A PROJECT ON
"COAL MINING SAFETY ROBOT"

SUBMITTED TO

STATE BOARD OF TECHNICAL EDUCATION

In partial fulfillment for the award of

DIPLOMA
IN
"ELECTRICAL AND ELECTRONICSENGINEERING"

Submitted by:

D. GNANA TEJA

(21002-EE-114)

Under the esteemed guidance of

SRI.A. KISHORE

JAWAHARLAL NEHRU GOVERNMENT POLYTECHNIC, RAMANTHAPUR, HYDERABAD-500013

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STATE BOARD OF TECHNICAL EDUCATION AND TRAINING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

CERTIFICATE

This is to certify the project work entitled **"COAL MINING SAFETY ROBOT"** submitted by **D. GNANA TEJA (PIN NO : 21002-EE-114)** a student of Department of Electrical & Electronics Engineering , Jawaharlal Nehru Government Polytechnic, Ramanthapur, have been successfully completed in the partial fulfilment of requirements for the award of **DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING** is a record of BONAFIDE work carried out during the academic year 2021-2024.

INTERNAL GUIDE

EXTERNAL EXAMINER

HEAD OF THE DEPT.

PRINCIPAL

DECLARATION

I declare that the work reported in the project entitled **"COAL MINING SAFETY ROBOT"** is a record of work done by me under the guidance of, SRI.A.KISHORE Dept. of Electrical & Electronics Engineering, J. N. Govt Polytechnic Ramanthapur. Few parts of the project is copied from books/journals/internet. The reported data is based on the project work done entirely by me and not copied from the other resources.

D. GNANA TEJA
(21002-EE-114)

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THANK YOU one and all.

D. GNANA TEJA

(21002-EE-114)

INDEX

FIGURE INDEX

IOT Based Coal Mine Safety Monitoring and Alerting System

ABSTRACT

The accidents in coal mines are increased day by day. There are numerous life losses of many skilled workers and laborers. There is no advent precaution measure to detect the alarming cause of the coal mine accidents and provide an alert system. Occupational accidents and occupational diseases are common in the mining. The most common causes of accidents in coal mining are firedamp and dust explosions, landslips, mine fires, and technical failures related to transport and mechanization. An analysis of occupational accidents in the consideration of social and economic factors reports that the real causes behind these accidents, which are said to happen inevitably due to technical deficiencies or failures. Thus an automated alarming coal mine accident detect ion system is employed to rescue and protect the workers from the hazards. This system incorporates the combined action of the temperature, pressure and gas sensor and IOT module to detect the temperature, pressure and atmosphere in the coal mine and log every data onto the cloud using data logging. Then these data are accepted by a admin controlled sever page through data acquisition. The data processing takes place at a server page and the alert is send to the device to glow the alarm and to the concerned officials and rescue stations for taking the prevention measures.

Index Terms— Sensors, WIFI, Arduino

1. INTRODUCTION

1.1. INTRODUCTION TO THE PROJECT

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifier and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. IoT has evolved from the convergence of wireless technologies, microelectromechanical systems(MEMS), microservices and the internet. The convergence has helped tear down the silo walls between operational technology and information technology, allowing unstructured machine-generated data to be analyzed for insights that will drive improvements. In earlier days, LED helmets were deployed in Industries to inform the workers about the hazardous events. Later sensors were deployed to detect the events and the alert can be sent to the remote monitoring unit to avoid losses. several wireless sensor network has been used to detect and transfer datas. The most commonly used technology for wireless transfer is zigbee .One of the main disadvantage in using zigbee as a medium of transfer is the coverage area.The coverage area of zigbee is usually 10– 100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. The proposed system uses Wi-Fi technology to transfer data from the working environment to the remote monitoring unit. The merit in using Wi-Fi as a medium of transfer is that it covers wider area and it is the latest modern technology that has been emerging worldwide for transferring data. In this system the transferred data is collected ,stored and analyzed using Android app application. Android app is one of the recently developed application in the field of IoT for analysing data transferred by wireless sensor networks.

Coal mining is the process of extracting coal from the ground. The natural conditions of coal mines are highly complicated, and mining conditions are extremely capricious. The structure of a coal mine environment is complex; the space for branch tunnels is limited, and the directions of

branch tunnels are not fixed. Wired transmission systems are often installed only in the main tunnel, which substantially limits the expansion of the network. When underground mining advances continuously, no wired network can be established in real time; naturally, it is thus impossible to monitor these dangerous regions in real time. In addition, due to cost and maintenance limitations, no safety monitoring systems are installed in abandoned underground tunnels, creating a great potential safety hazard. Many disasters can occur in mines, which increases the insecurity of coal mining and easily leads to major accidents, causing extreme difficulty in establishing safety. Thus, for coal mine safety monitoring and control, there are still many shortcomings in wired monitoring and control that should be addressed. It is not easy to install wired coal mine safety monitoring and control systems in many coal mine regions, such as abandoned tunnels and mining sections. Our project is coal mine monitoring system and alert system using IOT. It can detect all the hazardous gas using gas sensors, dust sensor, temperature and humidity sensor in the coal mine. Buzzer will glow after the threshold value of the gas. Hence this project will be use as rescued system and precautions for the coal mine workers.

2. LITERATURE REVIEW

Yongping Wu and Guo Feng implemented helmets that uses the Bluetooth wireless transmission system for the monitoring the working environment. As a standard of unified global short-range wireless communication, Bluetooth technology is to establish a common lowpower, low-cost wireless air interface and controlling software opening system . At the same time, the system uses CAN bus technology maturely, has realized the combination of wired and wireless data transmission system. The main difficulty of this system is that the Bluetooth is short distance wireless technology and use of cabling is difficult. When a natural calamity occurs,the cabling will gets damaged. So the reliability and long life of conventional communication system is poor. Jingjiang Song, Yingli Zhu proposed automatic monitoring system for industrial safety based on wireless sensor network. The sensor groups of the system intensively monitor temperature, humidity in the working area.The parameters measured are sent to wireless communication module by the micro- controller. The collected information is sent to long-distance monitoring centre by cable. So the reliability and long life of conventional communication system is poor. The another problem is that the working condition of industries is very noisy and if the distance of the workers and system is long,workers will not get proper message. Pranjal Hazarika presents implementation of safety helmet for workers. This helmet is equipped with methane and carbon monoxide gas sensor. This sensor sense the gas and the data is transmitted to the control room wirelessly, through a wireless module called Zigbee connected with the helmet. This system does not working conditions of the workers and whether the workers wear the helmet or not.The main difficulty of the system is the usage of zigbee technology.Zigbee technology has small area coverage and hence transferring to the monitoring agent is difficult to transfer data from the working area long distance monitoring unit.

"LabVIEW based coal mine monitoring and alert system with data acquisition"(IEEE)- This paper presents With the ever growing technology, human efforts are reduced to great extent but even now some industries do exist, where we cannot neglect the importance of manpower. Some of these industries that help us extract the natural resources; need a lot of human effort. One such a large scale industry is coal mines. Coal mines are the places where extraction of coal takes place. This extracted coal is then supplied to various other industries, where it is used for the production of electricity and heat through combustion or for some other secondary uses. Moreover, coal mine enterprises have to encounter various hazards regarding special geological condition . In the process of coal mining, numerous hazards have the potential to trigger accidents frequently, such as rock stresses, harmful gases, humidity, high temperatures, coal and silica dust, and specialized equipment . Worse still, the intensity and frequency of these hazards could result in extremely serious consequences for human health and life . Coal mine accidents will considerably bring about injuries, casualties, and loss of major assets of enterprise. "Impact of Gas Control Policy on the Gas Accidents in Coal Mine"- Coal plays an important role in the supply of energy worldwide for producing heat, electricity and other valuable industrial materials over the past few centuries. To date, coal still represents approximately 27.7% of the total primary energy supply in the world .According to statistics, in 2018, the total coal consumption in the world was 3.772 billion tons of oil equivalent. Among them, the United States used 317 million tons, and India used 452 million tons. China ranked first in all countries with 1.907 billion tons of coal consumption (BP, 2019). China is currently the world's largest consumer of coal, as well as the largest emitter of energy-related carbon dioxide (CO2). Nearly 80% of China's annual energy -related CO2 emissions are from the combustion of coal and coal-derived products . With the rapid development of China's economy, China has become a major energy producer and consumer in the world.

3. INTRODUCTION ABOUT EMBEDDED SYSTEMS

3.1 INTRODUCTION OF EMBEDDED SYSTEM:

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers.

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner.

This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do wish it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel.

Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement.

At the possible risk of confusing you, it is important to point out that a general-purpose computer is itself made up of numerous embedded systems. For example, my computer consists of a keyboard, mouse, video card, modem, hard drive, floppy drive, and sound card-each of which is an embedded system. Each of these devices contains a processor and software and is designed to perform a specific function. For example, the modem is designed to send and receive digital data over analog telephone line. That's it and all of the other devices can be summarized in a single sentence as well.

3.2. OVERVIEW OF EMBEDDED SYSTEM :

Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the ‘firmware’.

The same architecture is applicable to any computer including a desktop computer. However, there are significant differences. It is not compulsory to have an operating system in every embedded system. For small appliances such as remote control units, air conditioners, toys etc., there is no need foran operating system and you can write only the software specific to that application.

For applications involving complex processing, it is advisable to have an operating system. In such a case, you need to integrate the application software with the operating system and then transfer the entire software on to the memory chip. Once the software is transferred to the memory chip, the software will continue to run *for* a long time you don’t need to reload new software. Now, let us see the details of the various building blocks of the hardware of an embedded system. As shown in Fig. the building blocks are:

a. Central Processing Unit (CPU)
b. Memory (Read-only Memory and Random Access Memory)
c. Input Devices
d. Output devices
e. Communication interfaces
f. Application-specific circuitry

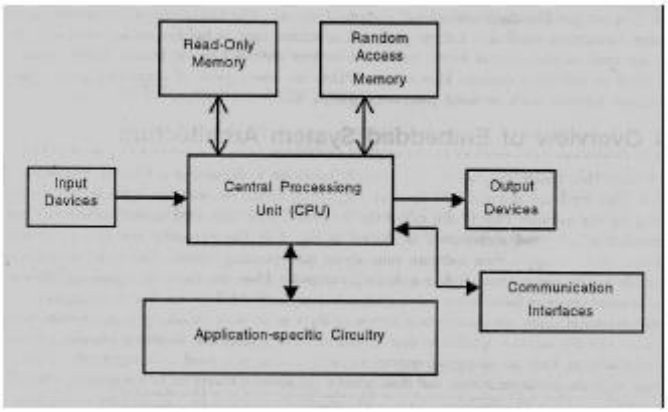


Fig: 3.1 Building blocks of the hardware of an embedded system

- **CENTRAL PROCESSING UNIT (CPU):**

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to digital converter etc.

So, for small applications, a micro-controller is the best choice as the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use many external components with them. D5P is used mainly for applications in which signal processing is involved such as audio and video processing.

- **MEMORY:**

The memory is categorized as Random Access 11emory (RAM) and Read Only Memory (ROM). The contents of the RAM will be erased if power is switched off to the chip, whereas ROM retains the contents even if the power is switched off. So, the firmware is stored in the ROM. When power is switched on, the processor reads the ROM; the program is program is executed.

- **INPUT DEVICES**:

Unlike the desktops, the input devices to an embedded system have very limited capability. There will be no keyboard or a mouse, and hence interacting with the embedded system is no easy task. Many embedded systems will have a small keypad-you press one key to give a specific command. A keypad may be used to input only the digits. Many embedded systems used in process control do not have any input device for user interaction; they take inputs from sensors or transducers 1'fnd produce electrical signals that are in turn fed to other systems.

- **OUTPUT DEVICES**:

The output devices of the embedded systems also have very limited capability. Some embedded systems will have a few Light Emitting Diodes (LEDs) to indicate the health status of the system modules, or for visual indication of alarms. A small Liquid Crystal Display (LCD) may also be used to display some important parameters.

- **COMMUNICATION INTERFACES**:

The embedded systems may need to, interact with other embedded systems at they may have to transmit data to a desktop. To facilitate this, the embedded systems are provided with one or a few communication interfaces such as RS232, RS422, RS485, Universal Serial Bus (USB), IEEE 1394, Ethernet etc.

- **APPLICATION-SPECIFIC CIRCUITRY:**

Sensors, transducers, special processing and control circuitry may be required fat an embedded system, depending on its application. This circuitry interacts with the processor to carry out the necessary work. The entire hardware has to be given power supply either through the 230 volts main supply or through a battery. The hardware has to design in such a way that the power consumption is minimized.

4. DESIGN OF HARDWARE

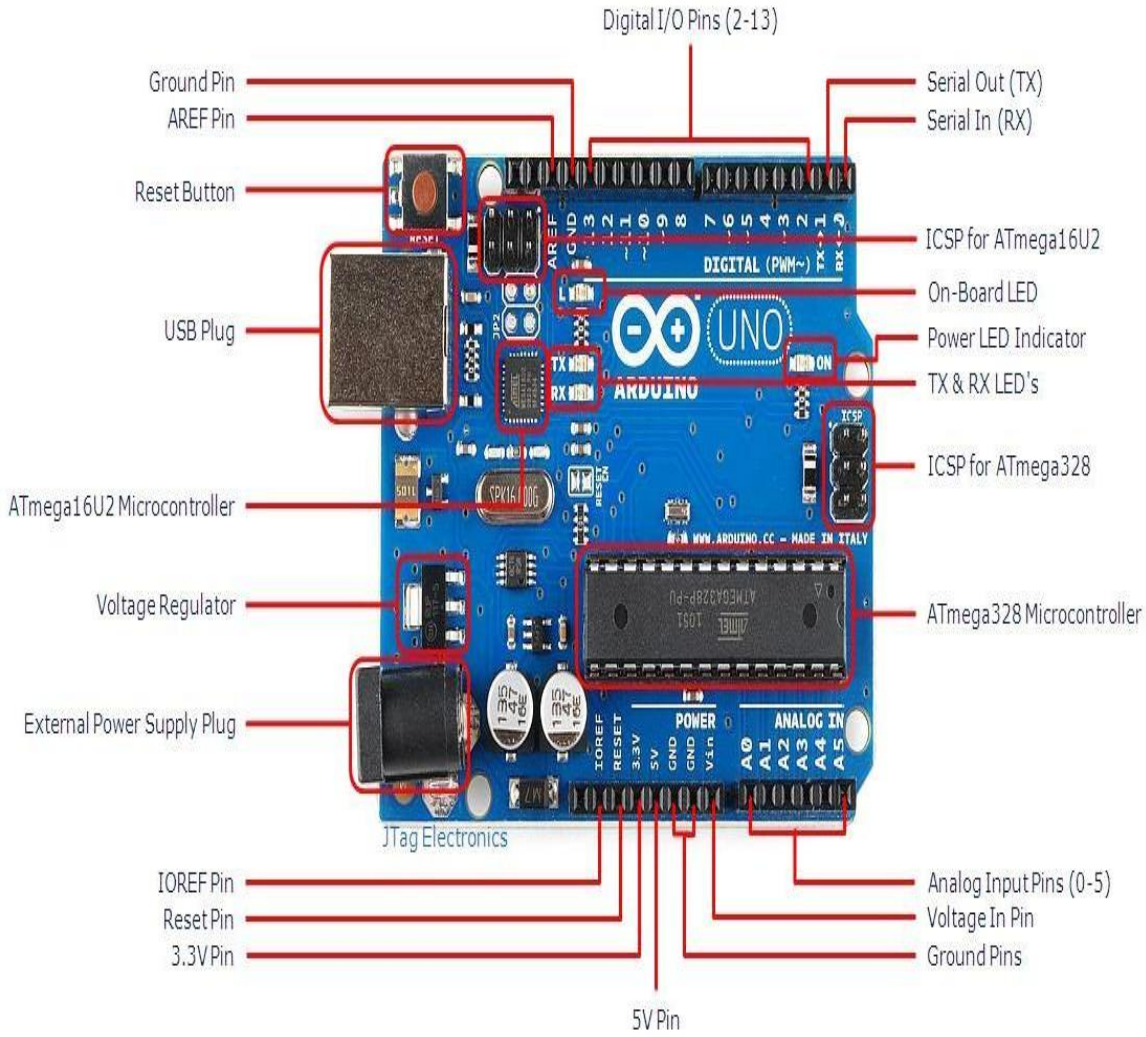
This chapter briefly explains about the Hardware implementation of IOT BASED SMART HELMENT SYSTEM FOR COAL MINE INDUSTRY . It discuss the circuit diagram of each module in detail.

4.1 ARDUINO:

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3).

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Microcontroller	:	ATmega328
Operating Voltage	:	5V
Input Voltage (recommended)	:	7-12V
Input Voltage (limits)	:	6-20V
Digital I/O Pins	:	14 (of which 6 provide PWM output)
Analog Input Pins	:	6
DC Current per I/O Pin	:	40 mA
DC Current for 3.3V Pin	:	50 mA
Flash Memory	:	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	:	2 KB (ATmega328)
EEPROM	:	1 KB (ATmega328)
Clock Speed	:	16 MHz
Length	:	68.6 mm
Width	:	53.4 mm



ArduinoUno R3 Board

- **USB Plug & External Power Supply Plug**

Every Arduino board needs a way to be connected to a power source. The Arduino Uno can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. The power source is selected automatically. The USB connection is also how you will load code onto your Arduino board. Please on my other post on how to program with Arduino can be found in Installing and Programming Arduino.

NOTE: The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V,

however, the 5V pin may supply less than five volts and the board may be unstable.If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts

.

- **Voltage Regulator**

The voltage regulator is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course,it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

- **Power Pins**

Voltage In Pin – The input voltage to the Arduino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V Pin – This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. It's not recommended.3.3V Pin – A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- **Ground Pins**

There are several GND pins on the Arduino, any of which can be used to ground your circuit.

- **IOREF Pin**

This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

- **Input and Output Pins**

Each of the 14 digital pins on the Uno can be used as an input or output. They operate at 5 volts. These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-5k Ohms. In addition, some pins have specialized functions.

- **Serial Out (TX) & Serial In (RX)**

Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- **External Interrupts**

Pins 2 and 3 can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM – You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). Think of these pins as being able to simulate analog output (like fading an LED in and out).

SPI – Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). SPI stands for Serial Peripheral Interface. These pins support SPI communication using the SPI library.

Analog Input Pins – Labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read. By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF

Pin (Stands for Analog Reference. Most of the time you can leave this pin alone). Additionally, some pins have specialized functionality:

TWI – Pins A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

- **Reset Pin**

Bring this line LOW to reset the microcontroller.Typically used to add a reset button to shields which block the one on the board.

- **LED Indicators**

Power LED Indicator – Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON'. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

On-Board LED – There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. This useful to quickly check if the board has no problem as some boards has a pre-loaded simple blinking LED program in it.

TX & RX LEDs – These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program ontotheboard).

Reset Button:Pushing the reset button temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times.

4.9. POWER SUPPLY:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as "Regulated D.C Power Supply".

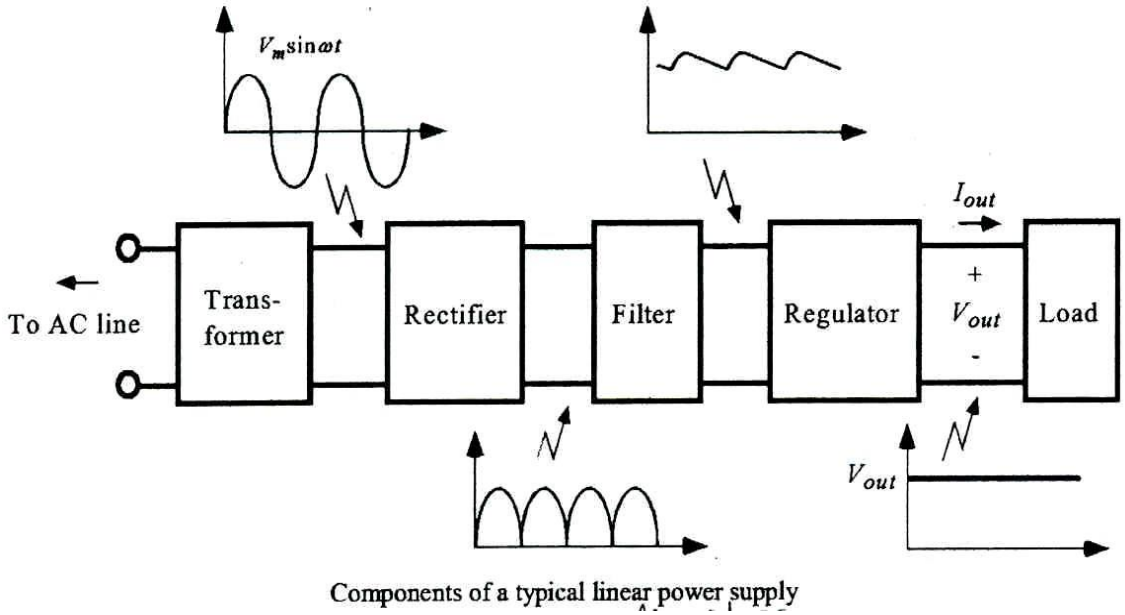


Fig:4.4. Block Diagram of Power Supply

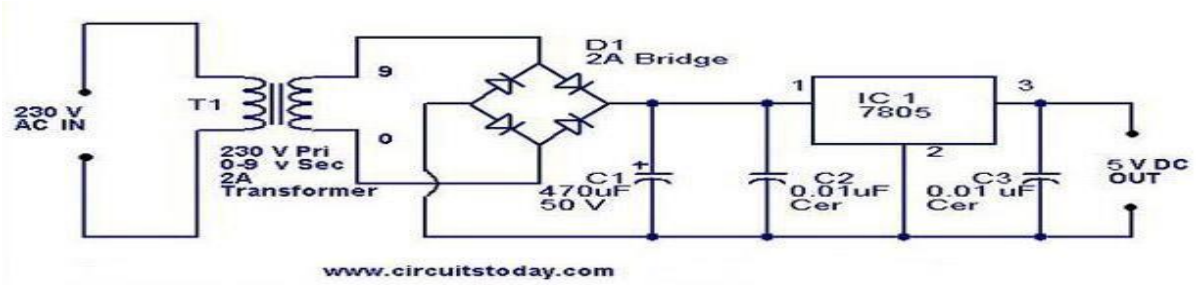


Fig:4.5. Schematic Diagram of Power Supply

4.9.1. TRANSFORMER:

A transformer is an electrical device which is used to convert electrical power from one Electrical circuit to another without change in frequency.

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/12-0-12v is used to perform the step down operation where a 230V AC appears as 12V AC across the secondary winding.

4.9.2. RECTIFIER:

A circuit which is used to convert a.c to dc is known as RECTIFIER. The process of conversion a.c to d.c is called “rectification.

Bridge Rectifier:

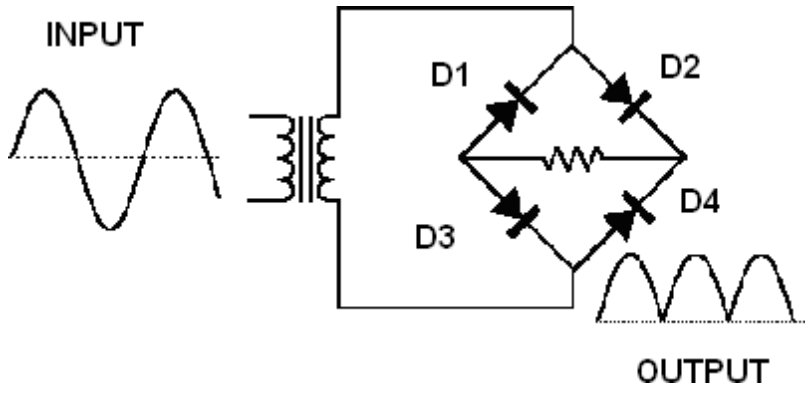


Fig: 4.6 Bridge Rectifier

OPERATION:

During positive half cycle of secondary, the diodes D2 and D3 are in forward biased while D1 and D4 are in reverse biased. During negative half cycle of secondary voltage, the diodes D1 and D4 are in forward biased while D2 and D3 are in reverse biased.

4.9.3. FILTER:

A Filter is a device which removes the a.c component of rectifier output but allows the d.c component to reach the load.We have seen that the ripple content in the rectified output of half wave rectifier is **121%** or that of full-wave or bridge rectifier or bridge rectifier is **48%** such high percentages of ripples is not acceptable for most of the applications. Ripples can be removed by one of the following methods of filtering. A capacitor, in parallel to the load, provides an easier by –pass for the ripples voltage though it due to low impedance. At ripple frequency and leave the d.c.to appears the load.

4.9.4. VOLTAGE REGULATOR:

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels,7805 and 7812

voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05,12 represent the required output voltage.

4.13. LCD:

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

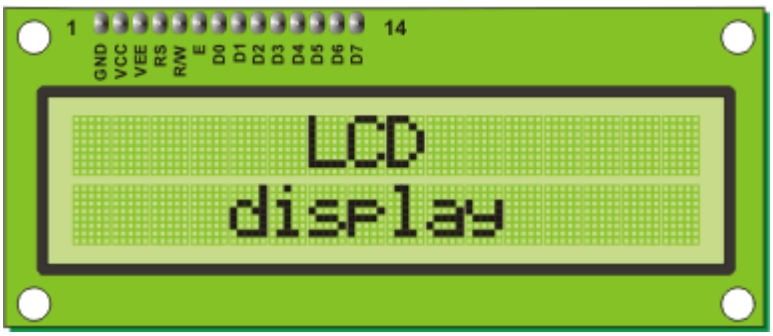


Fig: 4.10. LCD

4.13.1. PINS FUNCTIONS:

There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:

Function	Pin Number	Name	LogicState	Description
Ground	1	Vss	-	0V

Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 –Vdd
Control of operating / Data commands	4	RS	0 1	D0 – D7 are interpreted as commands D0 – D7 are interpreted as data
	5	R/W	0 1	Write data (from controller to LCD) Read data (from LCD to controller)
	6	E	0 1 From 1 to 0	Access to LCD disabled Normal operating Data/commands are transferred to LCD
	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

Table 4.2:LCD Pin Functions

4.13.2. LCD SCREEN:

LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).

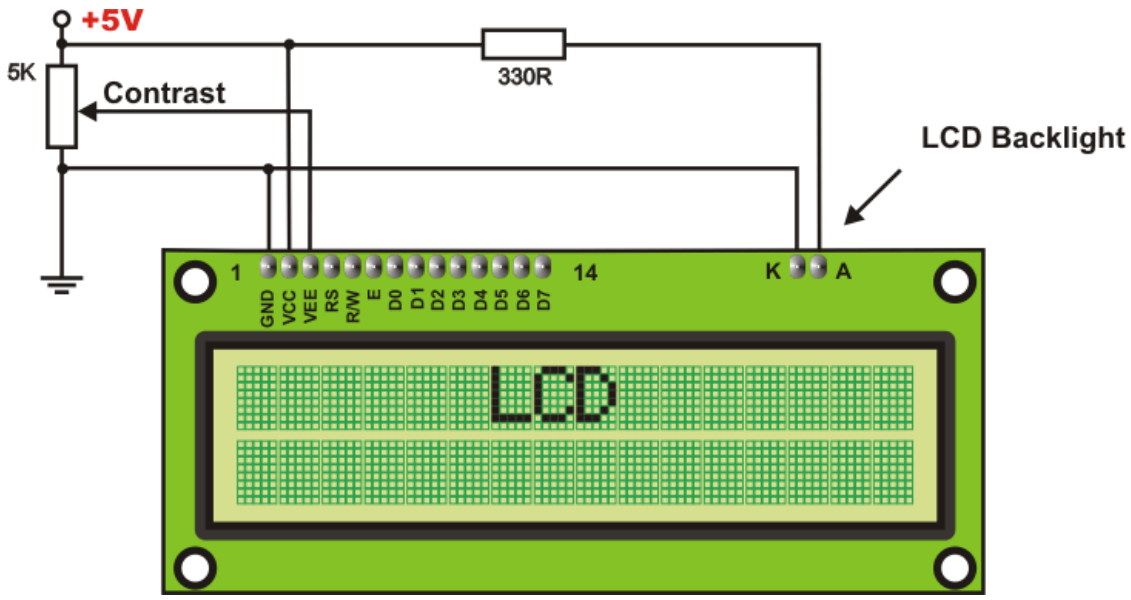
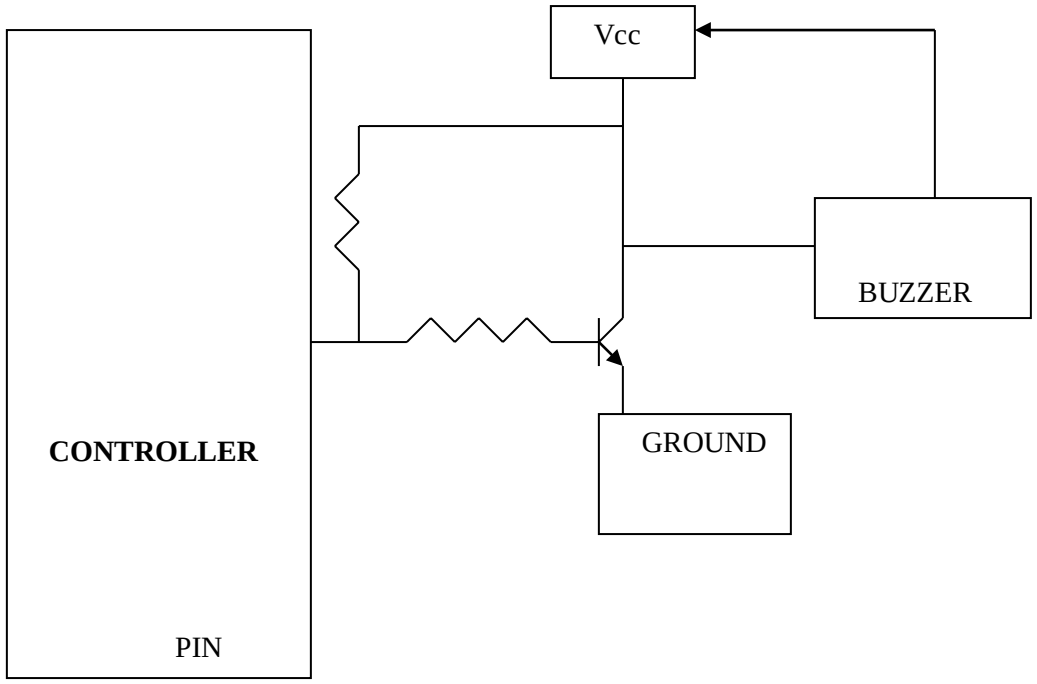


Fig: 4.11.LCD Screen Circuit Diagram

BUZZER DRIVER CIRCUIT:

Digital systems and microcontroller pins lack sufficient current to drive the circuits like relays, buzzer circuits etc. While these circuits require around 10milli amps to be operated, the microcontroller's pin can provide a maximum of 1-2milli amps current. For this reason, a driver such as a power transistor is placed in between the microcontroller and the buzzer circuit.

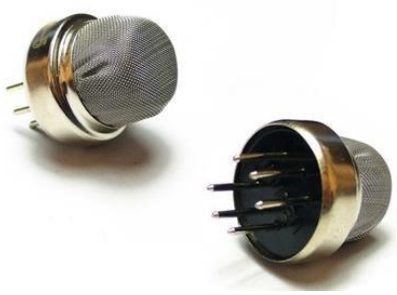


The operation of this circuit is as follows:

The input to the base of the transistor is applied from the microcontroller port pin P1.0. The transistor will be switched on when the base to emitter voltage is greater than 0.7V (cut-in voltage). Thus when the voltage applied to the pin P1.0 is high i.e., P1.0=1 (>0.7V), the transistor will be switched on and thus the buzzer will be ON.

When the voltage at the pin P1.0 is low i.e., P1.0=0 (<0.7V) the transistor will be in off state and the buzzer will be OFF. Thus the transistor acts like a current driver to operate the buzzer accordingly.

AIR / GAS DETECTOR:

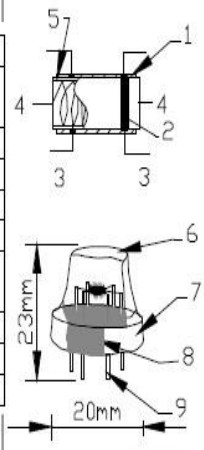


DESCRIPTION

MQ2 flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V.

Connecting five volts across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting five volts at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. Please note that the picture in the datasheet for the top configuration is wrong. Both configurations have the same pin out consistent with the bottom configuration. The resistive load should be calibrated for your particular application using the equations in the datasheet, but a good starting value for the resistor is 20 kΩ.

	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni



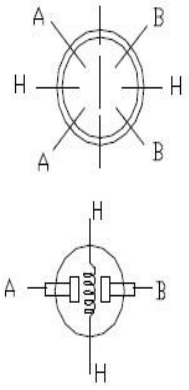


Fig. 1

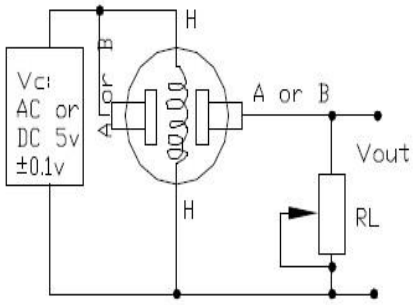


Fig.2

FEATURES

- Wide detecting scope
- Fast response and High sensitivity
- Stable and long life
- Simple drive circuit

TEMPERATURE SENSOR (LM35):

in order to monitor the temperature continuously and compare this with the set temperature preprogrammed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus a sensor has to be used and the sensor used in this project is LM35. It converts temperature value into electrical signals.

LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air.

Features

1. Calibrated directly in ° Celsius (Centigrade)

2. Linear + 10.0 mV/°C scale factor

3. 0.5°C accuracy guaranteed (at +25°C)

4. Rated for full −55° to +150°C range

5. Suitable for remote applications

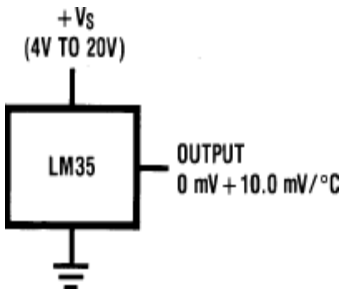
6. Low cost due to wafer-level trimming

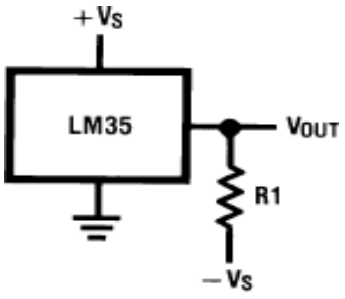
7. Operates from 4 to 30 volts

8. Less than 60 μA current drain

9. Low self-heating, 0.08°C in still air

10. Low impedance output, 0.1 W for 1 mA load





The characteristic of this LM35 sensor is:

For each degree of centigrade temperature it outputs 10milli volts.

ROLE OF LM35:

In this project, the temperature is to be monitored continuously and if the temperature exceeds the set value preprogrammed in the microcontroller, a buzzer indication is provided in the circuit to alert the people in the industry to stop the process immediately. Thus the temperature sensor LM35 has to read the temperature continuously and the microcontroller has to compare this

temperature value with the set temperature preprogrammed in it. When this temperature exceeds the set value, the microcontroller sends an indication to the buzzer which gives a loud noise.

HUMIDITY

Humidity is a term for the amount of water vapor in the air, and can refer to any one of several measurements of humidity. Formally, humid air is not "moist air" but a mixture of water vapor and other constituents of air, and humidity is defined in terms of the water content of this mixture, called the Absolute humidity. In everyday usage, it commonly refers to relative humidity, expressed as a percent in weather forecasts and on household humidistats; it is so called because it measures the current absolute humidity **relative** to the maximum. Specific humidity is a ratio of the water vapor content of the mixture to the total air content (on a mass basis). The water vapor content of the mixture can be measured either as mass per volume or as a partial pressure, depending on the usage.

In meteorology, humidity indicates the likelihood of precipitation, dew, or fog. High relative humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin. This effect is calculated in a heat index table, used during summer weather.

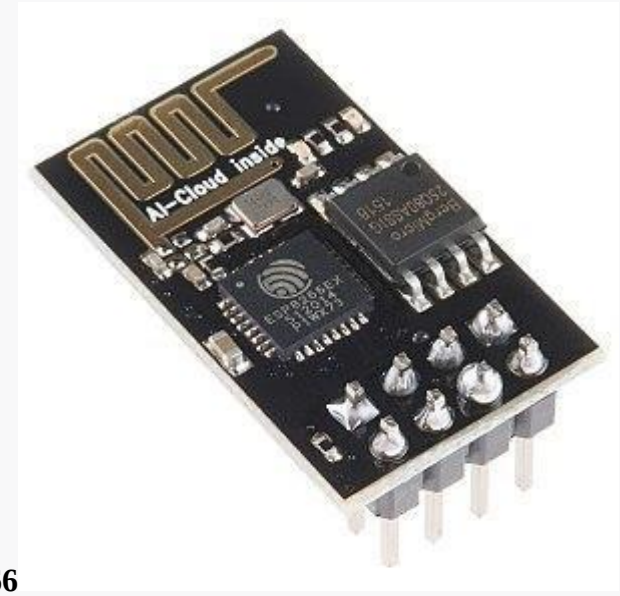
How do humidity sensors work?

Resistive humidity sensors utilize ions in salts to measure the electrical impedance of atoms. As humidity changes, so does the resistance of the electrodes on either side of the salt medium. Two thermal sensors conduct electricity based upon the humidity of the surrounding air.

DHT11 Digital Relative Humidity and Temperature Sensor

ESP8266 WIFI

The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]



ESP8266

ESP-01 module by Ai-Thinker

Manufacturer	Espressif Systems
Type	32-bit microcontroller

CPU	@ 80 MHz (default) or 160 MHz
Memory	32 KiB instruction, 80 KiB user data
Input	16 GPIO pins

The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

FIRE DETECTION SENSOR:

A fire detector is a device that detects the presence of a fire. This can be done in several ways, including the following: Smoke detectors use an optical or electrochemical sensor to detect smoke. Combustible gas detectors use an electrochemical cell or catalytic sensor to detect combustible gases in the air.

IR Fire Detector Sensor Module for Arduino Flame

5.DESIGN OF SOFTWARE

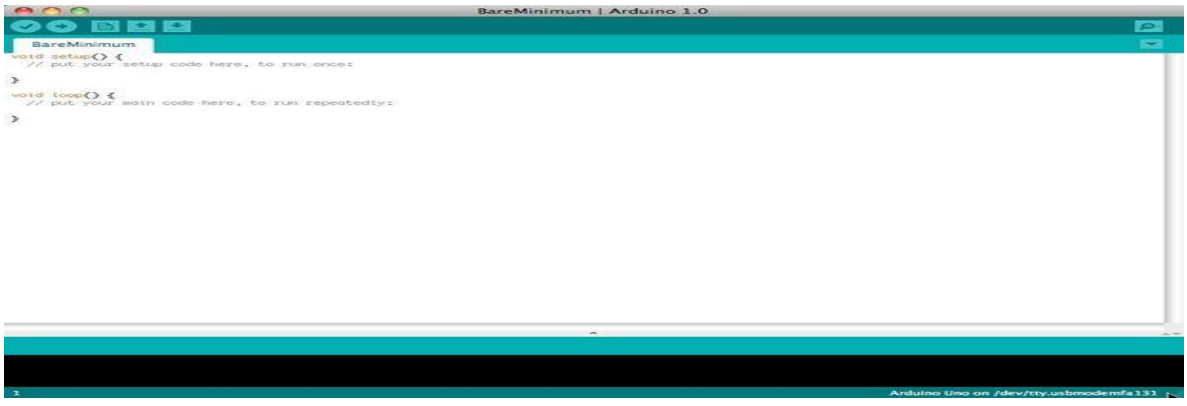
5.1. INTRODUCTION TO ARDUINO IDE SOFTWARE:

This is free software (evaluation version) which solves many of the pain points for an embedded system developer. This software is an Integrated Development Environment(IDE), which integrated text editor to write program, a compiler and it will convert your source code into HEX file. Here is simple guide to start working with Arduino IDE Vision which can be used for:

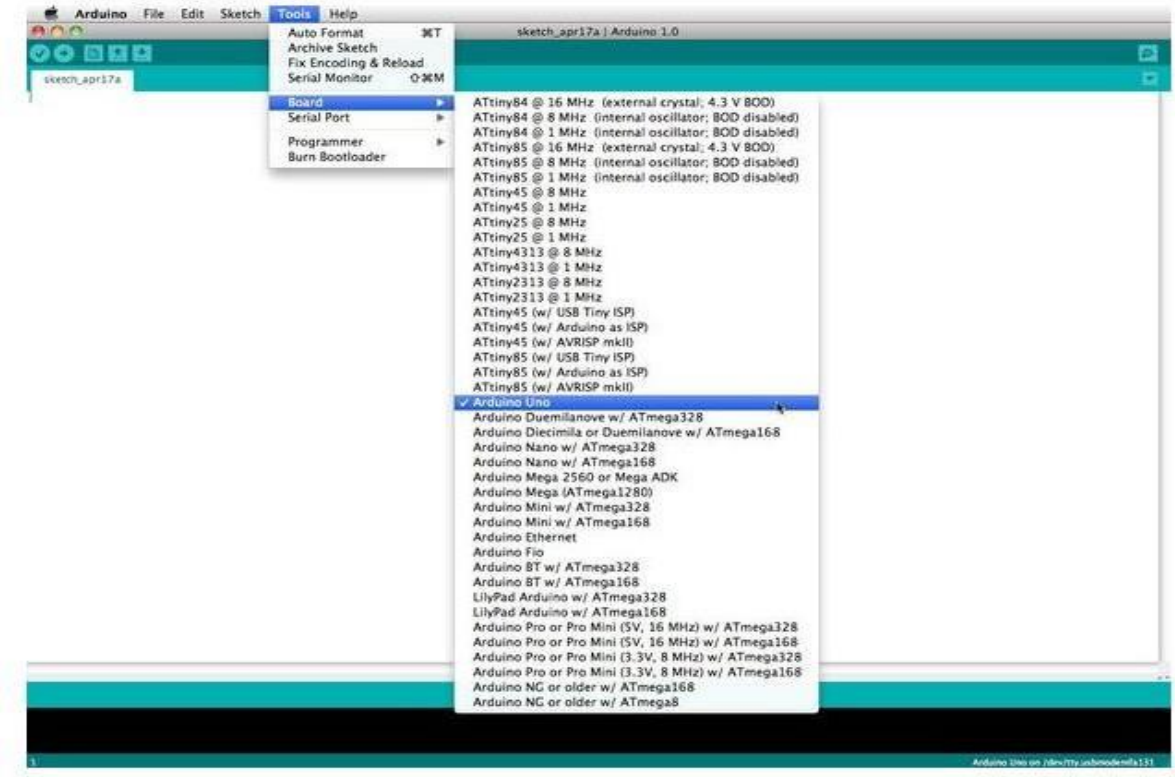
- Writing programs in Arduino IDE
- Compiling and assembling programs
- Debugging programs

5.2. SOFTWARE STEPS:

Before you can start doing anything with the Arduino, you need to download and install the Arduino IDE (integrated development environment).



After the opening IDE the settings are changed in order to connect to the Arduino.



Before you can start doing anything in the Arduino programmer, you must set the board-type and serialport.

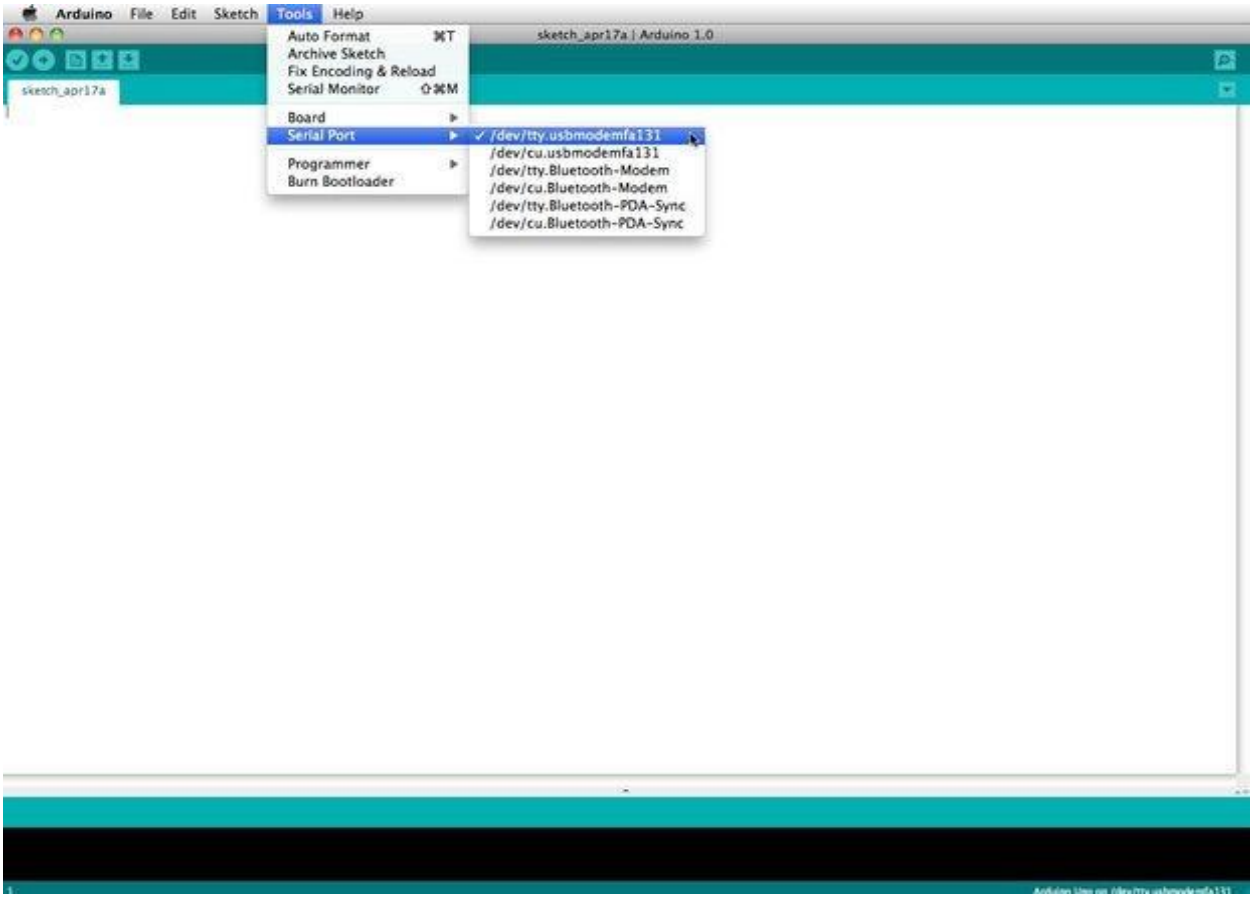
To set the board, go to the following:

Tools --> Boards

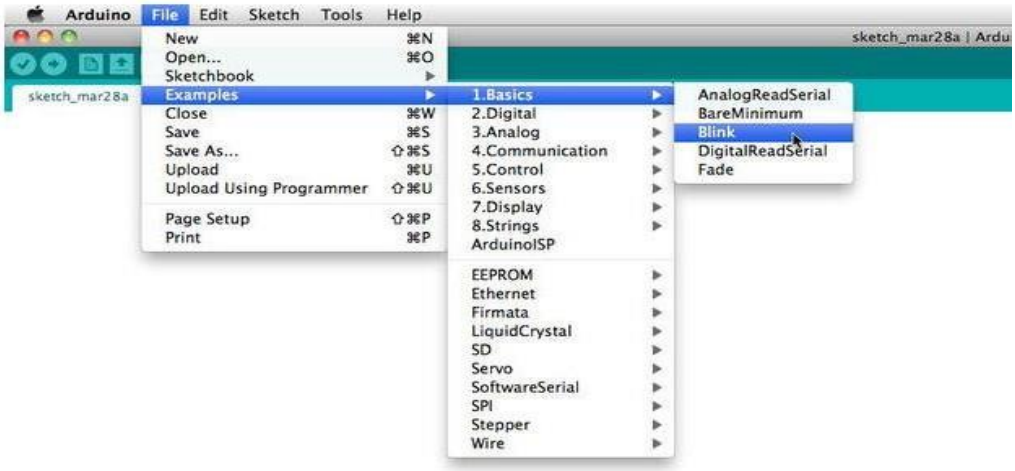
Select the version of board that you are using. Since I have an Arduino Uno plugged in, I obviously selected "Arduino Uno."

To set the serial port, go to the following:

Tools --> Serial Port



Arduino programs are called sketches. The Arduino programmer comes with a ton of example sketches preloaded. This is great because even if you have never programmed anything in your life, you can load one of these sketches and get the Arduino to do something.



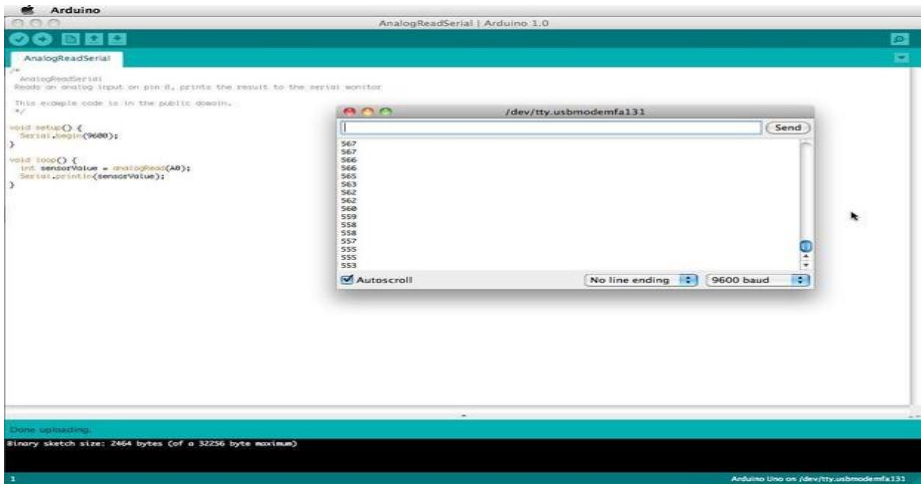
The serial monitor allows your computer to connect serially with the Arduino. This is important because it takes data that your Arduino is receiving from sensors and other devices and displays it in real-time on your computer. Having this ability is invaluable to debug your code and understand what number values the chip is actually receiving.

For instance, connect center sweep (middle pin) of a potentiometer to A0, and the outer pins, respectively, to 5v and ground. Next upload the sketch shown below:

File --> Examples --> 1.Basics --> Analog Read Serial

Click the button to engage the serial monitor which looks like a magnifying glass. You can now see the numbers being read by the analog pin in the serial monitor. When you turn the knob the numbers will increase and decrease.

The numbers will be between the range of 0 and 1023. The reason for this is that the analog pin is converting a voltage between 0 and 5V to a discreet number.



6.PROJECT DESCRIPTION

This chapter deals with working and circuits of "**COAL MINING SAFETY ROBOT**". It can be simply understood by its block diagram &circuit diagram.

6.1. BLOCK DIAGRAM:

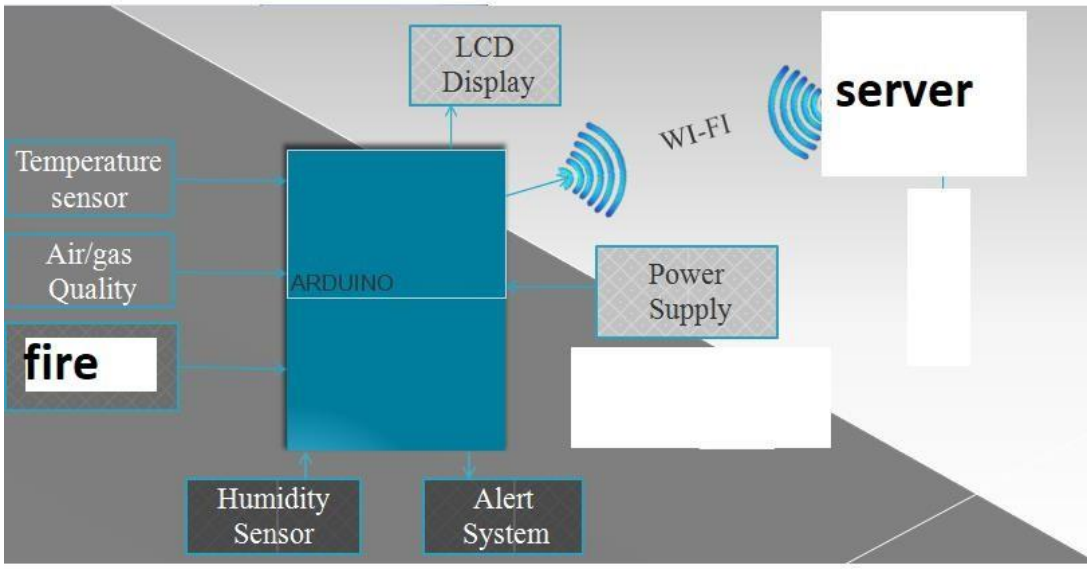


Fig 6.1 block diagram

6.2. SOFTWARE REQUIREMENTS:

- Arduino
- Embedded c language

6.3. HARDWARE REQUIREMENTS:

- Air Pollution Sensors
- TEMP, HUMIDITY Sensors
- Atmega 328 Microcontroller

- Wifi Modem
- LCD Display
- LED's
- Transformer
- Resistors
- Capacitors
- Diodes

6.4. WORKING

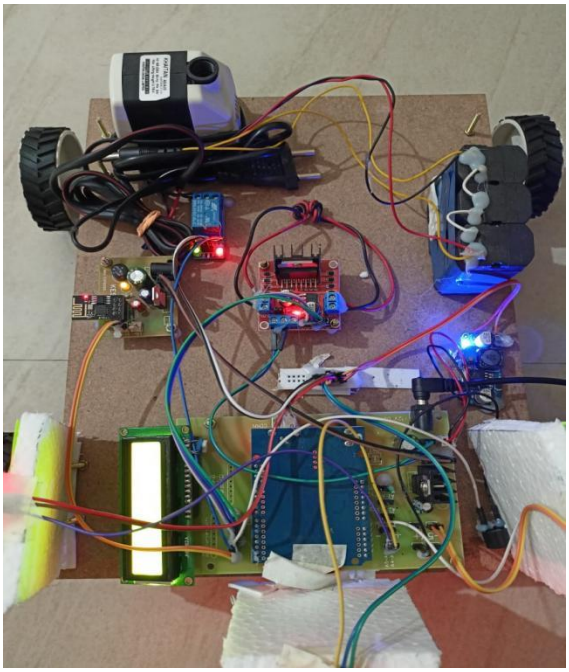
It is a difficult challenge to the employees who is working underground mine area to communicate with each other an also their many harmful gases present inside it. For them it is difficult to survive. Augmented reality, a technology that overlays the system on the real world has its smart hardware system that has been used to tackle real world problems. 'Coal Mine Safety Monitoring And Alerting System' a hardware project system that will overcome the problems facing the employees in real time. The setup is done in a hardware format it can easily connected to the undermine area for the safety purpose without any disturbance in the surrounding area and it easily detects and shows the percentage of gases present inside. The user/admin just have to login in the Thing speak server to get the corresponding values shows in the screen for the safety of the workers who is working inside the mine. Our Hardware system will provide solution to all these problems by providing the users a virtual way of placing our setup in to the coal mine.

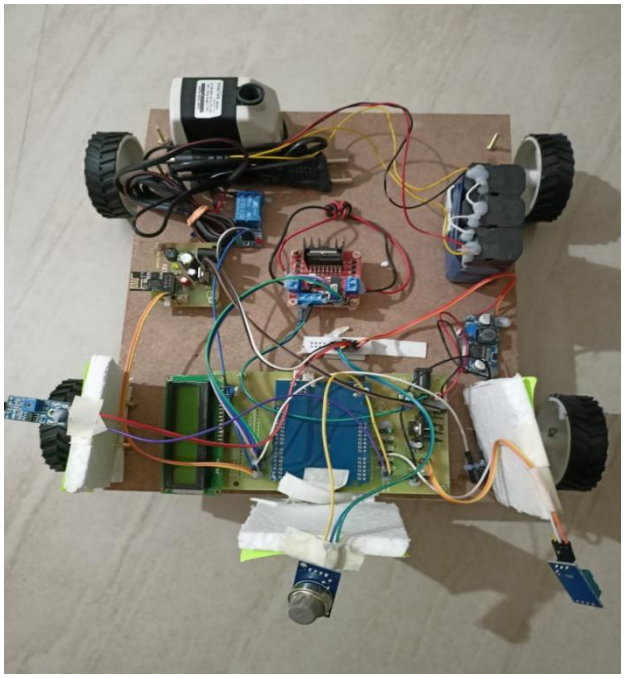
To explain the whole system, the system is divided in two sections. First section is the transmitter section and another is the receiver or monitoring section as show in figure 1 and figure 2. Transmitter section consists of helmet removal sensor, air/GAS quality sensor, HUMIDITY, fire and TEMP sensor, microcontroller and WIFI module. All the sensors are

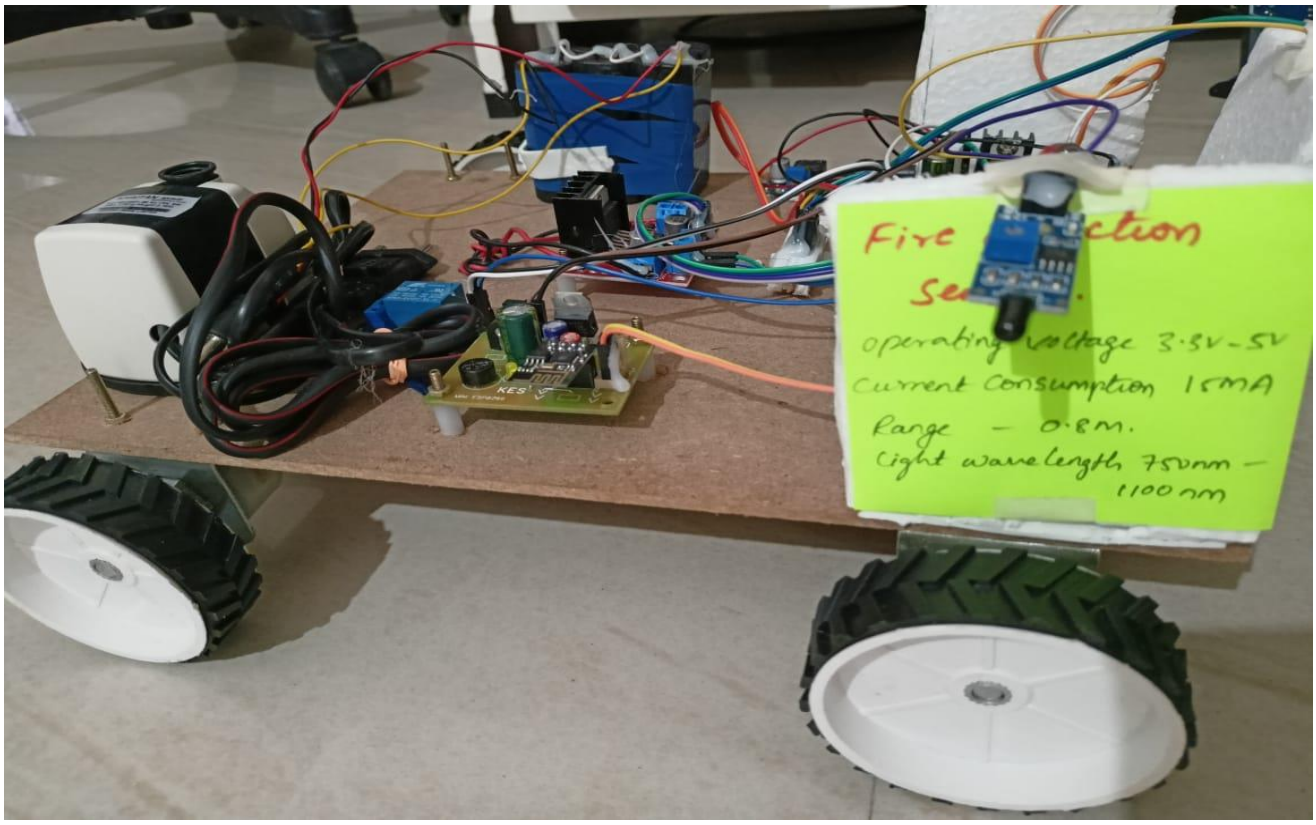
connected to the microcontroller. The helmet removal sensor is used to detect whether the safety helmet is remove or not by the miner. Air/GAS quality sensor is used to detect air/GAS pollution in miners working area. In mining industry air is polluted because of mining operation such as drilling, blasting etc. And the collision sensor is used to detect whether any object is fall on the miner head. All these sensors data is process by the microcontroller, if any dangerous event is occurred. Microcontroller processes receive signal and gives towards LCD display and buzzer.

In receiver section, when APP receiver receives alert signal then this signal is gives to the APP. Microcontroller processes receive signal and gives towards LCD display and buzzer.

6.5. RESULTS







7.1 FUTURE EXPANSION

- **Advanced Gas Analysis:**
  - Integrate advanced gas sensors for more precise identification of specific gases, providing detailed information on the type and concentration levels.
- **Machine Learning for Predictive Analysis:**
  - Implement machine learning algorithms to analyze historical data and predict potential hazards, enhancing the system's predictive capabilities.
- **Autonomous Navigation Enhancement:**
  - Upgrade the robot's navigation system to include advanced mapping and path optimization algorithms for more efficient and adaptable exploration.
- **Integration of Robotic Arm:**
  - Include a robotic arm for additional functionalities, such as sample collection, structural inspections, or even basic repair tasks within the mine.

7.2 ADVANTAGES

- Enhanced Safety: Minimizes risks to human miners by detecting and responding to potential dangers.
- Real-time Monitoring: Provides immediate data on environmental conditions to prevent accidents.
- Autonomous Operation: Reduces the need for human intervention in hazardous situations.
- Emergency Response: Enables timely and efficient responses to fire incidents or gas leaks.

CONCLUSION

We have planned to design a system for coal mine areas named as Coal Mine Safety Monitoring and Alert System. These system detects problem of coal mine employees who works underground. A real time monitoring system is developed to provide clearer and more point to point perspective of the underground mine. This system is displaying the parameters on the monitoring unit; it will be helpful to all miners present inside the mine to save their life before any casualty occurs. Alarm triggers whensensor values crosses the threshold level. This system also stores all the data in the computer for future inspection.

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