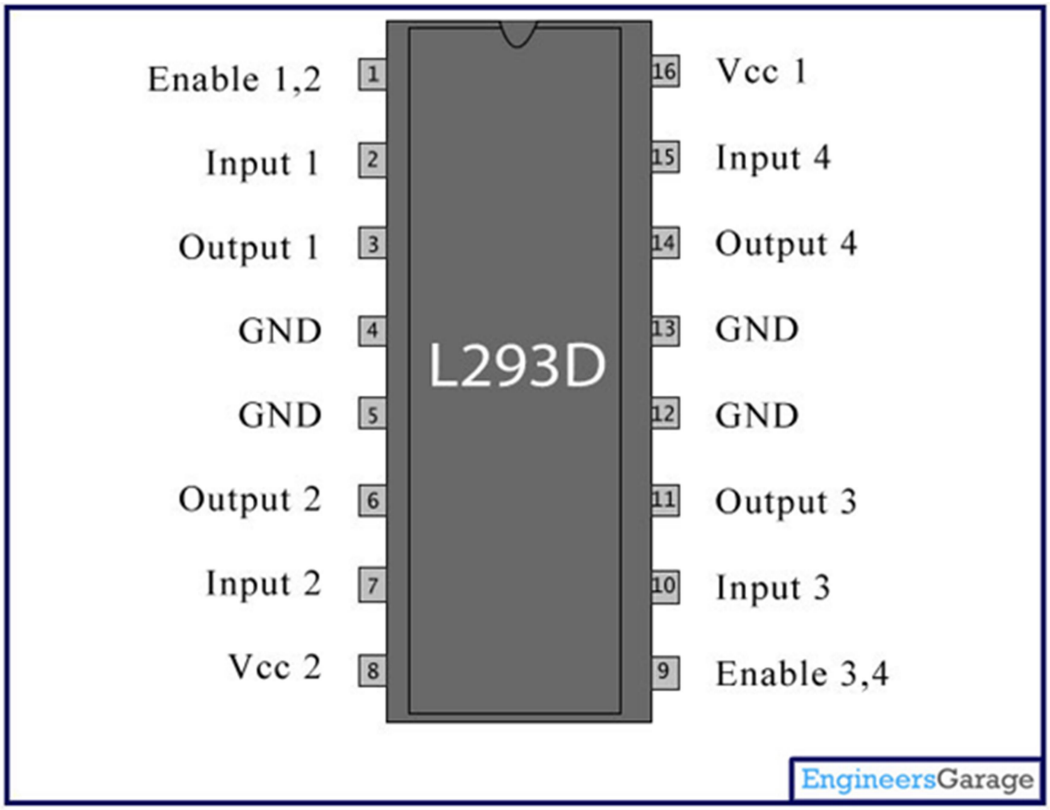


Figure 17 L293d-Driver Circuit

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enabled input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

Features

- Featuring Uni-trode L293 and L293D Products Now From Texas Instruments
- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Functional Replacements for SGS L293 and SGS L293D
- Output Current 1 A Per Channel (600 mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D)

Controlling Motors

While turning a motor on and off requires only one switch (or transistor) controlling the direction is deceptively difficult. It requires no fewer than four switches (or transistors) arranged in a clever way.

H-Bridges

These four switches (or transistors) are arranged in a shape that resembles an 'H' and thus called anH-Bridge. Each side of the motor has two transistors, one is responsible for pushing that side HIGHthe other for pulling it LOW. When one side is pulled HIGH and the other LOW the motor will spin in one direction. When this is reversed (the first side LOW and the latter HIGH) it will spin the opposite way.

DC Motor Example

The Arduino IDE has an included library for controlling stepper motors. To test it out with this setup,plug the stepper motor in with coil A across OUT 1 & 2, and coil B across OUT 3 & 4. Then download example code from http://tinyurl.com/**nyylun** and play around.

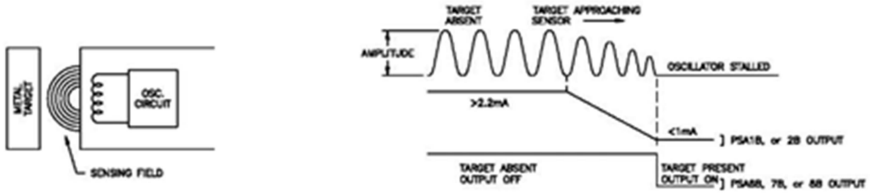
Metal Sensor/ Metal Detector

INDUCTIVE PROXIMITY SENSORS

Figure 18 Metal Sensor

- SENSE FERROUS & NON-FERROUS METAL OBJECTS TO "ZERO SPEED"
- 2-WIRE CURRENT SOURCE (NAMUR) & 3-WIRE NPN TRUE OPEN COLLECTOR OUTPUTS
- 5 SIZES & 3 SENSING DISTANCES FOR APPLICATION VERSATILITY
- L.E.D. TARGET INDICATOR (PSA 2B, 6B, 7B, & 8B)

DESCRIPTION & OPERATION



Inductive Proximity Sensors detect the presence of metal objects which come within range of their oscillating field and provide target detection to "zero speed". Internally, an oscillator creates a high frequency electromagnetic field (RF) which is radiated from the coil and out from the sensor face (See Figure 1). When a metal object enters this field, eddy currents are induced into the object.

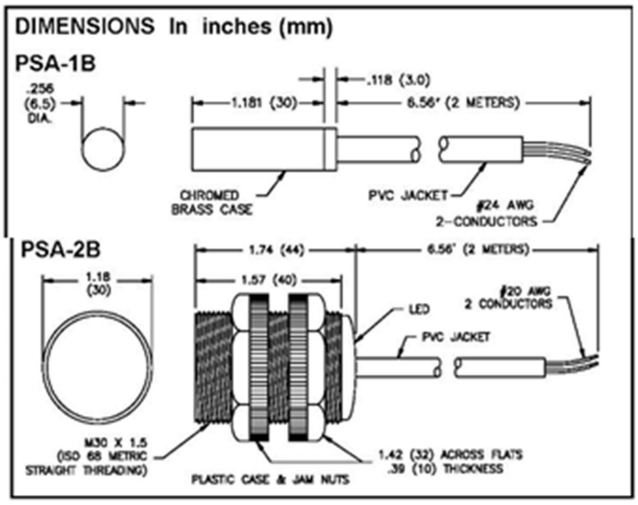


Figure 19 INDUCTIVE PROXIMITY SENSORS

As the metal moves closer to the sensor, these eddy currents increase and result in an absorption of energy from the coil which dampens the oscillator amplitude until it finally stops.

MODELS PSA-1B & 2B

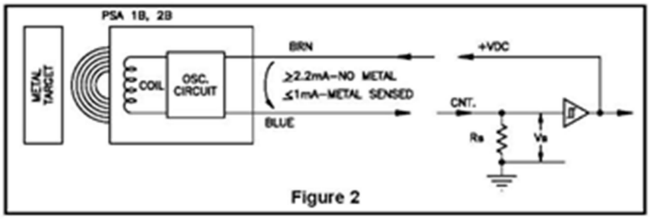


Figure 20 PSA-1B & 2B

The 2-wire Models PSA-1B and 2B contain only the coil and oscillator circuit (See Figure 2). With no metal object being sensed, the circuit oscillates and draws greater than 2.2 mA of supply current. As a metal object of sufficient size is brought into the sensing field, the oscillator amplitude dampens and finally stops, resulting in less than 1 mA of circuit current being drawn. This greater than 2.2 mA to less than 1 mA change in circuit current between oscillating and non-oscillating conditions is converted into a usable voltage signal (V_S) by placing a resistor (R_S) in series with the sensor leads.

PSA-1B & PSA-2B SPECIFICATIONS

1. Power Supply:	PSA-1B | PSA-2B
	+5 to +30 VDC
2. Maximum Switching Frequency:	5 KHz | 500 Hz
3. Output:	Less than 1 mA Target Sensed; Greater than 2.2 mA No Target.
4. Maximum Sensing Distance:	0.059" (1.5 mm) | 0.394" (10 mm)

5. Wire Color Code:	Brown = +VDC; Blue = Count
6. Operating Temperature:	-25°C to +70°C (-14°F to +158°F)
7. Construction:	NEMA 1, 3, 4, 6, 13, and IEC IP 67.

In addition to the coil and oscillator circuit, the 3-wire Models PSA-6B, 7B, and 8B each contain a Detector Circuit and NPN Transistor Output (See Figure 3). In these units, the Detector Circuit senses when the oscillator stops, and turns on the Output Transistor which controls the load. The Detector Circuit also turns on an integrally case mounted L.E.D., visually indicating when a metal object is sensed.

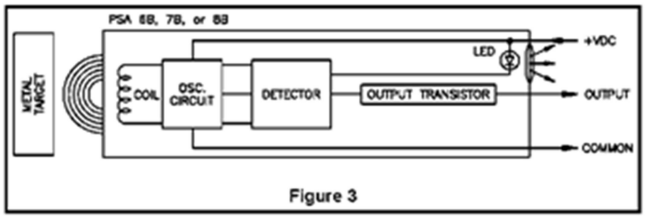


Figure 3

PSA-6B, 7B, & 8B

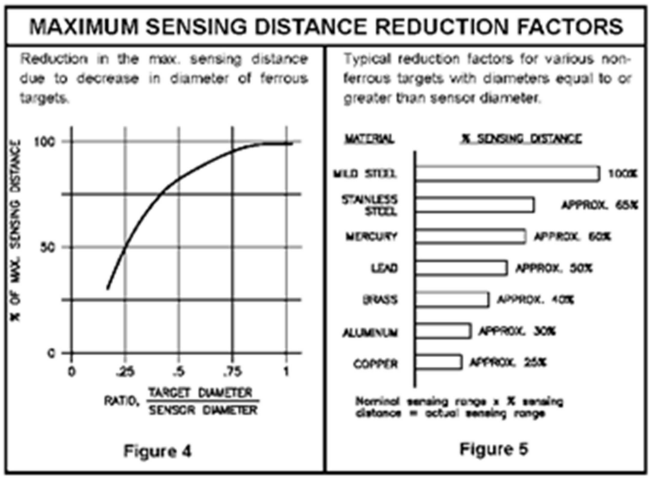
These Inductive Proximity Sensors have a maximum sensing distance of 0.059" (1.5 mm), 0.197" (5 mm) and 0.394" (10 mm) respectively, and operate over a wide power supply range (See Specifications Below). They are each housed in threaded metal cases and are supplied with 2 metal jam nuts for mounting. The NPN transistor outputs are true open collectors and are compatible with most RLC counter and rate input circuits. Maximum sensing frequencies are 2 KHz, 1 KHz, and 500 Hz respectively. In addition, the outputs are overload and short circuit protected. These sensors are shielded for flush mounting in metal applications.

PSA-6B, 7B, & 8B SPECIFICATIONS

	PSA-6B	PSA-7B	PSA-8B
1. Power Supply:	+10 to +30 VDC @ 10 mA max.		
	REVERSE POLARITY PROTECTION		
2. Maximum Switching Frequency:	2 KHz	1 KHz	500 Hz
3. Output:	NPN Open Collector Output, Overload and Short Circuit protected.		
	Vsat= 18 V @ 150 mA max. load	V_{sat} = 18 V @ 200 mA max. load	
4. Maximum Sensing Distance:	0.059" (1.5 mm)	0.197" (5 mm)	0.394" (10 mm)
5. Wire Color Code:	Brown = +VDC; Blue = Common; Black = Output		
6. Operating Temperature:	-25°C to +70°C (-14°F to +158°F)		
7. Construction:	NEMA 1, 3, 4, 6, 13 and IEC IP 67		

SELECTION & APPLICATION OF PROXIMITY SENSORS

Selection of the proper proximity sensor depends on the size, material, and spacing of the target being sensed and the sensing distance that can be maintained. The maximum sensing distance is defined as the distance in which the sensor is just close enough to detect a ferrous target whose diameter is equal to or greater than the sensor diameter. In actual application, the sensing distance should be between 50 to 80% of the maximum sensing range to assure reliable detection. For target sizes smaller than the sensor diameter, the maximum sensing distance can be estimated from the curve . A further reduction factor must also be applied if the target material is non-ferrous metal Ideally, spacing between adjacent targets should be at least one sensor diameter so that the first target completely leaves the sensor field before the next target appears. Individual targets can still be resolved as separate objects if this spacing is reduced to 70 or 75% of the sensor diameter, however, this can introduce a minimum limit on sensing distance that makes adjustment more critical. All Proximity sensors are internally shielded which allows the sensor face to be flush mounted in metal applications without reducing sensing distance. In applications where proximity sensors must be placed next to each other, a distance of at least 1 sensor diameter should separate sensors to eliminate any frequency interference (See Figure 6).



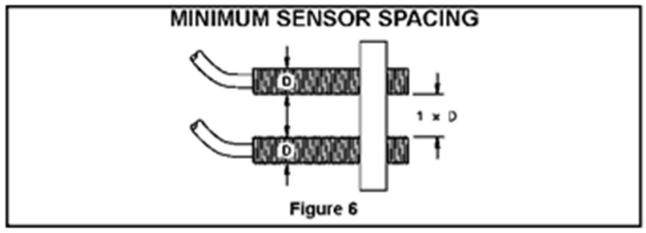


Figure 21 Sensor Spacing

Note: PSA-6B, 7B, and 8B outputs are NPN open collector outputs. A PSA-6B, 7B, or 8B may be used as an input to more than 1 indicator or control only if the respective power supplies of each unit are "unregulated" and can load share. It is recommended to use only one power supply for sensor power. An indicator or control with a regulated power supply may not be paralleled.

APPLICATION SELECTION CHART

	PSA-1B	PSA-2B	PSA-6B	PSA-7B	PSA-8B

MAX. SENSING DISTANCE	0.059" (1.5 mm)	0.394" (10 mm)	0.059" (1.5 mm)	0.197" (5 mm)	0.394" (10 mm)
MAX. SWITCHING FREQ.	5 KHz	500 Hz	2 KHz	1 KHz	500 Hz
POWER SUPPLY	5-30 VDC	5-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC
OUTPUT	<1 mA> 2.2 mA	<1 mA> 2.2 mA	NPN Open Collector Transistor		
L.E.D. TARGET INDICATOR	No	Yes	Yes	Yes	Yes

Fire Sensor

Specifications

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15ma
- Output Digital - 0V to 5V, Adjustable trigger level from preset
- Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor
- LEDs indicating output and power
- PCB Size: 3.2cm x 1.4cm
- LM393 based design

Board Schematic

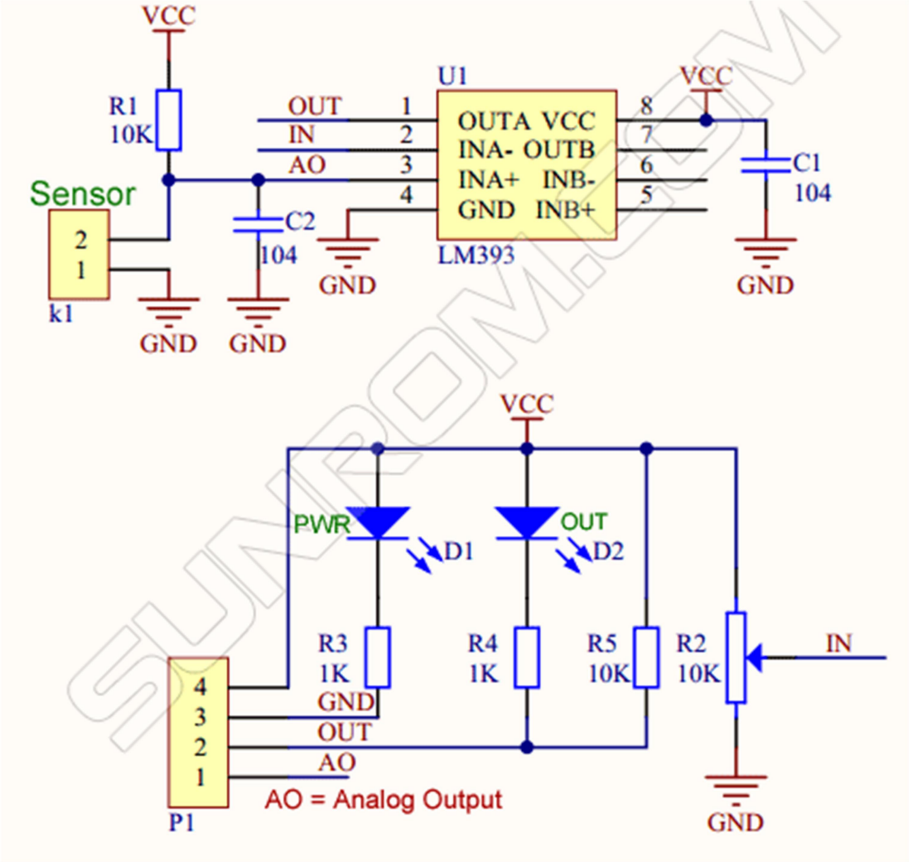


Figure 22 Fire Sensor

Pin details

- VCC = 3.3V to 5V DC
- GND = Ground
- DO = Digital Output
- AO = Analog Output

LM35

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino.

Power the IC by applying a regulated voltage like +5V (VS) to the input pin and connecting the ground pin to the ground of the circuit. Now, you can measure the temperature in the form of voltage as shown below.

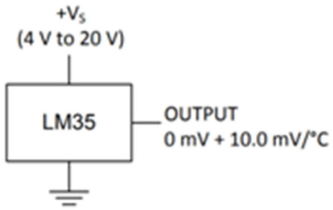


Figure 23 LM35

LM35 temperature measurement in the form of voltage.If the temperature is 0°C, then the output voltage will also be 0V. There will be a rise of 0.01V (10mV) for every degree Celsius rise in temperature. The voltage can be converted into temperature using the below formulae.

$V_{OUT} = 10\ mv/°C \times T$

where

- V_{OUT} is the LM35 output voltage
- T is the temperature in °C

LM35 Temperature Sensor Applications:

- Measuring temperature of a particular environment
- Providing thermal shutdown for a circuit/component
- Monitoring Battery Temperature
- Measuring Temperatures for HVAC applications.

5.3 Introduction of Technologies Used

Internet of Things (IoT):

The Internet of Things (IoT) is the internetworking of physical devices, vehicles (connecting devices, and smart devices), buildings, and other items-including embedded with electronics, software's, sensors, actuators, network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer –based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

IoT Functional Blocks:

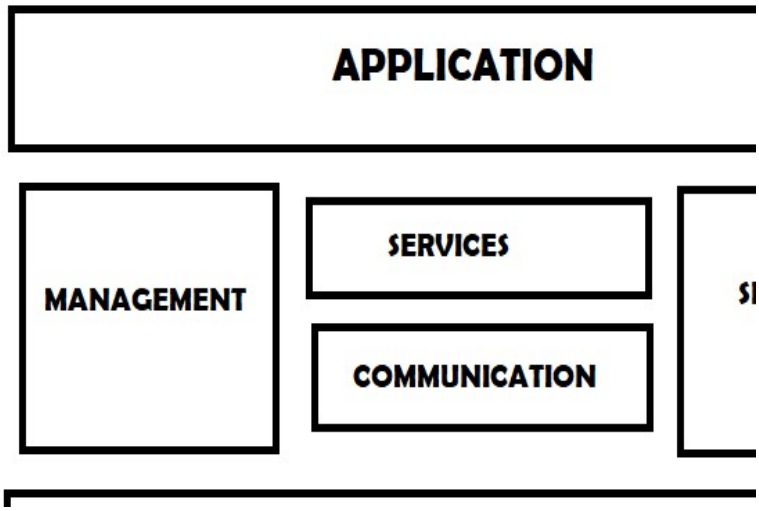


Figure 24 IoT Functional Blocks

An IoT system comprises a number of functional blocks that provide the system the capabilities for identification, sensing, actuation, and management as shown in figure. These functional blocks are described as follows:

- Device: An IoT system comprises devices that provide sensing, actuation, monitoring and control functions.
- Communication: The communication block handles the communication for the Iot system. The various protocols are used for communication by IoT systems
- Services: An IoT system uses various types of IoT services such as services for device monitoring, device control services, data publishing services and services for device discovery.
- Management: Management functional block provides various functions to govern the IoT system.
- Security: Security functional block secures the IoT system and by providing functions such as authentication, authorization, message and content integrity, and data security.
- Application: IoT applications provide an interface that the users can use to control and monitor various aspects of the IoT system. Applications also allow users to view the system status and view or analyse the processed data

Applications

The applications of Internet of Things span a wide range of domains including (but not limited to) homes, cities, environment, energy, systems, retail, logistics, industry, agriculture and health as listed.

- For homes, IoT has several applications such as smart lighting that adapt the lighting to suit the ambient conditions. smart appliances that can be remotely monitored and controlled, intrusion detection systems, smart smoke detectors etc.,
- For cities, IoT has applications such as smart parking systems that provide status updates on available slots, smart lighting that helps in saving energy, smart roads that provide information on driving conditions and structural health monitoring systems.
- For the environment, IoT has applications such as weather monitoring, air and noise pollution, forest fire detection and river flood detection systems.
- For energy systems, IoT has applications such as including smart grids, grid integration of renewable energy sources and prognostic health management systems.
- For the retail domain, IoT has applications such as inventory management, smart payments and smart vending machines.
- For the agriculture domain, IoT has applications such as smart irrigation systems that help in saving water while enhancing productivity and greenhouse control systems.
- Industrial applications such as smart irrigation systems. Industrial applications of IoT include machine diagnostics and prognosis systems.
- For health and lifestyle, IoT has applications such as health and fitness monitoring systems and wearable electronics.

IoT Protocols

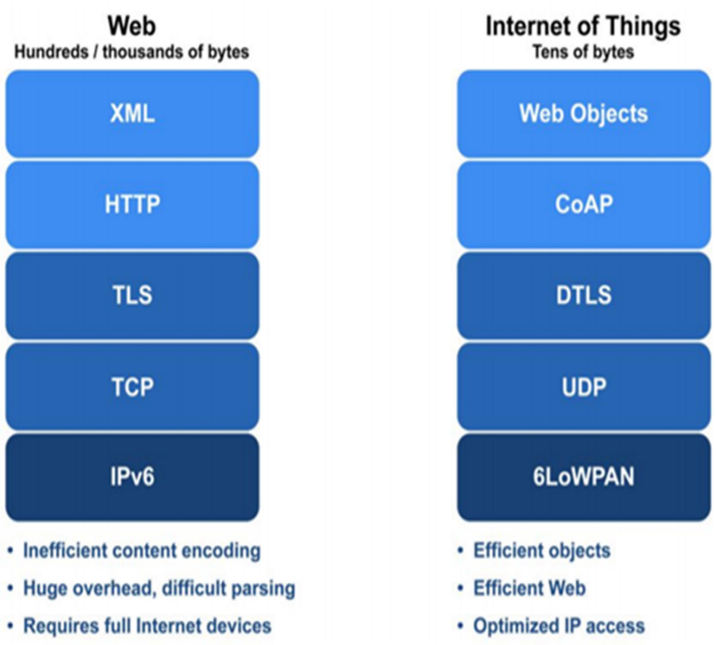


Figure 25 IoT Protocols

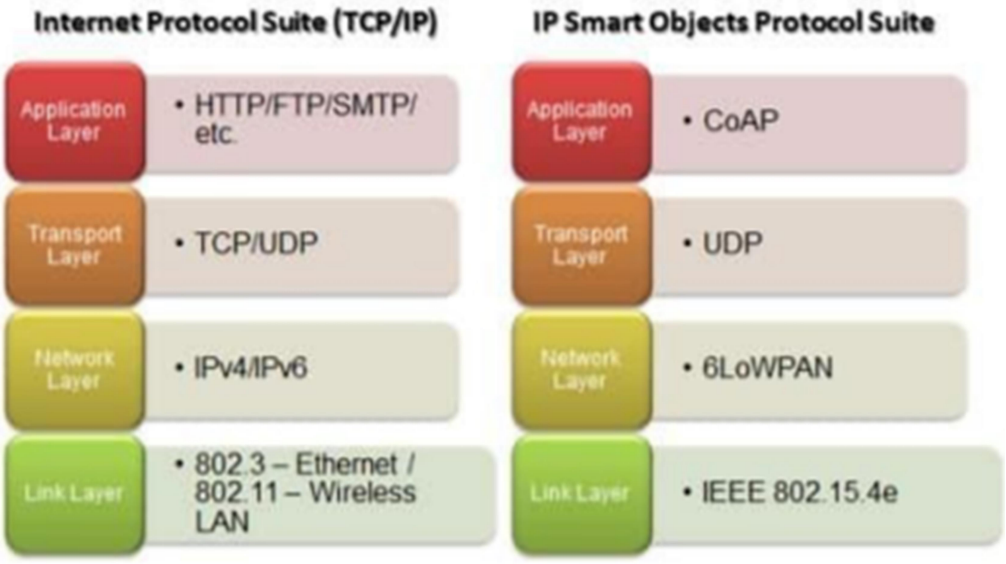


Figure 26 IP VS IP Smart Objects

Link Layer

Link Layer protocols determine how the data is physically sent over the

network's physical layer or medium (e. g., copper wire, coaxial cable, or a radio wave). The scope of the link layer is the network connection to which host is attached. Hosts on the same link exchange data packets over the link layer using link layer protocols. Link layer determines how the packets are coded and signalled by the hardware device over the medium to which the host is attached (such as a coaxial cable). Let us now look at some link layer protocols, which are relevant in the context of IoT.

- **802.3-ETHERNET:** IEEE 802.3 is a collection of wired Ethernet standards for the link layer. For example, 802.3 is the standard for 10BASIES Ethernet that uses coaxial cable as a shared medium, 802.3.i is the standard for 10BASE-T Ethernet over copper twisted-pair connections, 802.3ae is the standard for 10Gbit/Ethernet over fibre, and so on. optic connections, these standards provide data rates from 10Mbs to40Gbs and higher. The shared medium in Ethernet can be a coaxial cable, twisted-pair wire or an optical fibre. the shared medium (i.e., broadcast medium) carries the communication for all the devices propagation conditions and transceiver capabilities. The specifications of the 802.3 standards are available on the IEEE802.3 working group website.
- **802.3-WIFI:** IEEE 802.11 is a collection of wireless local area network (WLAN)communication standards, including extensive description of the link layer. For example, 802.11a operates in the 5GHZ band, 802.11b and 802.11g operate in the 2.4GHZ band 802.11n operates in the 2.4/5GHZ bands, 802.11ac operates from 1MB/S to up to upto6.75Gb/s. The specifications of the 802.11 standards are available on the IEEE 802.11 working group website
- **802.11-WIFI:** IEEE 802.16 is a collection of wireless broadband standards, including extensive description for the link layer (also called WiMAX). WiMAX. Standards provide data rates from 1.5 Mb/s to 1 G b/s. The recent update (802.16m) provides data rates of 100 Mbit/s for mobile stations and 1 G bit/s for fixed stations. The specifications of the 802.11 standards are readily available on the IEEE802.16 working group website.
- **802.15.4--LR-WPAN:** IEEE 802.15.4 is a collection of standards for low-rate wireless personal area networks (LR-WPANs). These standards form the basis of specifications for high level communication protocols such as ZigBee. LR-WPAN standards provide data rates from 4Kb/s 250 Kb/s. These standards

provide low-cost and low-speed communication for power constrained devices. The specifications of The 802.15.4 standards are available on the IEEE802.15 working group website.

- **2G/3/4G-MobileCommunication:** There are different generations of mobile communication standards including second generation (2G including GSM and CDMA), third generation (3G-including UMTS and CDMA2000) and fourth generation (4G-including LTE). IOT devices based on these standards can communicate over cellular networks. Data rates for these standards range for 9.6 Kb/s(for 2G) to up to 100Mb/s(for 4G) and are available from the 3GPP websites.

Network/Internet Layer

The network layers are responsible for sending IP datagrams from the source network to the destination network. This layer performs the host addressing and packet routing. The data grams contain the source and destination addresses which are used to route them from the source to destination across multiple networks. Host identification is done using hierarchical IP addressing schemes such as IPV4 or IPV6.

IPV4: Internet Protocol version 4(IPV4) is the most deployed Internet Protocol the is used to identify the devices on a network using a hierarchical addressing scheme. IPV4 uses a 32-bit address scheme that allows a total of 4,294,967,296 addresses. As more and more devices got connected to the Internet, these addresses got exhausted in the year 201. IPV4 has been succeeded by IPV6. The IP protocols establish connections on the packet network, but do not guarantee delivery of packets.

IPV6: Internet Protocols version 6(IPV6) IS The newest version of Internet Protocols and successor to IPV4. IPV6 uses 128-bit address scheme that allows total of 3.4*10 38 address.

6LoWPAN: 6LoWPAN (IPV6 over Low power Wireless Personal Area Networks) brings IP protocol to the low-power devices which have limited processing capability 6LoWPAN works with the 802,15.4-based networks.

Transport Layer

The transport layer protocols provide end-end message transfer capability independent of the underlying network. The message transfer capability can be set up on connections, either using handshakes (as in TCP) or without handshakes/acknowledgements (as in UDP). The transport layer provides functions such as error control, segmentation, flow control and congestion control.

- **TCP:** Transmission Control Protocol (TCP) is the most widely used transport layer protocol. that is used by web browsers along with HTTP, HTTPS application layer protocols, email programs (SMTP application layer protocols) and file transfer (FTP). TCP is connection oriented and stateful protocol. While IP protocol deals with sending packets. TCP ensures reliable transmission of packets in-order. TCP also provides error detection capability so that duplicate packets can be discarded and lost packets are retransmitted. The flow control capability of TCP ensures that the rate at which the sender sends the data is not too high for the receiver to process. The congestion collapse which can lead to degradation of network performance TCP is described in RFC 793.
- **UDP:** Unlike TCP, which requires carrying out an initial setup procedure. UDP of a connectionless protocol. UDP is useful for the time-sensitive applications that have very small data units to exchange and do not have stateless protocol. UDP does not provide guaranteed delivery or ensure connections created are reliable. UDP is described in RFC768.

Application Layer:

Application Layer protocols define how the applications interface with the lower layer protocols to send the data over the network. The application data, typically in files, is encoded by the application layer protocol and encapsulated in the transport layer protocol which provides connection or transaction-oriented communication over the network. Port numbers are used for application addresses (for example port 80 for HTTP port 22 for SSH etc.). Application layer protocols enable process-to-process connections using ports.

- **HTTP:** Hypertext Transfer Protocol (HTTP) is the application layer protocol that forms the foundation of the World Wide Web (WWW). HTTP includes

commands such as GET, PUT, POST, DELETE, HEAD, TRACE, OPTIONS, etc. The protocol follows a request-response model where a client can send a request to a server using the HTTP commands. HTTP is a stateless protocol and each HTTP request is independent of the other requests. An HTTP client can be a browser or an application running on the client (e.g., an application running on an IOT device, a mobile application or other software).

- **CoAP:** Constrained Application Protocol (CoAP) is an application layer protocol for machine-to-machine(M2M) applications. meant for constrained environments with constrained devices and constrained networks. Like HTTP, CoAP is a web transfer protocol and uses a request-response model, however it runs on top of UDP instead of TCP. COAP uses a client-server architecture where clients communicate with servers using connectionless data grams COAP is designed to easily interface with HTTP. Like HTTP, COAP supports methods such as GET, PUT, POST, and DELETE, COAP draft specifications are available on IEFT Constrained environments (CORE) working Group Website.
- **Web Socket:** Web Socket protocol allows full-duplex communication over a single socket connection for sending messages between client and server. Web server is based on TCP and allows streams of messages to be sent back and forth between the client and server while keeping the TCP connection open. The client can be a browser, a mobile application or an IOT device.
- **MQTT:** Message Queue Telemetry Transport (MQTT) is a light-weight messaging protocol based on the publish-subscribe model. MQTT uses a client-server (also called MQTT Broker) and publishes messages to topics. MQTT is well suited for constrained environments where the devices have limited processing and memory resources and the network bandwidth is low MQTT specifications are available on IBM developer Works.
- **XMPP:** Extensible Messaging and Presence Protocol (XMPP) is a protocol for real-time communication and streaming XML data between entities. XMPP powers a wide range of applications including messaging, presence, data syndication, gaming, multi-party chat and voice/video calls. XMPP allows sending small chunks of XML data from one network entry to another in near real-time. XMPP is a decentralized protocol and uses a client-server architecture. XMPP supports both client-to-server and server-to-server

communication paths. In the context of IOT, XMPP allows real-time communication between IOT devices.

- **DDS:** Data Distribution Service (DDS) is a data-centric middleware standard for device to-device or machine-to-machine. DDS uses a publish-subscribe for models where publishers (e g. devices that generate data) create topics to which subscribers (e.g., devices that want to consume data) can subscribe. Publisher is an object responsible for data distribution and the subscriber is responsible for receiving reliability. DDS provides quality-of-service (QOS) control and configurable reliability .DDS is described in Object Management Group (OMG)DDS specification.
- AMQP: Advanced Messaging Queuing Protocol (AMQP) is an open application layer protocol for business messaging. AMQP supports both point-to-point publishers (e.g devices or applications that generate data). Publishers publish the connections to consumers (applications that process data). Publishers publish the messages to exchange which then distribute message copies to queues. Messages are either delivered by the broker to the consumers which have subscribed to the queues or the consumers can pull the messages from the queues. AMQP specification is available on the AMQP working group website.

5.4 Sample Code

```
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
LiquidCrystal lcd(13,12,11,10,9,8);
SoftwareSerial IOTSerial(2,3);
const int xpin = A0;
int n=0;
const int m1_d1 = 16;
const int m1_d2 = 17;
const int m2_d1 = 18;
const int m2_d2 = 19;

const int buzzer = 5;
const int fire = 6;
const int Metal = 7;
char inChar;
int digitalValue = 0;
float analogVoltage = 0.00;
```

```
float temp=0.00;
float temp1;
int i;
void setup()
{

pinMode(m1_d1, OUTPUT);
pinMode(m1_d2, OUTPUT);
pinMode(m2_d1, OUTPUT);
pinMode(m2_d2, OUTPUT);
pinMode(buzzer,OUTPUT);

pinMode(fire,INPUT_PULLUP);
pinMode(Metal,INPUT_PULLUP);

digitalWrite(m1_d1, LOW);
digitalWrite(m1_d2, LOW);
digitalWrite(m2_d1, LOW);
digitalWrite(m2_d2, LOW);
digitalWrite(buzzer,HIGH);

IOTSerial.begin(9600);
lcd.begin(16, 2);
lcd.setCursor(0, 0);
lcd.print("   FIRE/METAL ");
lcd.setCursor(0, 1);
lcd.print(" DETECTING ROBOT");
delay(3000);
lcd.clear();
}
void loop()
{

 lcd.setCursor(8,0);
 lcd.print("TSP:35");
 lcd.print((char)223);
 lcd.print("C");
 for(i=0;i<2;i++)
    {
     lcd.setCursor(8, 1);
     lcd.print("TMP:");
     digitalValue=analogRead(xpin);
```

```
    analogVoltage = (digitalValue * 5.00)/1024.00;
    temp=analogVoltage*100;
    lcd.print(temp,0);
    lcd.print((char)223);
    lcd.print("C");
    delay(500);
   }
if(temp>35)
{
 digitalWrite(buzzer,LOW);
 delay(1000);
 digitalWrite(buzzer,HIGH);
}
if(IOTSerial.available()>0)
inChar  = IOTSerial.read();

if(digitalRead(Metal)==LOW)
{
  lcd.setCursor(0, 0);
  lcd.print("M:CLR");
}
else
{
  lcd.setCursor(0, 0);
  lcd.print("M:DET");
  digitalWrite(buzzer,LOW);
  delay(1000);
  digitalWrite(buzzer,HIGH);
}

if(digitalRead(fire)==LOW)
{
  lcd.setCursor(0, 1);
  lcd.print("F:DET");
   digitalWrite(buzzer,LOW);
  delay(1000);
  digitalWrite(buzzer,HIGH);
}
else
{
  lcd.setCursor(0, 1);
  lcd.print("F:CLR");
```

```
}
 if(inChar=='2')
 {
  Serial.println("Robot Moving Forward");
  digitalWrite(m1_d1, LOW);
  digitalWrite(m1_d2, HIGH);
  digitalWrite(m2_d1, HIGH);
  digitalWrite(m2_d2, LOW);
  delay(5000);
  digitalWrite(m1_d1, LOW);
  digitalWrite(m1_d2, LOW);
  digitalWrite(m2_d1, LOW);
  digitalWrite(m2_d2, LOW);
 }
 else if(inChar=='1')
 {
  Serial.println("Robot Moving Backward");
  digitalWrite(m1_d1, HIGH);
  digitalWrite(m1_d2, LOW);
  digitalWrite(m2_d1, LOW);
  digitalWrite(m2_d2, HIGH);
  delay(5000);
  digitalWrite(m1_d1, LOW);
  digitalWrite(m1_d2, LOW);
  digitalWrite(m2_d1, LOW);
  digitalWrite(m2_d2, LOW);
 }
 else if(inChar=='3')
 {
  Serial.println("Robot Moving Left");
  digitalWrite(m1_d1, LOW);
  digitalWrite(m1_d2, HIGH);
  digitalWrite(m2_d1, LOW);
  digitalWrite(m2_d2, HIGH);
  delay(1000);
  digitalWrite(m1_d1, LOW);
  digitalWrite(m1_d2, LOW);
  digitalWrite(m2_d1, LOW);
  digitalWrite(m2_d2, LOW);
 }
  else if(inChar=='4')
 {
```

```
   Serial.println("Robot Moving Right");
   digitalWrite(m1_d1, HIGH);
   digitalWrite(m1_d2, LOW);
   digitalWrite(m2_d1, HIGH);
   digitalWrite(m2_d2, LOW);
   delay(1000);
   digitalWrite(m1_d1, LOW);
   digitalWrite(m1_d2, LOW);
   digitalWrite(m2_d1, LOW);
   digitalWrite(m2_d2, LOW);
   }
   else if(inChar=='5')
   {
    digitalWrite(m1_d1, LOW);
    digitalWrite(m1_d2, LOW);
    digitalWrite(m2_d1, LOW);
    digitalWrite(m2_d2, LOW);
   }
   else
   {
   digitalWrite(m1_d1, LOW);
   digitalWrite(m1_d2, LOW);
   digitalWrite(m2_d1, LOW);
   digitalWrite(m2_d2, LOW);
   }

IOTSerial.print("<h1">FIELD UPDATES</h1>");
IOTSerial.print("<h3>TEMPERATURE SET PT : 35C</h3></br>");
IOTSerial.print("<h3>FIELD TEMPERATURE: ");
 IOTSerial.print(temp);
  IOTSerial.print("C</h3>");
  if(temp>35)
  IOTSerial.print("<h3>HIGH TEMERATURE</h3>");
if(digitalRead(Metal)==LOW)
   IOTSerial.print("<h3>METAL: SEARCHING</h3>");
else
   IOTSerial.print("<h3>METAL: DETECTED</h3>");
if(digitalRead(fire)==LOW)
   IOTSerial.print("<h3>FIRE: DETECTED</h3>");
else
   IOTSerial.print("<h3>FIRE: CLEAR</h3>");}
```

6. TEST CASES

Case 1 When the robot is moving on the land and after continuous detection if it finds no trace of any landmines or fire then it shows clear status for both on our application.

Fire Detected Clear
Metal Detected Clear

Case 2 When the robot is moving on land and after continuous detection if it finds no trace of any fire but a landmine is detected then it shows clear status for fire and detected status for Landmine on our application.

Fire Detected Clear
Metal Detected Detected

Case 3 When the robot is moving on land and after continuous detection if it finds no trace of any landmine but a fire is detected then it shows clear status for Landmine and detected status for fire on our application.

Fire Detected Detected
Metal Detected Clear

Case 4 When the robot is moving on land and after continuous detection if it finds traces of both fire and landmine then it shows detected status for both fire and Landmine on our application.

Fire Detected Detected
Metal Detected Detected

7. SCREENSHOTS

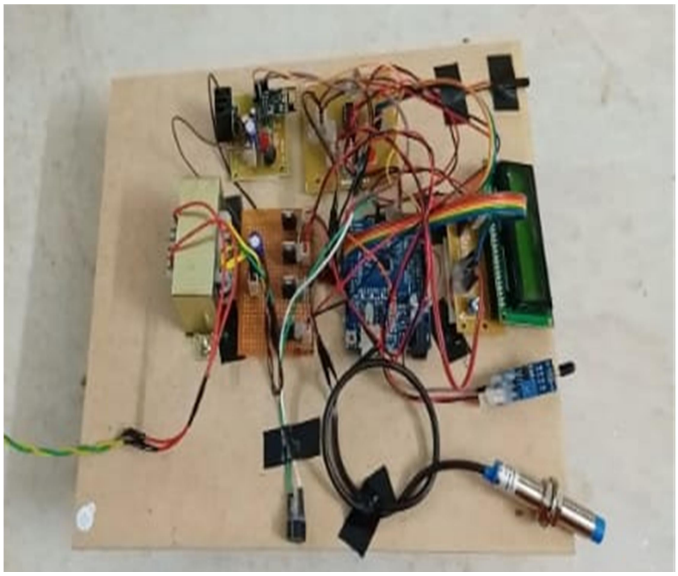


Figure 27 Proposed System

The above figure 27 is the picture of our working model the rover is controlled with the application in our phone which is shown below figure 28

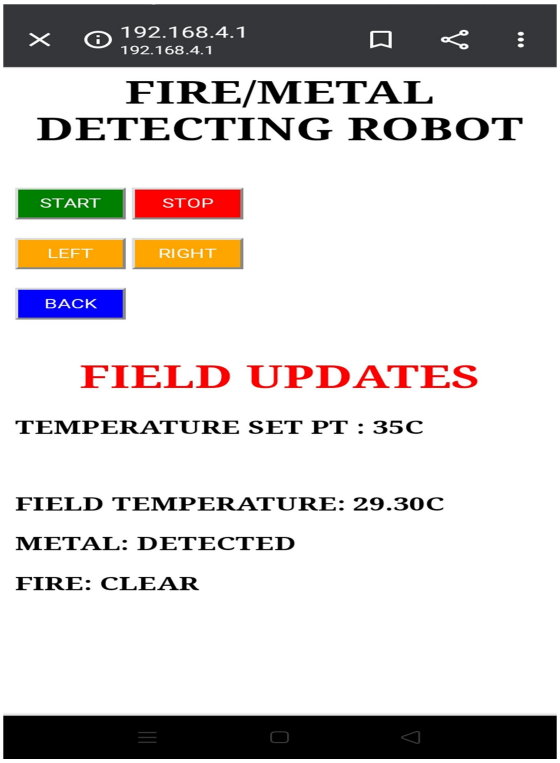


Figure 28 Webpage

When the robot is moving over the land we can keep sensing the ground and get updates live on our application and when we encounter a landmine or fire we will get an immediate answer on our application saying Landmine or fire detected.

The sensors keep sensing the entire time and any change it encounters it updates on the application for the user to see. When we encounter a landmine we can immediately send help to defuse it which can save many lives and help us avoid tragic accidents same goes for fire accidents if we use the robot to check for the situation it will give us accurate understanding of the situation as where there is fire and where it is not this makes the rescue operation lot more easier.

8. CONCLUSIONS

The proposed Defence robot can be used in metal and fire detection so the robot instead of humans can be put to detect a dangerous item. Thus, it reduces the chance of human injury or fatality to a great extent. Our prototype is controlled wirelessly from a safe distance. It is an inexpensive and efficient defence robot for landmine detection and fire sensing.

This project has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

We have successfully designed and developed a landmine and fire detector robotic vehicle that can be used in landmine detection and fire detection so the robot instead of humans can be put to detect a dangerous item and thus reduce the chance of human injury or fatality to a great extent. Our prototype is controlled wirelessly from a safe distance. Use of readily available simple electronic components has made this design inexpensive and efficient. Further improvement of the design can make it an excellent choice for deployment and use in perilous zones infested with land mines and other dangerous metallic and fire items.

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