A Project Report

on

INDUSTRY ORIENTED AUTOMATION ROBOT

Submitted in partial fulfillment of the requirements

for the award of degree

BACHELOR OF TECHNOLOGY

in

Information Technology

by

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DECLARATION

We hereby declare that the work presented in this project entitled " **INDUSTRY ORIENTED AUTOMATION ROBOT** " submitted towards completion of the project in IV year II sem of B.Tech IT at "BVRIT HYDERABAD College of Engineering for Women", Hyderabad is an authentic record of our original work carried out under the esteemed guidance of Ms. Ch. Sai Lalitha Bala, Assistant Professor, Department of IT.

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CERTIFICATE

This is to certify that the major project report on **"INDUSTRY ORIENTED AUTOMATION ROBOT"** is a bonafide work carried out by **Ms. V. Sai Akshita (19WH1A1212), Athiya Fathima (19WH1A1232), Priyanka Kolli (19WH1A1236), M. Preethi (19WH1A1259)** in the partial fulfillment for the award of B.Tech degree in **Information Techonology, BVRIT HYDERABAD College of Engineering for Women, Bachupally, Hyderabad** affiliated to the Jawaharlal Nehru Technological University Hyderabad under my guidance and supervision. The results embodied in the major project work have not been submitted to any other university or institute for the award of any degree or diploma.

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ABSTRACT

This Industry Oriented Automation Robot can be used to monitor an industry's environment using sensors.The industrial automation robot is a cutting-edge tool that is revolutionizing industrial safety and efficiency. It features advanced sensors such as an LDR, three ultra-sonic sensors, a fire sensor, a gas sensor and a metal sensor. The robot can pick up tiny metal pieces on the floor with a magnet, making it an asset in facilities that handle metal parts. One of the key features of this robot is its connectivity to a Telegram bot. The robot sends alerts to the bot if any abnormal values are detected by its sensors. This real-time monitoring allows for quick and efficient responses to potential hazards. The LDR allows for adaptation to changing light conditions, and the ultra-sonic sensors provide 360-degree coverage around the robot, enabling obstacle detection and collision avoidance. The fire sensor and gas sensor ensure a safe working environment by detecting potential hazards, while the metal sensor and magnet make it easy to remove metal debris from the floor. Overall, the industrial automation robot offers unparalleled safety, making it a must-have in any industrial setting. Therefore, if any issues in the environment of the industry, this robot allows the sensors to sense the values.

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1. INTRODUCTION

Industrial oriented robot can be used to monitor the industry's environment using sensors. It is a self-guided autonomous robot, which can be maneuver with the help of ultrasonic sensor. Prevention hazardous conditions by detection abnormal gases, fire accidents. Precession control for smooth robot movement. Industrial Autonomous robot is used to monitor the industrial environment conditions using sensors. Detects Fire and GAS detector is used to detect any leakage of smoke and any fire accidents in the industry.

Robot uses light sensor(LDR) for measuring accurate light intensity in the industry. Movement of the robot mainly comprising of L293D a motor driver IC which drivers the motors in both the directions. The mechanism makes smart use of motors to achieve vehicle movement in forward backward as well as turning left/right simultaneously. The micro controller processes the commands and then operates the motors to achieve the desired vehicle movement based on sensors. The purpose of building this robot was to provide industrial automated robot.

The rise of industrial automation has transformed the way industries operate, with robotics playing a crucial role in enhancing efficiency, safety, and productivity. Industrial robots have been widely adopted in factories, warehouses, and other industrial settings to streamline production processes, reduce costs, and improve overall quality.One of the latest innovations in industrial robotics is the industrial automation robot that features advanced sensors such as an LDR for light detection, three ultra-sonic sensors for obstacle detection, a fire sensor, a gas sensor for detecting harmful gases, and a metal sensor for detecting metal pieces on the floor. In addition, the robot has a magnet that can be used to pick up metal debris from the floor.

The LDR is a device that detects changes in ambient lighting conditions and is useful for adapting to its surroundings. The three ultra-sonic sensors provide a 360-degree view of the robot's environment, enabling it to detect obstacles and avoid collisions. The fire sensor and gas sensor are critical safety features that detect potential hazards and help prevent accidents. The metal sensor and magnet are particularly useful in facilities that handle metal parts, allowing the robot to pick up and remove metal debris from the floor.

This robot's interaction with a Telegram bot is one of its unique characteristics. If any aberrant values are identified by the robot's sensors, the robot sends alerts to the bot, and an administrator or a concerned official of the industry can access the bot to view the robot's performance in real-time. This capability enables for quick and effective reactions to possible threats, making it particularly helpful in emergency situations.Normal Telegram bots are not private. Anyone can find and use them. However, Telegram bots can also only be made accessible to certain users if a separate communication channel with the bot is set up. This channel is a "private" group with the bot, to which only you, users approved by you and the actual bot belong. In this way, the Telegram Bot can only be used by the user group controlled by you.The Internet of Things (IoT) and this is where a Telegram Bot comes in. It can, in environments defined by you, comfortably inform and react. Telegram can not only enable communication between people, but with a Telegram Bot, it can also enable communication between people and programmable machines. We can thus forward messages to multiple devices with one click or receive them from you. The actual Telegram bot application with the relevant data is stored on its own computers and databases. Here, the application security depends on the administrator of the local PC environment on site. The Telegram Bot only delivers the message outputs defined in the application to the respective end devices. Only these message outputs are then located in the Telegram Cloud.All messages and thus also the communication with a bot are secured via client-server/server-client encryption. In the Telegram Cloud, this data is also divided among a number of servers and stored there in encrypted form.

Overall, the industrial automation robot represents a significant breakthrough in the field of industrial robotics. With its advanced sensors, it offers unparalleled safety and efficiency features that can help industries operate with greater ease and peace of mind. The integration with the Telegram bot further enhances its value by providing real-time monitoring and alerts, enabling swift and decisive action to address any issues that may arise.

The robot's capabilities extend beyond safety and efficiency, as it can also increase productivity and reduce costs. By automating tedious and repetitive tasks, it frees up human workers to focus on more complex and creative tasks that require higher-level thinking. Additionally, the robot's precision and accuracy in carrying out tasks can improve the quality of the products produced and reduce waste. The industrial automation robot is a cutting-edge tool that is revolutionising industrial

automation, to sum up. It offers unmatched safety, efficiency, and productivity qualities that make it a necessity in any industrial setting thanks to its sophisticated sensors and connectivity with the Telegram bot. As technology develops, we may anticipate seeing more innovations that improve industrial processes and make businesses run more efficiently.

The requirement of placing a smart fire detection system is important within buildings especially in the buildings where many people are inside or valuable belongings. Fire detection systems are important to avoid the loss of personal items caused by both man-made and induced fire. The fire detection system is essential to alert people in time before fire engulfs the building. They help in the early detection and early warning of fire so that we can extinguish the fire quickly and avoid great disaster and property loss. However, FDS, requires a lot of wiring and labor to install. Hence, we have planned to make an IoT-based wireless fire detection system that is very easy to use.

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

1.1 Internet of Things

The Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment. It is non-standard devices that connect wireless to a network with each other and able to transfer the data. It is an advanced automation and analytic system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

The IoT as a whole consists of different modules and devices which include various embedded systems, sensors, processors, and other information-sharing devices to provide efficient communication. These devices work as the backbone for an IoT system in collecting data and analyzing them either by sending them to the cloud or analyzing them logically, depending on the requirement of the end-user. These act according to the functions or the operations that are given to them in the setup. As said earlier, the main advantage of using an IoT system is to operate without people's intervention. However,the entire preliminary setup is to be done by people interacting with the devices. A light bulb that can be switched on using a smartphone app is an IoT device, as is a motion sensor or a smart thermostat in your office or a connected streetlight. An IoT device could be as fluffy as a child's toy or as serious as a driver less truck.

IoT devices are used in our day-to-day life to monitor and control the electrical, electronic, and mechanical systems used in homes, commercial places, industries, and buildings. IoT stands for "Internet of Things" which means connecting the physical things or objects to the digital world by using various sensors and software connected to a central hub that measures the boundary of the real world as they change time-tot-time and can make a database of the readings or values gathered. When the data gets to the cloud, software processes the data, and then it decides to act, such as sending an alert message without the help of a human. The Internet of Things inter-connect and inter-relate objects, devices, and people through the wireless network. When the data gets to the cloud, software processes the data, and then it decides to act, such as sending an alert message without the help of a human.

It has become important factor nowadays to bring the technology into our home and office. By making the place smart, the day-to-day activities are becoming more and easier. The development of home automation has become mandatory in homes as people are moving towards to the smart home concepts. With the help of assistant systems like ‘Okay Google’, ‘Alexa’ and ‘IRI”, the normal routine activities like turning ON the light can be implemented with just a single voice command. With these comforts flowing into a person’s life, it has become essential to protect it from damages and accidents. This is where ‘Internet of things (IoT)’ comes into picture. As only the regular works has become smart, the things used are still the same like Gas cylinder in homes. According to the reports, over 1500 LPG accidents happen in India every day. This is equivalent to the death of 1500 people including the children. Even the neighbourhood is affected in a single accident. So there comes the need to bring in technology to prevent accidents. IoT is a fast-growing technology in industries. IoT is basis for Industry 4.0 development.

1.2 Objective

This robot can be used to monitor the industrial environment using sensors that perform particular tasks. If any abnormal values are measured by the sensors, the robot sends an alert to the Telegram bot and saves the values in IoT. Based on values measured in IoT, particular measures will be taken by the user to avoid accidents. One of the best solutions to avoid industrial accidents and saves lives of workers and equipment. As technology develops, we may anticipate seeing more innovations that improve industrial processes and make businesses run more efficiently. The objectives of the industrial automation robot are to:

- improve safety
- enhance efficiency
- improve quality
- provide real-time monitoring
- offer adaptability
- remove metal debris
- avoids accidents

These objectives work together to create a versatile and effective solution for industrial automation.

Significant Features of Industrial Oriented Automation Robot:

- Fire detection by Fire Sensor
- Gas detection by Gas Sensor
- Light detection by LDR Sensor
- Metal detection by Metal Sensor
- Obstacle Detection by Ultrasonic Sensor
- Collection of metal particle by Magnet Sensor

- Fire/Flame sensor infrared receiver module ignition source detection module is Arduino compatible and can be used to detect flame or wavelength of the light source.
- Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gases. They are commonly used to detect toxic or explosive gases.
- A metal detector is an instrument that detects the nearby presence of metal. Metal detectors are useful for finding metal objects on the surface.
- As the metal sensor identifies the presence of metal particles, the magnet positioned next to it can be helpful to collect the metal particles.
- When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it. The sensitivity of the circuit can be adjusted by varying the present. When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it.
- An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. This sensor has a ceramic transducer that vibrates when electrical energy is applied to it.
- Based on ultrasonic signal robot moves in right and left direction. When object detect in right side, then robot moves left direction and vice-versa with the help of DC motor. DC motors work well in robotics because they allow the robot to be battery powered, which offers great advantages for a variety of robotic applications, particularly mobile and collaborative robots.

1.3 Problem Definition

Many accidents have been caused by human error in the past few years in various industrial fields. Due to this accidents there has been so much property damage and many people have lost their lives. Though it is in the nature of human beings to make an error, we cannot take a risk and let these little errors take power and turn hazardous to either other living beings are the environment. The existing system uses RF communication. RF based technology is used to operate the robot which requires human intervention and involves manual control. It works with in the range of the radio frequency and has limitation in control. Due to manual operation it has limited operations of control. The proposed system it is an automated without any radio frequency control. In case of any abnormalities in the sensors, One of the key features of this robot is its connectivity to a Telegram bot. The robot sends alerts to the bot if any abnormal values are detected by its sensors.Based on values measured in IoT, particular measures will be taken by the user to avoid accidents.one of the best solutions to avoid industrial accidents and saves lives of workers and equipment's. This real-time monitoring allows for quick and efficient responses to potential hazards. This helps in preventing major accidents as this situation is much more common then we notice and hence, it is very important to counter this problem.

The industrial automation robot is a cutting edge tool that is revolutionizing industrial safety and efficiency. It features advanced sensors such as an LDR, three ultra-sonic sensors, a fire sensor, a gas sensor and a metal sensor. The robot can pick up tiny metal pieces on the floor with a magnet, making it an asset in facilities that handle metal parts. One of the key features of this robot is its connectivity to a Telegram bot. The robot sends alerts to the bot if any abnormal values are detected by its sensors. This real-time monitoring allows for quick and efficient responses to potential hazards. The LDR allows for adaptation to changing light conditions, and the ultra sonic sensors provide 360-degree coverage around the robot, enabling obstacle detection and collision avoidance. The fire sensor and gas sensor ensure a safe working environment by detecting potential hazards, while the metal sensor and magnet make it easy to remove metal debris from the floor. Overall, the industrial automation robot offers unparalleled safety, making it a must-have in any industrial setting.

2. Literature Survey

IOT Based Fire Detection System paper acknowledged that When the monitored temperature increases above 40 degrees Celsius, it is considered a fire situation. There are many types of sensors for fire detection such as heat sensors and smoke sensors; Heat sensors are classic options when the temperature reaches a particular level. Heat sensors have a low false alarm rate, but it is slow in response because the temperature rises slowly in case of fire. Smoke alarms will detect fires before it really starts because in the initial stage of fire smoke will be in large quantity than heat. Also, we cannot place smoke sensors in frozen areas. If one sensor fails to detect fire in the above condition another will detect the fire. Therefore, we have used both sensors for accurate results. For monitoring of room temperature, we have used ThingSpeak cloud. Bluetooth is used to communicate between the FDS and mobile phone application . When user turn on the Bluetooth we need to turn on the battery of FDS. After Bluetooth is turned on, we need to connect android app to FDS by clicking on the connect button in the app. When it shows connected in the app, click on the start button and user can move the robot manually with the help of forward, reverse, left, right buttons.

Structure of the System The FDS uses various sensors to detect security risks. The sensors are Smoke sensor (MQ02) Ultrasonic Sensor (HR04) Temperature and Humidity sensor(DHT11). All these sensors are directly connected to microcontroller (Arduino UNO) based on the Microchip ATmega328P which is used as the main controller. And another Smoke sensor (MQ02),Temperature and Humidity sensor(DHT11) is connected to the NodeMCU (based on the ESP-12 module) which is used to send the data on Cloud. So this system provide safety for human while patrolling, and also it is userfriendly to use. This makes security surveillance more effective by providing Buzzer on the hardware setup and also provide immediate alert by sending SMS when any gas leakage, fire, smoke is detected. In additional in our system NodeMCU is also connected which send continuous data on cloud in every 15 seconds for continuous track of the sensor values. In microcontroller Ultrasonic sensor is connected for proper movement of system. Moving on to the structure of the FDS, the microcontroller, Sensors, NodeMCU are placed on wooden block and covering is made using plastic material which is durable and strong enough which can sustain hits to some extent. FDS has the size of 31.5 cm x 24 cm x 28 cm and with plastic covering.The placement of four wheels at four sides enables system to run without slip [4].

India stated that The ultimate aim of the project is to make a finished product of Gas leakage detection system for Household. With the advancement of internet in homes, the safety can be further increased with introduction of Internet of things. The product consists of outer wooden casing in shape of a box to carry the Arduino controller, solenoid, MQ4 sensor, ESP Wi-Fi module and a Buzzer. The mouth of the sensor is placed right above the mouth of cylinder and the pipeline. A solenoid is placed such a way that whenever there is signal, it will close the pipe to stop the flow of gas. Arduino acts as brain of control. ESP module is used as the Wi-Fi module to connect Arduino with IoT. The Arduino signal is interfaced with IoT software called Thingspeak. The purpose of this software is to activate the online alert messages to the user. The working of Thingspeak is to create a flow chart the signals sent by Arduino and send alert messages as Twitter messages to user's account via an App developed by Thingspeak called "Thingtweet". In this way, many users including the neighborhood can be interfaced so that when there is problem everyone in surrounding gets to know and can act immediately. Apart from this, a 12V buzzer is connected with Arduino to indicate the user offline. The buzzer is set to a time limit. The product is cost efficient and can also be implemented in hotels.

Var01 indicates the amount of gas detected by the MQ5 sensor. The limit has been set to 300, so whenever the signal crosses 300, the input is sent to Arduino through which control goes to Solenoid valve and Buzzer. Simultaneously, the twitter alert message is sent to user's twitter account. This process happens very quickly and can prevent further leakage of gas. The twitter accounts of the neighbor can also be interfaced to indicate them in case of emergency This system provides a control action during gas leakage by closing the solenoid valve. And it activates the alarm and also sends alert messages to the users within a short time. It is an economical system which can be installed in apartments, hotels and wherever it is needed. The cost of the proposed system is lesser than the commercially available detectors in the market. It can help us to prevent from accidents in all directions. There are some products available which are similar to this gas leakage detector but those are not cost efficient and doesn't have any safety mechanisms. If this product becomes commercial, it will overcome all demerits of other similar products [5].

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

The author presents an advanced solution and a new direct approach for remote sensing GPS, RF Arduino based on the concept of metal detectors. Conventionally, Wirelesscontrolled robot's circuits, which have the drawbacks of limited working range, limited RF frequency range and the limited control. Use of use GPS Arduino Microcontroller and RF robotic control can overcome these limitations. It provides the advantage of robust control, working range as large as the coverage area of the service provider, no interference with other controllers . Metal detectors are used to search for metals underground Usually metal detectors give some indication of the distance; As the metal approaches, the tone in the earpiece rises or the needle moves further. The metal detector produces a magnetic field when it is above a metal object, marking the circuit in which that object is located. In this paper, we rely on the establishment of an electronic metal detection system that can be used in several fields such as mineral exploration, building security and search for lost items. These devices often consist of a portable unit with a sensor that can penetrate the ground or other objects. If the sensor is connected to a piece of metal, it will emit a signal.The proposed system and the all components of the of the metal detection system controlled with the Arduino microcontroller, the ultrasonic sensor for the metal detector and the GPS module equipped with the prototype of the vehicle and the use of a receiver and an RF transmitter to transmit and receive signals from the vehicle system to the system operators Which can be a long distance from it and the GPS module to send the car center to the operator when the system detects metal signals from the sensor equipped to the system and send information data to the users as well as protect the person from the risks [3].

The project is implemented with ESP32-DEV module by interconnecting DC motor and distinctive sensors like temperature, smoke, flame sensor is interfaced to cloud by enabling inbuilt Wi-Fi module of ESP32, the system is connected to the cloud as well as android mobile loaded with Blynk application tool kit. The sensor parameter variation is uploaded to the cloud. Through the Cloud all sensors in the industrial applications are monitored easily and efficiently. In this application is Cayenne project builder is used as cloud and user mobile is connected using Blynk, which is android application tool kit. Blynk can be accessed through mobile or Laptop and also used as the cloud. If the sensor parameters limit exceeds than specified limit motor or load which is connected to the load automatically triggered and informed through SMS or electronic mail to the registered users such application very uses full for small scale industry. In this system, industrial processes like energy meter monitoring, DC speed control, Temperature, Humidity, Gas levels and Fire accidents if any are monitored through android mobiles, and parameters data can be updated periodically by using cloud.

All the components are placed and assembled accordingly. By using the cayenne cloud application, the hardware components are interfaced with cloud. By using proposed system, the changes in the industrial parameters are monitored and controlled using mobile application as well as PC application. Using the triggers in the cloud we primarily set some threshold values to every sensor, when the sensors detect the values greater than the threshold values, alarming devices will alert us by sending email or SMS to mobile devices. Thereby we turn on the Relay switch by mobile or PC application to turn on the cooling fans. The main advantage of this concept is that we can monitor the changes in the industry from anywhere and can operate them easily without requirement of human beings. Proposed module connected to the cloud through in-built Wi-Fi module of ESP32 distinct parameters of the sensors are computed to the cloud, updated values are monitored through smartphone using Blynk application toolkit (BLYNK APP), processed values exceeds the specified limit automatic SMS or electronic mail send to the registered users by the cloud.Proposed module implemented with DC motor and distinct sensors by connecting to the ESP32Dev at different conditions and displayed and stored in the cloud, monitored and controlled by the industrialist even from remote areas. For example, if industry caught with any fire accident based on the updating values of the sensors (smoke, temperature values exceeds specified limit), machinery or production automatically stopped from the remote area by the responsible person of the industry [6].

The ultimate goal of the project is to design and construct a robot to move into different locations and receive the details of that area with the help of inbuilt sensors on it.A robot is designed and constructed here to move into different locations and receive the details of that area with the help of inbuilt sensors on it. The sensors on it can detect gas like CO, LPG, smoke. The robot also detects the fire. The robot acts according to the command given by the program. It will move in all the direction like forward, reverse, right and left. The Robot will send the real time streaming, which could be seen at monitor or mobile through wireless connection of Wi-Fi module i. e one can control the robot with the help of mobile or laptop through Internet of Things (IoT). We are well aware that every hardware system has a main component which is used to control the system by giving a set of instructions. we have two main components in our system which are Nodemcu Esp8266 microcontroller and Esp32-Cam. Here, the Esp32-Cam is used for surveillance purpose as well as for controlling the L298N Motor Driver module. The L298N Motor driver is used to control DC motor for both speed and rotating directions. The PWM technique is used to vary input voltage in order to control the speed of the motor while the H-Bridge circuit is used for controlling the rotation direction of the motor. NODEMCU Esp8266 microcontroller is used to control the sensors like MQ2 Gas Sensor and Flame Sensor mounted on the robot. MQ2 Gas Sensor is used to detect the presence of gases like LPG, CO and Smoke. The values of the presence of particular gas are found in ppm in the most accurate way possible. The flame sensor is used to detect and respond to the occurrence of a fire or flame.

So, summing up the hardware part of the system we can state that a system is designed in which Esp8266 module is used to control the industrial security related sensors while the Esp32 cam is used for surveillance as well as for controlling the direction of the robot.The two different web applications are designed using HTML for two different controller's output. The application of ESP 8266 has the values of LPG, CO, Smoke which are taken from by processing the analog data of MQ2 Sensor while the message for presence of fire or flame is given by reading the digital data of flame sensor. The MQ2 Sensor analog output is processed using C programming in Arduino IDE in which some complex mathematical equations are performed on the logarithmic graph. Also, the controls of the motor like forward, backward, left and right are present on the web application This was the detailed information stated this in paper [2].

The project's first objective was design a robotic vehicle using 14 pins microcontroller (PIC16F676) that input and output pins used accurately. The working components such as ultrasonic sensor, LDR, DC motors, transistor, and other devices are connected with the microcontroller. There is a program in the microcontroller and which direction must help to detect light and obstacle of the robotic vehicle.Our project's second objective was to develop the light- and obstaclesensing capability of the robotic vehicle. The vehicle LDR sensor can detect to any type of light beam; to fulfill to our project objective, when a light beam falls on an LDR sensor then the vehicle will stop and the light-sensing capacity is high. We also used an ultrasonic sensor, which can sense any type of obstacle. When an obstacle is found to be in front of the robotic vehicle then it will stop travelling, else the robotic vehicle always goes forward.In what follows, we review works related to the current study of the ultrasonic sensor and photosensor-detecting light and obstacle robotic vehicle system technology. We reviewed different obstacle-detecting robot mechanisms that have been built. These robots can be divided into two categories: either mobile or fixed robots. The purpose of this chapter is to briefy describe mobile robots that are used in difficult or dangerous environments.

Sensory input is provided by (in order of priority) front bumper switches, IR collision avoidance, stereo sonar ranging, photodetectors, passive IR motion detection, and shaft-encoder odometry.The work presents a prototype design and construction of a light-detecting and obstacle-sensing robot. We showed how to build the overall circuit and programmed the PIC we chose to test the robotic vehicle. Based on the distance between the sensors and the surface of obstacles, the robotic vehicle (as the vehicle we were working on had different polarity stuff) will stop if it detects the obstacles or else seamlessly move forward. Our preliminary feasibility of building this multi-sensor based robotic vehicle shows promise, and we are currently extending this to be an Internet of Things (IoT) enabled device. The results of the work utilized the following sensors:

1. Two ultrasonic range fnders mounted on the vehicle to detect obstacles and provide information to detour around the obstacle.
2. Light sources attached to a position in the room and a rotating lightdetecting sensor located on the vehicle to update the absolute position [7].

Smart home devices are one of the most popular and well-known of all contemporary technological advancements. After all, who doesn't want to be able to operate their home appliances from their smartphones with just a few taps? People are becoming increasingly familiar with the usage of smartphones and tablets, which can perform much of the work that a computer can. As a result, we've chosen to create a low-cost Embedded system that uses smart phones to help automate the entire home. The field of automation has advanced significantly in industry, with automated assembly lines found in the majority of vehicle and bottling factories. Everyday life would be made easier if automation were implemented in homes. It can keep track of what's going on inside and outside our home with a home automation system. These security cameras also capture footage of suspicious passers by on your property. Smart door locks also enable us to unlock the door remotely for children, the elderly, or visitors when we are not at home. It will receive real-time alerts on who is entering your home via your Smartphone, even if you are not present.

The planned home automation system's design is shown in the diagram below. Different sensors, such as smoke and flame and actuators such as buzzers and displays, make up the system. The microcontroller, or main controlling unit, of the Node MCU unit is the system's main controlling unit. The user sets commands for the appliances' operation using the mobile app. Following the signal, the Node MCU uses a relay to switch on or off the appliance. Physical connections are made between the Node MCU, relay, and final appliances. The microprocessor, relay, and final appliances are all powered by a single power supply unit. The state of the application is also displayed on a display unit [1].

3. SYSTEM ANALYSIS & DESIGN

3.1 Architecture Design

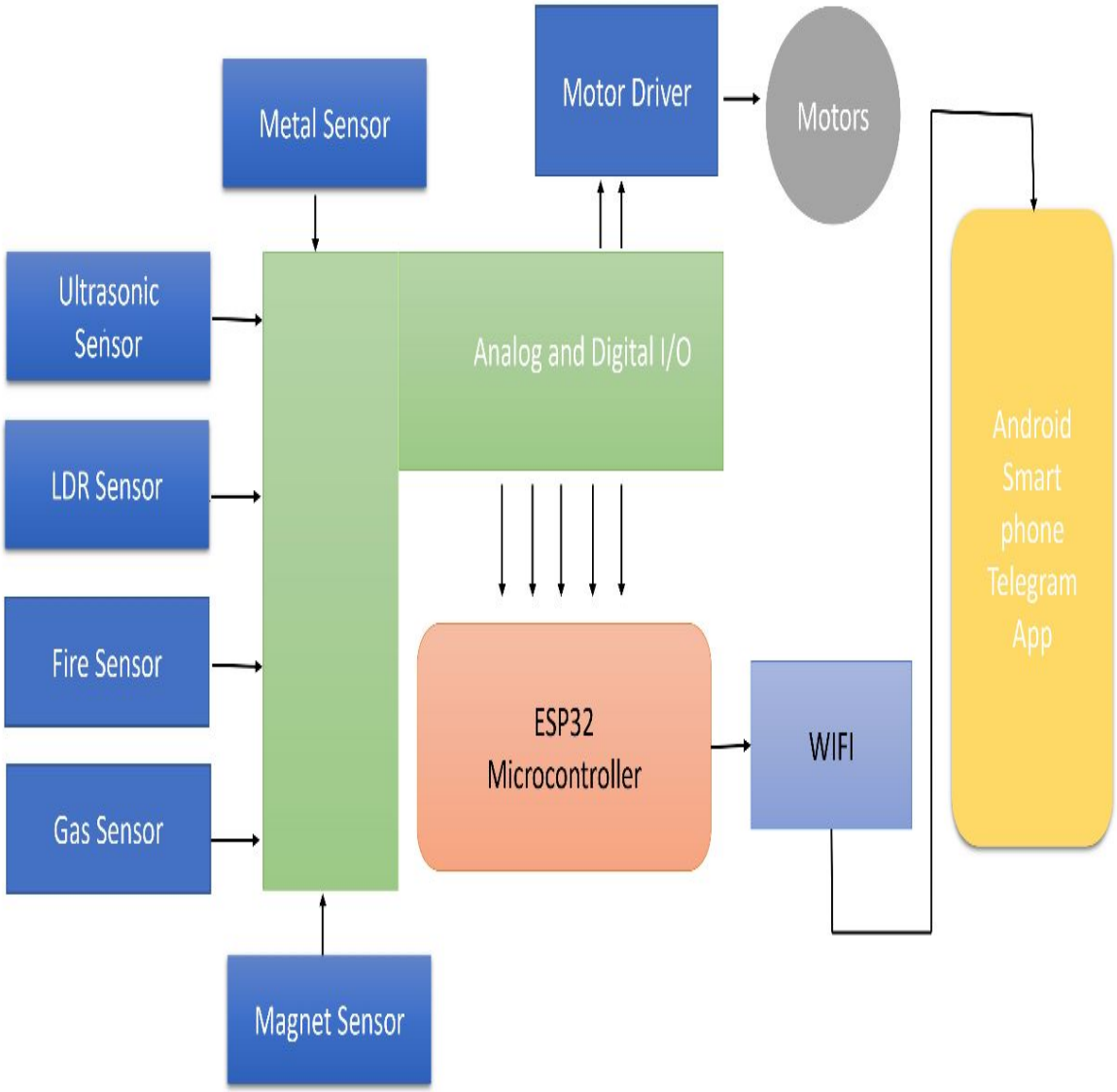

Figure 3.1: Block Diagram of Industry Oriented Automation Robot

3.2 Components Required

3.2.1 Ultrasonic Sensor

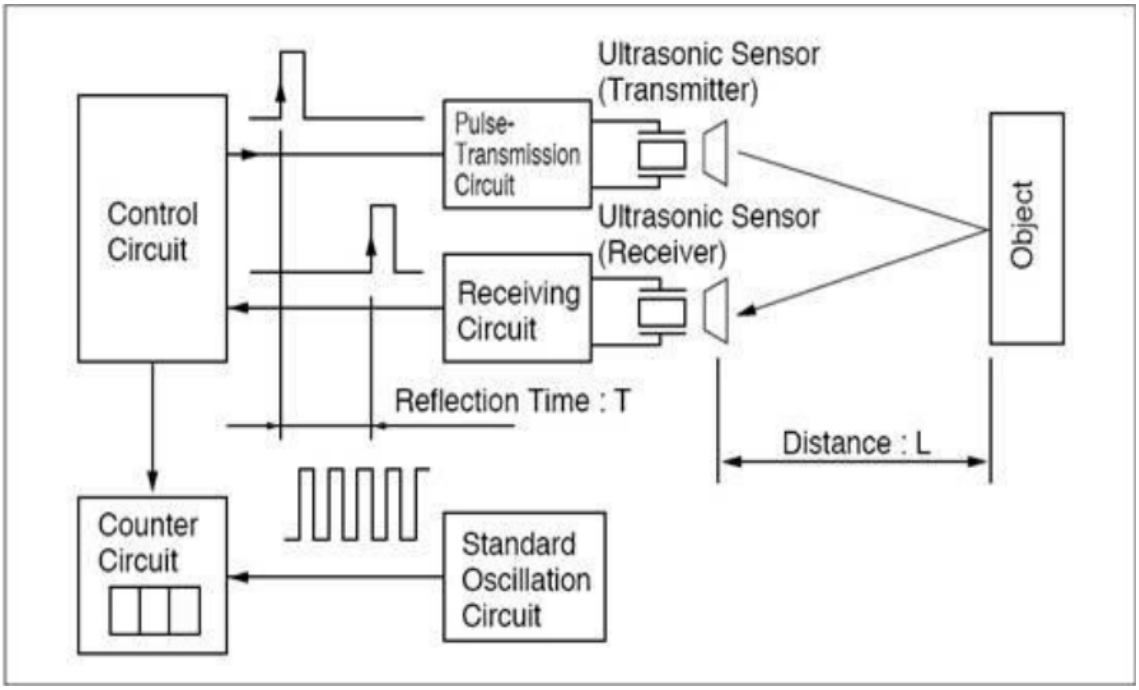

Figure 3.2.1: Ultrasonic Sensor

Ultrasonic sensors are industrial control devices that use sound waves above 20,000 Hz, beyond the range of human hearing, to measure and calculate distance from the sensor to a specified target object. It is an electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound.An electrical charge is given to the ceramic transducer of this sensor, which causes it to vibrate. As waves travel from the sensor face to a target item, vibrations compress and expand air molecules. In a transducer, sound is both transmitted and received. By first generating a sound wave, the ultrasonic sensor determines the distance by "listening"for a predetermined amount of time to capture the sound wave's return echo after hitting the target. Its range is between 2 and 500 cm, and its resolution is 0.3 cm. Less than 2mA of standby current is required for it to run from a 5V DC supply. The component sends out an ultrasonic signal, detects its echo, calculates the time difference between the two events, and outputs a waveform.

Features :

- Devices with TEACH-IN functionality for fast and simple installation
- ULTRA 3000 software for improved adaptation of sensors to applications
- Adjustable sensitivity to the sound beam width for optimized adjustment of the sensor characteristics according to the application
- Temperature compensation - compensates for sound velocity due to varying air temperatures
- Synchronization input to prevent cross-talk interference when sensors are mounted within close proximity of each other
- Sensors with digital and analog outputs

Working:

The sensor has a ceramic transducer that vibrates when electrical energy is applied to it. The vibrations compress and expand air molecules in waves from the sensor face to a target object. A transducer both transmits and receives sound. The ultrasonic sensor will measure distance by emitting a sound wave and then ”listening”for a set period of time, allowing for the return echo of the sound wave bouncing off the target, before retransmitting. Microcontroller and the ultrasonic transducer module HC-SR04 forms the basis of this circuit. The ultrasonic module sends a signal to the object, then picks up its echo and outputs a wave form whose time period is proportional to the distance. The Microcontroller accepts this signal, performs necessary processing and displays the corresponding distance on the 3 digit seven segment display. This circuit finds a lot of application in projects like automotive parking sensors, obstacle warning systems, terrain monitoring robots, industrial distance measurements etc.

The HR-SR04 has four pins namely Vcc, Trigger, Echo, GND and they are explained in detail below.

1. **VCC :** 5V DC supply voltage is connected to this pin.
2. **Trigger :** The trigger signal for starting the transmission is given to this pin. The trigger signal must be a pulse with 10uS high time. When the module receives a valid trigger signal it issues 8 pulses of 40KHz ultrasonic sound from the transmitter. The echo of this sound is picked by the receiver.

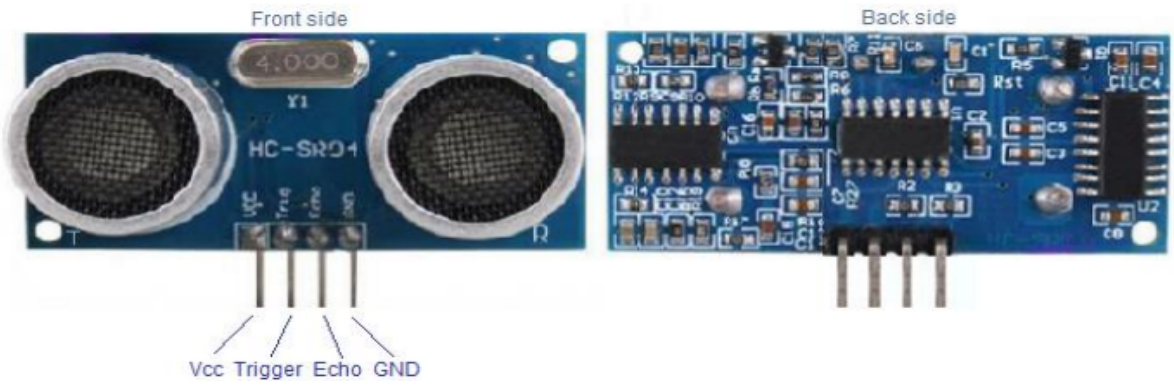

Figure 3.2.2: Pin Description and View of Ultrasonic Sensor

3. **Echo :** At this pin, the module outputs a waveform with high time proportional to the distance.
4. **GND :** Ground is connected to this pin

3.2.2. Light Dependent Resistor (LDR)

Light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity or vice versa. As the name suggests, LDR is a type of resistor whose working depends upon only on the light falling on it. The resistor behaves as per amount of light and its output directly varies with it. In general, LDR resistance is minimum (ideally zero) when it receives maximum amount of light and goes to maximum (ideally infinite) when there is no light falling on it.An LDR (Light Dependent Resistor) sensor is a type of sensor that measures the intensity of light in its environment. It is a passive component that changes its resistance based on the amount of light it detects.

An LDR sensor consists of a semiconductor material that has a high resistance when there is little or no light present, and a low resistance when exposed to bright light. When light falls on the LDR, the number of electrons in the semiconductor material increases, which lowers the resistance of the sensor.

LDR sensors are commonly used in a wide range of applications, such as streetlights, security systems, and camera exposure controls. They are also used in industrial automation and robotics projects for applications such as light sensing, color sensing, and object detection.

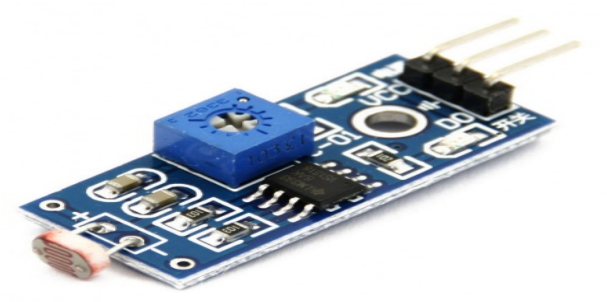

Figure 3.2.3: LDR Sensor

One of the key advantages of LDR sensors is their low cost and simplicity, making them a popular choice for applications where cost and simplicity are important factors. However, they do have some limitations, such as slow response times and sensitivity to temperature changes, which can affect their accuracy and reliability.

The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. The sensitivity of the signal detection can be adjusted using a potentiometer.

LDR Specifications

- Resistance : 400ohm to 400Kohm
- Sensitivity: about 3msec
- Voltage ratings: I used it on 3V,5V and 12V

Light Dependent Resistor Symbol

The circuit symbol used for the light dependent resistor or photo-resistor combines its resistor action while indicating that it is sensitive to light. The basic light dependent resistor symbol has the rectangle used to indicate its resistor action, and then has two incoming arrows the same as those used for photodiodes and phototransistors to indicate its light sensitivity.

3.2.3. Fire Sensor

Fire/Flame sensor infrared receiver module ignition source detection module is Arduino compatible can use to detect flame or wavelength of the light source within 760nm 1100nm also useful for Lighter flame detect at the distance 80cm.

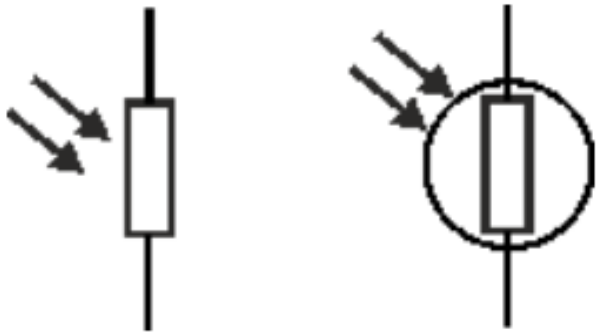

Figure 3.2.4: Light Dependent Resistor Symbol Used In Circuit Diagrams

A fire sensor is a type of device that is used to detect the presence of fire or smoke in a given area. Fire sensors are designed to provide an early warning of a potential fire, giving people in the area enough time to evacuate and for firefighters to respond. a fire alarm system, which can alert people in the area to the presence of a fire and trigger the activation of fire suppression systems such as sprinklers.

Figure 3.2.5: fire sensor

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1-2 meters. The device, weighing about 5 grams, can be easily mounted on the device body. It gives a

high output on detecting fire. This output can then be used to take the requisite action. An on-board LED is also provided for visual indication.

Features :

- Typical Maximum Range :2 m .
- Indicator LED with 3 pin easy interface connector.
- Operating Voltage 5v

An automatic fire sensor sense the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alert system is classified as either automatically actuated, manually actuated, or both. Fire sensor are intended to notify the fire in the building occupants to evacuate in the event of a fire or other emergency, report the event to an off-premises location in order to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.

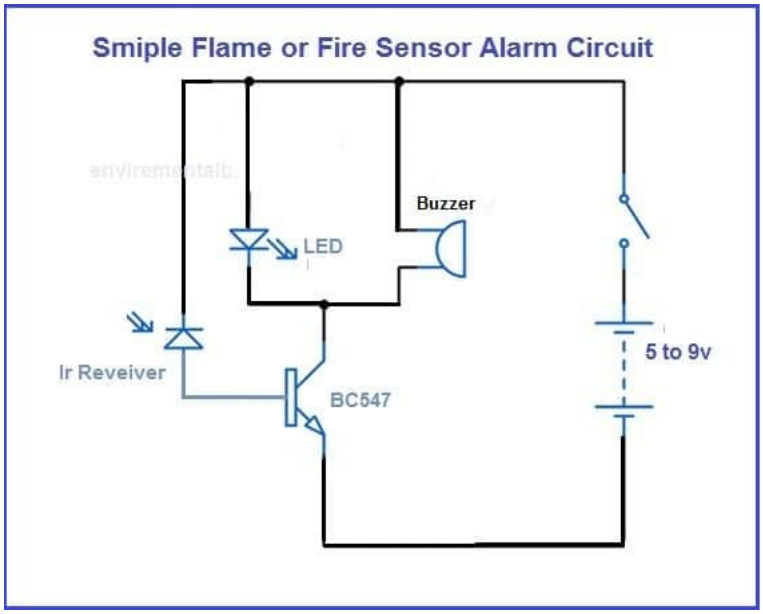

Figure 3.2.6: fire sensor circuit

3.2.4. Gas Sensor

MQ135 Gas Sensor module for Air Quality having Digital as well as Analog output. Sensitive material of MQ135 gas sensor is SnO2, which with lower conductivity in clean air. When the target

combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. MQ135 gas sensor has high sensitivity to Ammonia, Sulphide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and suitable for different application. A gas sensor, also known as a gas detector, is a device that is used to detect the presence of various gases in the air or a specific environment. Gas sensors are widely used in industrial, commercial, and residential settings for safety, environmental monitoring, and process control purposes. Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight coversa methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current.

Figure 3.2.7: Gas Sensor

Gas sensors are devices that can detect the presence and concentration of various hazardous gases and vapors, such as toxic or explosive gases, volatile organic compounds (VOCs), humidity, and odors. Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gases. They are frequently used to detect dangerous or explosive gases. The MQ135 Gas Sensor Module for Air Quality includes both digital and analogue output. The MQ135 gas sensor uses SnO2, which has a reduced conductivity in clean air. When the target flammable gas is present, the sensor conductivity rises along with the gas concentration. The MQ135 gas sensor has a high sensitivity to ammonia, sulphur dioxide, and benzene steam; it is also sensitive to smoke and other hazardous gases. It is inexpensive and versatile.The ability of a Gas sensor to detect gases depends

on the chemiresister to conduct current. The most commonly used chemiresistor is Tin Dioxide (SnO2) which is an n-type semiconductor that has free electrons (also called as donor). Normally the atmosphere will contain more oxygen than combustible gases. The oxygen particles attract the free electrons present in SnO2 which pushes them to the surface of the SnO2. As there are no free electrons available output current will be zero. The below gif shown the oxygen molecules (blue color) attracting the free electrons (black color) inside the SnO2 and preventing it from having free electrons to conduct current. **Features :**

- High sensitivity to LPG, natural gas , town gas .
- Small sensitivity to alcohol, smoke.
- Fast response .
- Stable and long life.
- Simple drive circuit.

3.2.5. Metal Sensor

NPN Inductive Proximity Sensor to detect metal or any metal objects, this device also can be

Figure 3.2.8: Metal Sensor

used as a metal detector screening when people walking through the entrance to find metal objects.

Detecting Distance: 4mm

Supply Voltage: DC6-36V

Current Output: 300 mA

Response Frequency: 100Hz

Detect Object: Metal

Column Sensor Dia.12mm

Metal sensors, also known as metal detectors or metal sensors, are devices that are used to detect the presence of metallic objects or substances in a given environment. Metal sensors are widely used in various industries, security settings, and consumer applications for a variety of purposes, including security screening, quality control, and material inspection. Whenever some current passes through the coil, it generates a magnetic field around it. And the change in the magnetic field generates an electric field. Now according to Faraday's law, because of this Electric field, a voltage develops across the coil which opposes the change in magnetic field and that's how Coil develops the Inductance, means the generated voltage opposes the increase in the current. The unit of Inductance is Henry and formula to measure the Inductance is:

L = (* N2 * A) / l

Where,

L- Inductance in Henries

- Permeability, its 4*10-7 for Air

N- Number of turns

A- Inner Core Area (r2) in m2

l- Length of the Coil in meters

When any metal comes near to the coil then coil changes its inductance. This change in inductance depends upon the metal type. Its decreases for non-magnetic metal and increases for ferromagnetic materials like iron. Depending on the core of the coil, inductance value changes drastically. In the figure below you can see the air-cored inductors, in these inductors, there will be no solid core. They are basically coils left in the air. The medium of flow of magnetic field generated by the inductor is nothing or air. These inductors have inductances of very less value. These inductors are used when the need for values of few microHenry. For values greater than few milliHenry.

3.2.6. Battery

A battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Batteries are another way to produce electricity. They are smaller and

safer. Batteries have one end that is positive and one end that is negative. For batteries to work, you need to make sure you put them in the right way. Batteries have become a common power source for many household and industrial applications. There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes, from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.

Figure 3.2.9: Battery

A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cation (positively charged ions) migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, cations are reduced at the cathode, while anions are oxidized at the anode. The electrodes do not touch each other but are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes. A separator between half-cells allows ions to flow, but prevents mixing of the electrolytes. For example, for telegraph circuits, were restored to operation by replacing the components of the battery consumed by the chemical reaction. 33 Secondary batteries are not indefinitely rechargeable due to dissipation of the active materials, loss of electrolyte and internal corrosion.

Batteries are classified into two broad categories, each type with advantages and disadvantages.

- Primary batteries irreversibly (within limits of practicality) transform chemical energy to electrical energy. When the initial supply of reactants is exhausted, energy cannot be readily restored to the battery by electrical means.
- Secondary batteries can be recharged; that is, they can have their chemical reactions reversed by supplying electrical energy to the cell, restoring their original composition.

3.2.7. DC Motor

Figure 3.2.10: DC Motor

A DC motor in simple words is a device that converts direct current(electrical energy) into mechanical energy. It's of vital importance for the industry today. A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homo-polar motor, and the ball bearing motor, which is a novelty. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.

A DC motor (Direct Current motor) is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly

to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction.The DC motor or Direct Current Motor to give it its full title, is the most commonly used actuator for producing continuous movement and whose speed of rotation can easily be controlled, making them ideal for use in applications were speed control, servo type control, and/or positioning is required. A DC motor consists of two parts, a ”Stator”which is the stationary part and a Rotor”which is the rotating part. The result is that there are basically three types of DC Motor available.A DC motor is an electric motor that converts electrical energy into kinetic energy and works only on DC systems the device is composed in its simplest form of two magnetic poles, a north pole and a south pole, separated by a certain distance, in which a coil connected to a battery or any voltage source that generates a current is placed.

Thus, a permanent magnetic field will be generated as a result of the magnetic flux lines passing from the north to the south pole, knowing that the torque is directly proportional to the number of these lines passing through the coil.DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor’s speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. larger DC motors are used in propulsion of electric vehicles, elevator and hoists.

A motor driver is an electronic circuit often used to control motors in robots. Motor driver is interface between Arduino and the motors. The most common used motor driver IC’s are from the L293 series such as L293D, L293NE, etc. ICs was designed to control 2 DC motors simultaneously. L293D consistof two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

3.2.8. ESP32

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor

or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and powermanagement modules. ESP32 is created and developed by Espressif Systems, a Shanghai based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

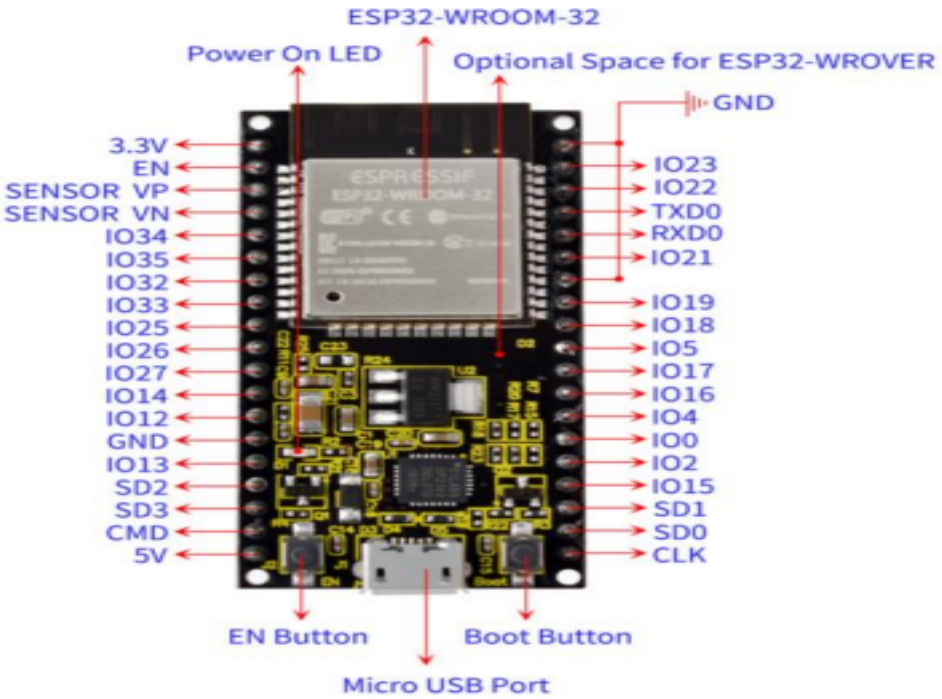

Figure 3.2.11: ESP32

This keye studio ESP32 core board is a Mini development board based on the ESP WROOM-32 module. The board has brought out most I/O ports to pin headers of 2.54mm pitch. These provide an easy way of connecting peripherals according to your own needs. When it comes to developing and debugging with the development board, the both side standard pin headers can make your operation more simple and handy. The ESP-WROOM-32 module is the industry's leading integrated WiFi + Bluetooth solution with less than 10 external components. It integrates antenna switch, RF balun, power amplifiers, low noise amplifiers, filters and power management modules. At the same time, it also integrates with TSMC's low-power 40nm technology, so that power performance and RF performance are safe and reliable, easy to expand to a variety of applications.ESP32 is capable of

functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external circuit imperfections and adapt to changes in external conditions.

ESP32 is highly-integrated with in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 adds priceless functionality and versatility to your applications with minimal Printed Circuit Board (PCB) requirements.Engineered for mobile devices, wearable electronics and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes and dynamic power scaling.ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

3.3 Hardware Description

3.3.1. Power supply

The power supply section is the section which provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

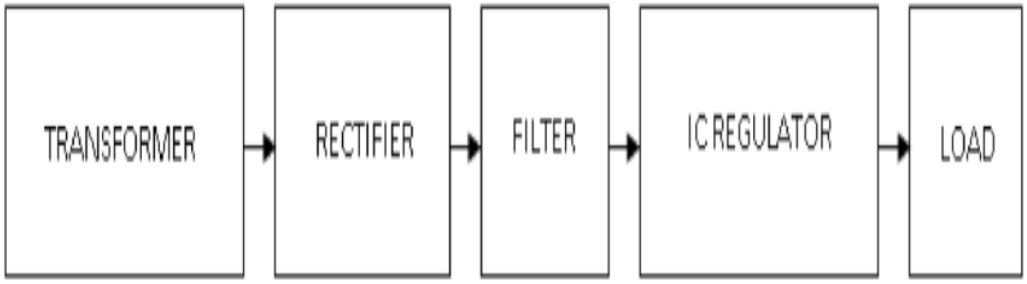

Figure 3.3.1: Block Diagram of Power Supply

3.3.2. Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage.The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic. Field created in the soft-iron core of the transformer. Transformers waste very little power so the power out is equal to the power in. The transformer will step down the power supply voltage 230V to level. Then the secondary of the potential transformer will be connected to the bridge rectifier, which is constructed with the help of PN junction diodes. The advantages of using a bridge rectifier are it will give peak voltage output as DC.

The most crucial equipment of transmission and distribution of electric power is Transformer. Transformer is a device used in the power transmission of electrical energy. Transformer works on the principle of Electromagnetic Induction Mutual Induction. The transmission current is AC. Their function is to increase or decrease the supply voltage without change in the frequency of AC between circuits. Transformers are essentially required in various fields like Power generation grid, Distribution sector, Transmission and electric energy consumption.

Condition monitoring of transformer is the process of acquisition and processing of data related to various parameters, to predict and prevent the failure of a transformer. This can done by observing the deviation of the transformer parameters from their expected values. This will help and guide the utilities to optimally use the transformer and keep the equipment in operation for longer period. The proposed project presents design and implementation of embedded system to measure temperature and different gas detection. This is possible by using on-line measuring system using Internet of Things (IoT) for fault condition alert, with Arduino microcontroller and sensors installed with transformer. Whenever any change occurs in the condition of transformer oil exceeding the permissible range, the sensor detects these changes and there is an alert via push messages. It also detects the faults such as electrical faults, Thermal fault and overheating of oil. This paper includes the description of components, block diagram and the results obtained.

3.3.3. Rectifier

There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full-wave varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC.A rectifier is a device that converts an oscillating two-directional alternating current (AC) into a single-directional direct current (DC). Rectifiers can take a wide variety of physical forms, from vacuum tube diodes and crystal radio receivers to modern silicon-based designs.

The simplest rectifiers, called half-wave rectifiers, work by eliminating one side of the AC, thereby only allowing one direction of current to pass through. Since half of the AC power

input goes unused, half-wave rectifiers produce a very inefficient conversion. A more efficient conversion alternative is a full-wave rectifier, which uses both sides of the AC waveform.Rectifiers are fundamental to how many different devices operate. Because the standard electrical distribution grid uses AC power, any device that runs on DC power will require a rectifier to function correctly. Virtually all modern electronics need the steady, constant power of DC to operate correctly.
Additionally, we use rectifiers to change voltage in DC power systems. Because it is relatively difficult to convert DC voltage directly in some scenarios, the simplest solution may be the following process:
1. Convert DC to AC
2. Change the voltage using a transformer
3. Convert AC back to DC using a rectifier

3.3.4. Bridge Rectifier

A Bridge rectifier is an Alternating Current (AC) to Direct Current (DC) converter that rectifies mains AC input to DC output. Bridge Rectifiers are widely used in power supplies that provide necessary DC voltage for the electronic components or devices. They can be constructed with four or more diodes or any other controlled solid-state switches.Depending on the load current requirements, a proper bridge rectifier is selected. Components' ratings and specifications, breakdown voltage, temperature ranges, transient current rating, forward current rating, mounting requirements, and other considerations are taken into account while selecting a rectifier power supply for an appropriate electronic circuit's application.

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that

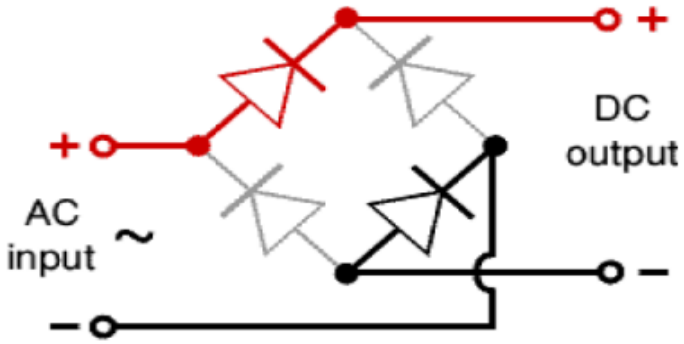

Figure 3.3.2: Bridge Rectifier

of the conventional full-wave circuit. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown below. The result is still a pulsating direct current but with double the frequency.

Smoothing

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

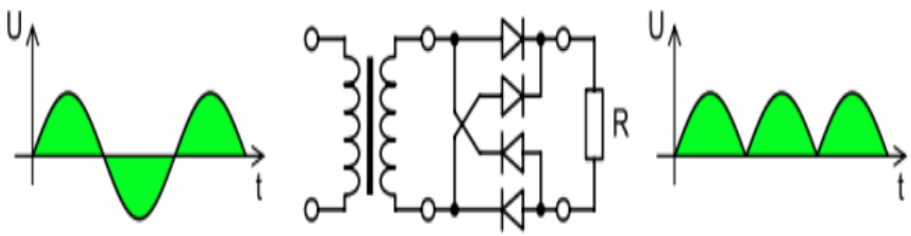

Figure 3.3.3: Output Waveform of DC

3.3.5. Voltage Regulators

Voltage Regulators (VRs) keep the voltages from a power supply within a range that is compatible with the other electrical components. While voltage regulators are most commonly used for DC/DC power conversion, some can perform AC/AC or AC/DC power conversion as well. Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts. A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

Any voltage regulator needs to provide some specific functions. First, the regulator needs to step up or down the voltage between the battery and different sub-circuits in the device. Step-up functionality is required by high-voltage devices like OLEDs, while the step down function helps reduce the power consumed by digital CMOS circuits. This provides longer battery life and enables new features like additional cameras and haptic feedback without a significant impact on battery size.There are two main types of voltage regulators: linear and switching. Both types regulate a system's voltage, but linear regulators operate with low efficiency and switching regulators operate with high efficiency. In high-efficiency switching regulators, most of the input power is transferred to the output without dissipation.

Linear regulators are simple transistor-based devices usually packaged as ICs. Their internal circuitry uses differential amplifiers to control output voltage against a reference voltage. Linear voltage regulators may implement fixed output or have an adjustable control. They typically need input current comparable to the output current.Switching regulators toggle a series device ON/OFF at high frequency, varying the duty cycle of voltage transferred as output. Their common topologies are buck, boost, and buck-boost. Buck converters are more efficient during voltage step down and are still capable of stepping up the output current. Boost converters, like the TPS6125 from Texas Instruments (TI), can step up the output voltage to more than the input voltage.

Positive and negative voltage regulators can be used together to power sensors, op-amps, and other electronic modules that need both voltages.All common microcontroller development boards, like those from Arduino and Raspberry Pi, can be powered using the LM7805 output to the 5 V pin. Arduino boards also have an onboard low-dropout voltage regulator like On Semiconductor's NCP1117S to regulate power input coming from the barrel jack or Vin.Voltage regulators are one of the most important components of an electronic circuit. They are responsible for its safe and consistent functioning.

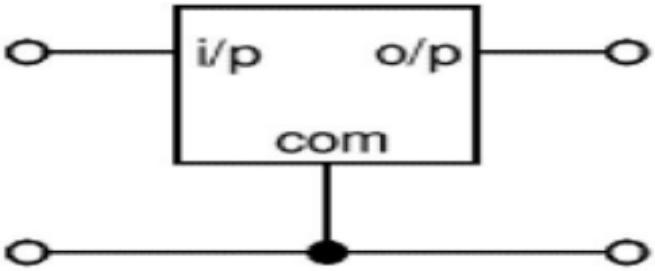

Figure 3.3.4: Regulator

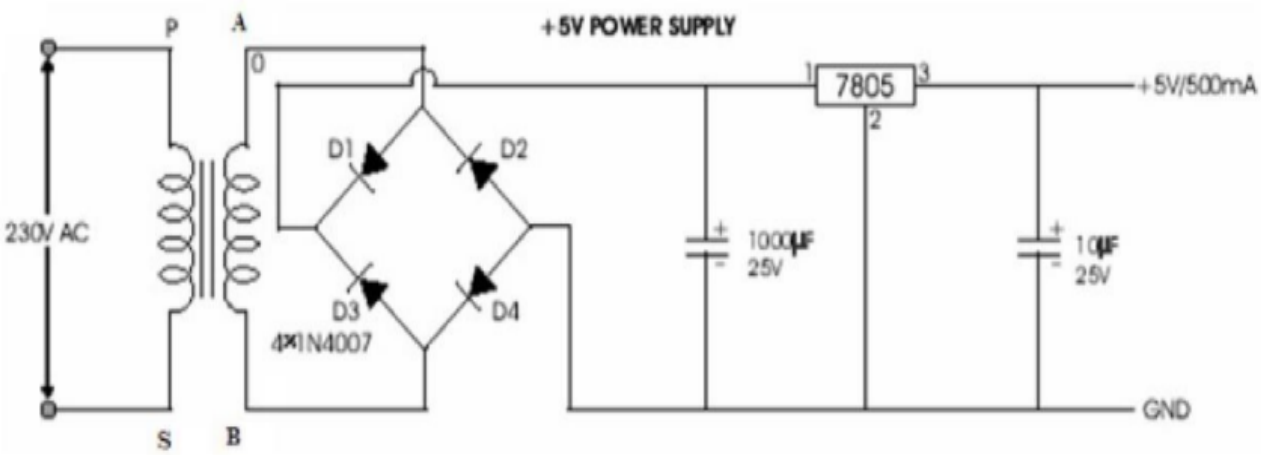

Figure 3.3.5: Circuit Diagram of Power Supply

3.4 Software Description

Telegram Bot

A Telegram Bot is a programme that behaves like a normal chat partner with additional functions. It performs predefined tasks independently and without the user's involvement. The term bot is derived from the term for robot.An important function of a Telegram bot is the possibility to execute commands in a Telegram chat, which then directly trigger actions or request information. For example, it is possible to send the bot the command "/help" or "/help", which then outputs the commands possible for this bot in the chat as text feedback. This could be the following command list:

/status

/temperature

/last alarm

/stop

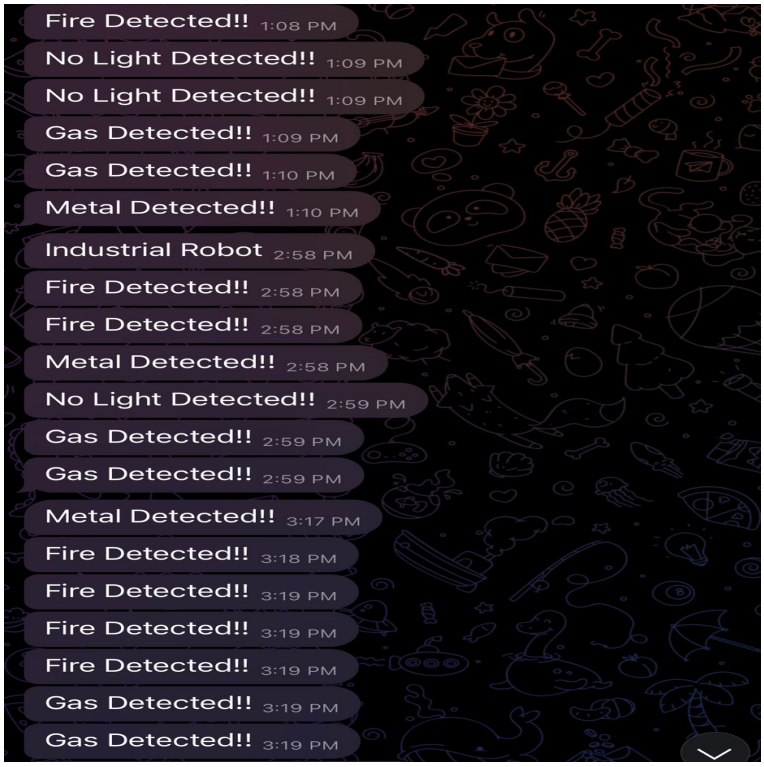

Figure 3.4.1: Telegram Bot

Normal Telegram bots are not private. Anyone can find and use them. However, Telegram bots can also only be made accessible to certain users if a separate communication channel with the bot is set up. This channel is a “private” group with the bot, to which only you, users approved by you and the actual bot belong. In this way, the Telegram Bot can only be used by the user group controlled by you.The Internet of Things (IoT) and this is where a Telegram Bot comes in. It can, in environments defined by you, comfortably inform and react. Telegram can not only enable communication between people, but with a Telegram Bot, it can also enable communication between people and programmable machines.

We can thus forward messages to multiple devices with one click or receive them from you.The actual Telegram bot application with the relevant data is stored on its own computers and databases. Here, the application security depends on the administrator of the local PC environment on site. The Telegram Bot only delivers the message outputs defined in the application to the respective end devices. Only these message outputs are then located in the Telegram Cloud.All messages and thus also the communication with a bot are secured via client-server/server-client encryption. In the Telegram Cloud, this data is also divided among a number of servers and stored there in encrypted form.

If one considers the Telegram Bot in the context of the data source, the actual data usually remains on the local servers of the data source. The bot accesses the required data sets there and then prepares them for message output as requested on the end device.A Telegram Bot can also share production data. As soon as a production order is complete, departments involved can receive a message and initiate the next order from there or inform logistics to start shipping. That helps to avoid downtime and increase overall plant effectiveness. Due to its intelligent communication, the Telegram Bot is a valuable addition, especially in industry.

3.5 UML Diagrams

Activity Diagram

Activity diagram is basically the activity can be described as an operation of the system.The activity diagram helps in envisioning the workflow from one activity to another. It put emphasis on the condition of flow and the order in which it occurs. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. 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.

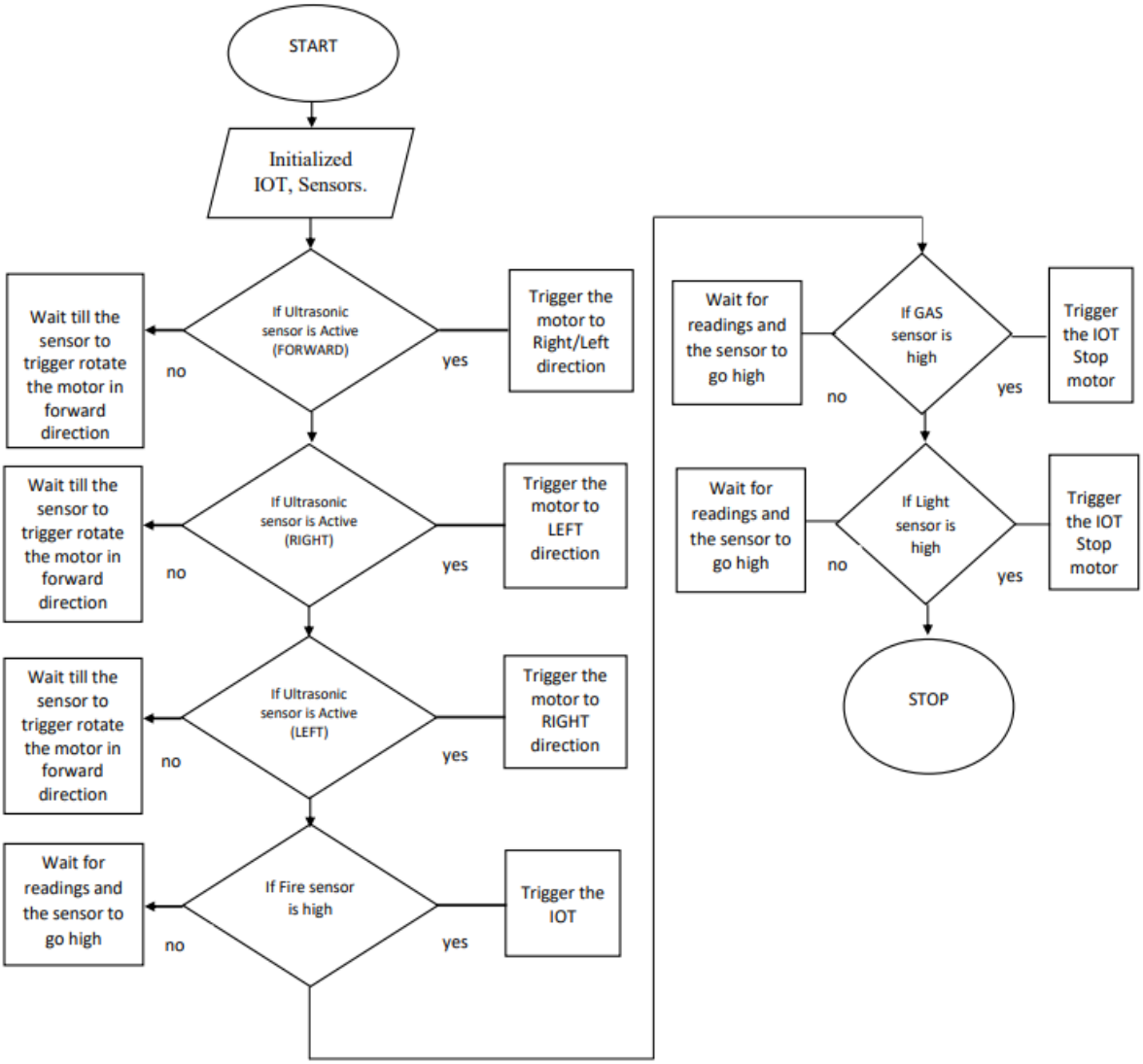

Figure 3.5.1: Activity Diagram

4. MODULES

4.1 Light Detection

In our project, we employ an LDR sensor to measure light intensity. The abbreviation LDR stands for ”light-dependent resistor,”which refers to a resistor whose resistance is light-sensitive. In this instance, the voltage drop is entirely caused by the fluctuating resistance because the LDR’s resistance decreases when the light hits it. Since the LDRhas a high resistance when no light is shining on it, a significant voltage drop occurs across it. By changing the present, it is possible to modify the circuit’s sensitivity. When there is no light falling on the LDR, its resistance increases and practically the full voltage drop occurs across it.we are using LDR sensor for detecting intensity of light. LDR, an acronym for light dependent resistor is a resistor whose resistance is dependent on light. In this when the light falls on LDR, the resistance of LDR becomes low and the entire voltage drop takes place across the variable resistance. When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it. The sensitivity of the circuit can be adjusted by varying the present. When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it. The sensitivity of the circuit can be adjusted by varying the present.

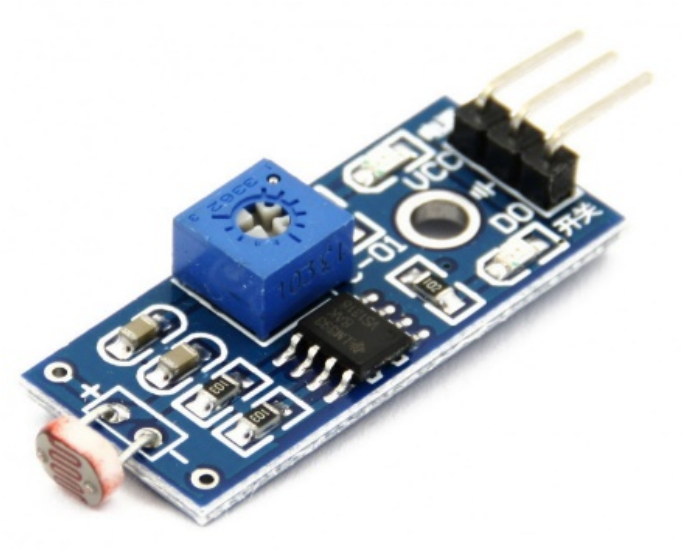

Figure 4.1.1: Light detection by LDR Sensor

4.2 Obstacle Detection

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. This sensor has a ceramic transducer that vibrates when electrical energy is applied to it. The vibrations compress and expand air molecules in waves from the sensor face to a target object. A transducer both transmits and receives sound. The ultrasonic sensor measures distance by emitting a sound wave and then "listening"for a set period of time, allowing for the return echo of the sound wave bouncing off the target, before retransmitting. It has a resolution of 0.3cm and the ranging distance is from 2cm to 500cm. It operates from a 5V DC supply and the standby current is less than 2mA. The module transmits an ultrasonic signal, picks up its echo, measures the time elapsed between the two events and outputs a waveform whose high time is modulated by the measured time which is proportional to the distance.There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). You will find this sensor very easy to set up and use for your next range-finding project!
This sensor has additional control circuitry that can prevent inconsistent "bouncy"data depending on the application.

Figure 4.2.1: Obstacle Detection by Ultrasonic Sensor

4.3 Robot Motion

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object. While some sensors use a separate sound emitter and receiver, it's also possible to combine these into one package device, having an ultrasonic element alternate between emitting and receiving signals. Based on ultrasonic signal robot moves in right and left direction. When object detect in right side, then robot moves left direction and vice-versa with the help of DC motor. DC motors work well in robotics because they allow the robot to be battery powered, which offers great advantages for a variety of robotic applications, particularly mobile and collaborative robots. The drive electronics of these motors actually work from a DC source. A desirable feature of a DC motor is that it offers variable speed – a wide range both above and below the rated speed.There are three ways to control the speed of a DC motor. Because the motor speed is directly proportional to the supply voltage, you can vary the speed by varying the supply voltage. Additionally, since the speed of the motor is inversely proportional to the flux due to the field findings, by varying the flux and the current through field winding you can vary the speed. Lastly, with the speed of the motor inversely proportional to the armature voltage drop, you can vary speed by varying armature voltage and resistance.

Figure 4.3.1: Robot Motion by DC Motor

4.4 Fire detection

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. Flame or light source wavelengths can be detected using the fire/flame sensor infrared receiver module ignition source detection module, which is Arduino compatible. Flame sensors, which are sensitive to light intensity and are used to identify flames based on intensity, are typically embedded with alarm functions in industrial applications to detect fire incidents. This module can identify flames in the visible light spectrum between 760 and 1100 nanometers. Up to 100 cm is the detection range. 60 degrees is the detection angle. Analogue or digital signals are produced by the sensor.Smart fire detection, a critical part of monitoring systems, aims at providing safety and robustness in Industry.The fire detection system aims to monitor for the presence of fire to alert and allow control actions to be initiated manually or automatically to minimize the likelihood of fire escalation and the probability of people being exposed and to minimize the probability of a fire condition to develop and escalate.This sensor/detector can be built with an electronic circuit using a receiver like electromagnetic radiation. This sensor uses the infrared flame flash method, which allows the sensor to work through a coating of oil, dust, water vapor, otherwise ice.

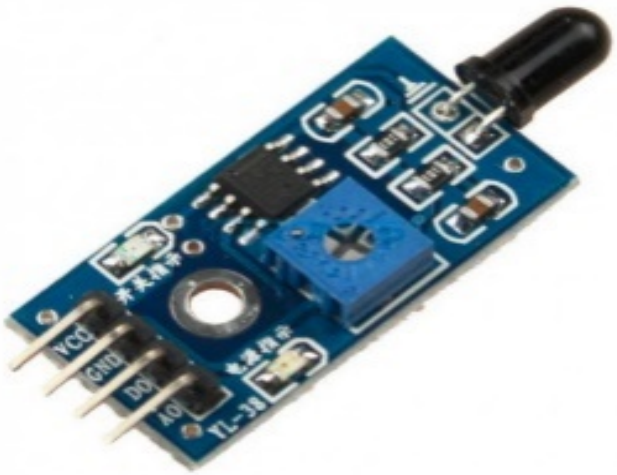

Figure 4.4.1: Fire detection by Fire Sensor

4.5 Gas detection

Gas sensors are devices that can detect the presence and concentration of various hazardous gases and vapors, such as toxic or explosive gases, volatile organic compounds (VOCs), humidity, and odors. Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gases. They are frequently used to detect dangerous or explosive gases. The MQ135 Gas Sensor Module for Air Quality includes both digital and analogue output. The MQ135 gas sensor uses SnO2, which has a reduced conductivity in clean air. When the target flammable gas is present, the sensor conductivity rises along with the gas concentration. The MQ135 gas sensor has a high sensitivity to ammonia, sulphur dioxide, and benzene steam; it is also sensitive to smoke and other hazardous gases. It is inexpensive and versatile.The ability of a Gas sensor to detect gases depends on the chemiresister to conduct current. The most commonly used chemiresistor is Tin Dioxide (SnO2) which is an n-type semiconductor that has free electrons (also called as donor). Normally the atmosphere will contain more oxygen than combustible gases. The oxygen particles attract the free electrons present in SnO2 which pushes them to the surface of the SnO2. As there are no free electrons available output current will be zero. The below gif shown the oxygen molecules (blue color) attracting the free electrons (black color) inside the SnO2 and preventing it from having free electrons to conduct current.

Figure 4.5.1: Gas detection by Gas Sensor

4.6 Metal detection

A metal detector is a device that detects metal in its immediate vicinity. Metal detectors can assist you in the detection of metal objects on the ground. Metal detectors employ electromagnetic induction. Inductor coils in metal detectors interact with metallic elements in the ground. If the circuit detects any metal in the vicinity, it activates the proximity sensor, which turns on the LED and transmits a message to the user.Inductive proximity sensors can only detect metal targets. They do not detect non-metal targets such as plastic, wood, paper, and ceramic. Unlike photoelectric sensors, this allows a inductive proximity sensors to detect a metal object through opaque plastic. Two-wire type inductive proximity sensors allow simplified wiring and can be used for both NPN and PNP circuits. Another advantage is that their current consumption is extremely low such as 1 mA.Inductive Proximity Sensors are durable. For example, all KEYENCE sensor head models satisfy the IP67 requirements by sealing the inside with filling material or other measures. Since these sensors only detect metal objects, the detection is not affected by accumulated dust or oil splash on the sensor head.

Figure 4.6.1: Metal detection by metal Sensor

4.7 Collection of metal particles by Magnet Sensor

A high-frequency magnetic field is generated by coil L in the oscillation circuit. When a target approaches the magnetic field, an induction current (eddy current) flows in the target due to electromagnetic induction. As the target approaches the sensor, the induction current flow increases, which causes the load on the oscillation circuit to increase. Then, oscillation attenuates or stops. The sensor detects this change in the oscillation status with the amplitude detecting circuit, and outputs a detection signal.A magnetic sensor usually refers to a sensor that converts the magnitude and variations of a magnetic field into electric signals. Magnetic fields, as exemplified by the magnetic field of the earth (earth magnetism) or magnets are familiar yet invisible phenomena. Magnetic sensors that convert invisible magnetic fields into electric signals and into visible effects have long been the subject of research. As the magnet sensor identifies the presence of metal particles, the magnet positioned next to it can be helpful in collecting the metal particles. It is possible to use a magnet to collect metal particles that are identified by a metal sensor. The magnet can be positioned near the metal particles, and the magnetic force of the magnet will attract and hold the particles. This can be a useful method for collecting metal particles in various industrial and manufacturing applications.

Figure 4.7.1: Collection of metal particle by Magnet Sensor

5. IMPLEMENTATION & RESULTS

5.1 CODE & OUTPUT

```
#include <WiFi.h>
#include <WiFiClientSecure.h>
#include <UniversalTelegramBot.h>
#include <ArduinoJson.h>

// Network credentials
const char* ssid = "dell";
const char* password = "12345678";

// Initialize Telegram BOT Token and Chat ID
#define BOTtoken "5900072045:AAEFqb-AW4uryM80nN5DPeTOHDsrzt6VLUI"

#define CHAT_ID "969506549"
//897542465

//#define CHAT_ID "897542465"
#define A0 13
#define A1 12
#define A2 14
#define A3 27


// defining the pins
const int trigPin1 = 15;
const int echoPin1 = 2;
const int trigPin2 = 4;
const int echoPin2 = 5;
```

```
const int trigPin3 = 18;
const int echoPin3 = 19;


const int irPin = 22;
const int gasPin = 21;
const int ldrPin = 23;
const int metalPin = 34;

int irState = 0;
int gasState = 0;
int ldrState = 0;
int metalState = 0;


// defining variables
long duration1 ;
long duration2 ;
long duration3 ;
int distanceleft ;
int distancefront ;
int distanceright ;


WiFiClientSecure client ;
UniversalTelegramBot bot(BOTtoken, client );

void setup() {


  Serial .begin(115200); // Starts the serial communication
```

```
WiFi.mode(WIFI_STA);
WiFi.begin( ssid , password);

// Add root certificate for api . telegram . org
client .setCACert(TELEGRAM_CERTIFICATE_ROOT);

pinMode(trigPin1 , OUTPUT);
pinMode(trigPin2 , OUTPUT);
pinMode(trigPin3 , OUTPUT);// Sets the trigPin as an Output


pinMode(echoPin1, INPUT); // Sets the echoPin as an Input
pinMode(echoPin2, INPUT);
pinMode(echoPin3, INPUT);

pinMode(A0, OUTPUT);

pinMode(A1, OUTPUT);

pinMode(A2, OUTPUT);

pinMode(A3, OUTPUT);

pinMode(irPin, INPUT);

pinMode(gasPin, INPUT);

pinMode(ldrPin, INPUT);

pinMode(metalPin, INPUT);
```

```
  bot.sendMessage(CHAT_ID, "Industrial Robot", "");
}

void loop() {
  irState = digitalRead(irPin);

  gasState = digitalRead(gasPin);

  ldrState = digitalRead(ldrPin);

  metalState = digitalRead(metalPin);



  digitalWrite(trigPin1, LOW);

  delayMicroseconds(2);

  digitalWrite(trigPin1, HIGH);

  delayMicroseconds(10);

  digitalWrite(trigPin1, LOW);

  duration1 = pulseIn(echoPin1, HIGH);

  distanceleft = duration1 * 0.034 / 2;

  // Serial.print("Distance1: ");

  // Serial.println(distanceleft);
```

```
 digitalWrite ( trigPin2 , LOW);
delayMicroseconds(2);
 digitalWrite ( trigPin2 , HIGH);
delayMicroseconds(10);
 digitalWrite ( trigPin2 , LOW);
duration2 = pulseIn(echoPin2, HIGH);
 distancefront = duration2 * 0.034 / 2;
// Serial . print ("Distance2: ");
// Serial . println ( distancefront );
 digitalWrite ( trigPin3 , LOW);
delayMicroseconds(2);
 digitalWrite ( trigPin3 , HIGH);
delayMicroseconds(10);
 digitalWrite ( trigPin3 , LOW);
duration3 = pulseIn(echoPin3, HIGH);
```

```
distanceright = duration3 * 0.034 / 2;

// Serial . print ("Distance3: ");

// Serial . println ( distanceright );

if ( irState == LOW) {
    Serial . println ("Fire Detected");
    bot.sendMessage(CHAT_ID, "Fire Detected!!", "");
    stop_();

}

else if ( gasState == LOW) {
  // turn LED on:
   Serial . println ("Gas Active");
  bot.sendMessage(CHAT_ID, "Gas Detected!!", "");
  stop_();
}

else if ( ldrState == HIGH) {
  // turn LED on:
    Serial . println ("NO Light");
   bot.sendMessage(CHAT_ID, "No Light Detected!!", "");
   stop_();
}

//else if ( metalState == LOW) {
  // turn LED on:
//      Serial . println ("Metal Detected");
//      bot.sendMessage(CHAT_ID, "Metal Detected!!", "");
```

```
//      stop_();
 //}

 else{

 // stright
 if (( distanceleft <= 15 && distancefront > 15 && distanceright <= 15) || ( distanceleft
     > 15 && distancefront > 15 && distanceright > 15))

 {
    digitalWrite (A0, HIGH);

    digitalWrite (A1, LOW);

    digitalWrite (A2, HIGH);

    digitalWrite (A3, LOW);

    Serial . println ("Forward");

 }

 //FRONT
 if (( distanceleft <= 15 && distancefront <= 15 && distanceright > 15) || ( distanceleft
     <= 15 && distancefront > 15 && distanceright > 15))
 {

    Serial . println (" left ");

    digitalWrite (A0, HIGH);
```

```
      digitalWrite (A1, LOW);

      digitalWrite (A2, LOW);

      digitalWrite (A3, HIGH);

  }

  if (( distanceleft > 15 && distancefront <= 15 && distanceright <= 15) || ( distanceleft
      > 15 && distancefront > 15 && distanceright <= 15) || ( distanceleft > 15 &&
      distancefront <= 15 && distanceright > 15) )
  {

      Serial . println (" right ");

      digitalWrite (A0, LOW);

      digitalWrite (A1, HIGH);

      digitalWrite (A2, HIGH);

      digitalWrite (A3, LOW);

  }
  }
}
void stop_()
{

    digitalWrite (A0, LOW);
```

```
  digitalWrite (A1, LOW);

  digitalWrite (A2, LOW);

  digitalWrite (A3, LOW);

}
```

Figure 5.1.1: Output

5.2 RESULTS

This robot can be used to monitor the industrial environment using sensors that perform particular tasks. If any abnormal values were measured in sensors, the robot sent an alert to the Telegram bot.Based on values measured in IoT, particular measures willbe taken by the user to avoid accidents.

Significant Features of Industrial Oriented Automation Robot:

1. Fire detection by Fire Sensor
2. Gas detection by Gas Sensor
3. Light detection by LDR Sensor
4. Metal detection by Metal Sensor
5. Obstacle Detection by Ultrasonic Sensor
6.Collection of metal particle by Magnet Sensor

These are the important features that are implemented in this robot which makes it special and unique based on its multi-tasking features when compared to other papers:

- Gas leakage, fire, smoke is detected and Temperature and Humidity are measured.
- Gas leakage detection system for Household and it activates the alarm and also sends alert messages to the users within a short time.
- Metal detector to study the frequencies of various metals and send information data to the users as well as protect the person from the risks.
- Meter monitoring, DC speed control, Temperature, Humidity, Gas levels and Fire accidents are monitored through android mobiles, and parameters data can be updated periodically by using cloud.
- Esp32-Cam is used for surveillance purpose and MQ2 Gas Sensor is used to detect the presence of gases like LPG, CO and Smoke. The flame sensor is used to detect andrespond to the occurrence of a fire or flame.
- The light and obstacle sensing capability of the robotic.

- Sensors, such as smoke and flame and actuators such as buzzers and displays, make up the system and Following the signal, the Node MCU uses a relay to switch on or off the appliance.

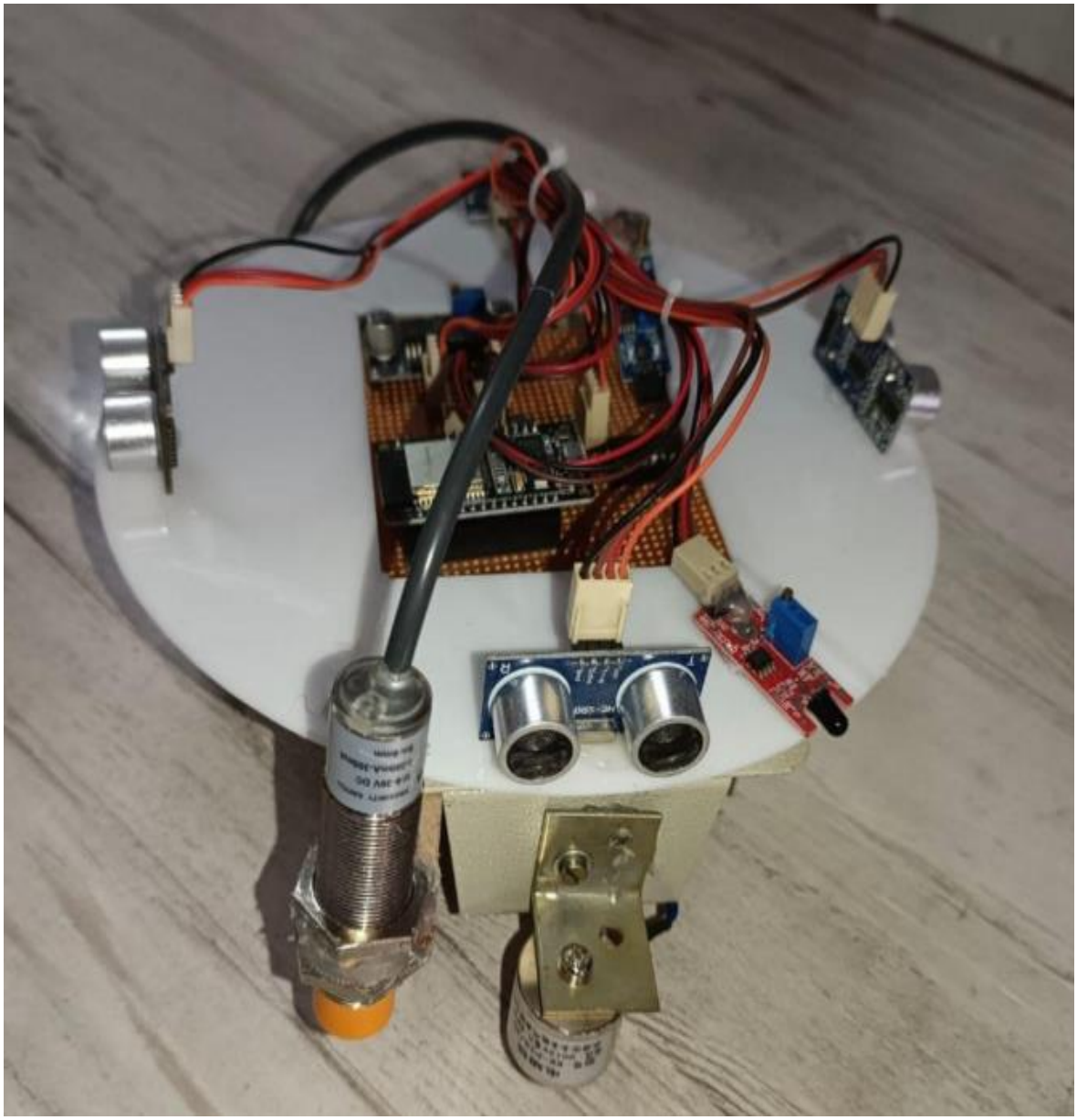

Figure 5.2.1: Industry Oriented Automation Robot

5.3 FEATURES

1. Improve safety

2. Enhance efficiency

3. Improve quality

4. Provide real-time monitoring

5. Offer adaptability

6. Remove metal debris

7. Driver less control

8. Industrial parameter monitoring

9. Accurate and fast in response

10. Avoids fire Accidents

11. Protects from harmful gasses

12. Wi-Fi Bluetooth Modulations

6. CONCLUSION & FUTURESCOPE

The proposed system, presents the advancement of Internet technology in day to day life. The system is suitable for real time small scale industrial process monitoring and controlling applications. proposed module implemented on ESP32, one of the best solutions to avoid industrial accidents and saves lives of workers and equipment's. The objectives of the industrial automation robot are to improve safety, enhance efficiency, improve quality, provide realtime monitoring, offer adaptability, and remove metal debris. These objectives work together to create a versatile and effective solution for industrial automation. This will make the user aware of the dangerous situation and can easily prevent it. Thus, the design system provides a better and safer environment.

Along with these features that we have implemented, one can also try do add a vacuum module that can pick-up any dust particles that are present on the floor on which the robot moves and High-end computers allow us to integrate machine learning, which will eventually eliminate the need for sensors. One can also add sprinklers to the module to put off the fire when it is detected and can improvise the gas sensors by identifying the intensity of the gas and type of gas. In order to improve our ability to judge from our gaze, controlled cameras can help with vision-related issues

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