CHAPTER-1
INTRODUCTION

1.1-Introduction

Considering the daily newspapers and any other electronic or print media, a devastating news which is spreading day by day is people is becoming sick and the climate is changing such a way that it has become miserable for living of people. From the aspect from top to bottom, every people are suffering the curse of climate change. The main reason for the climate change and people health is air pollution. It has brought changes in climate like global warming, global dimming, over raining, drought, storms, acid rain, foggy weather etc. The living things on earth and under water are suffering many problems like change in life due to lack of proper facilities of life. Air is the most useful thing for each and every living thing. Researching on this serious issue this system's main purpose was to estimate the quality of air for people and any other living thing which exist on earth. Very important to know for our living is that how much safe we are now and how the weather and climate has changed for air pollution and it will sustain sound. This system will ease to know the answers for air quality. Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone. Whereas in EU number reaches to 300,000 and over 3,000,000 worldwide. IOT Based Air Pollution Monitoring System monitors the Air quality over a web server using Internet and will trigger an alarm when the air quality goes down beyond a certain threshold level, means when there are sufficient amount of harmful gases present in the air like CO2, smoke, alcohol, benzene, NH3, LPG and NOx. It will show the air quality in count on the LCD and as well as on webpage so that it can monitor it very easily. LPG sensor is added in this system which is used mostly in houses. The system will show temperature and humidity. The system can be installed anywhere but mostly in industries and houses where gases are mostly to be found and gives an alert message when the system crosses threshold limit.

1.2 Objective of this Project

The main objective of IOT Air Pollution Monitoring System is that the Air pollution is a growing issue these days. It is necessary to monitor air quality and keep it under control for a better future and healthy living for all. Due to flexibility and low cost Internet of things (IoT) is getting popular day by day. With the urbanization and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analysed interpreted and presented. This information can then be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day.

1.3 Thesis Contribution

Previously some researchers have done some experiments on air pollution monitoring system. As we are moving forward to smart system day by day so according to the fact the objective for making the system was to take the environmental automatically and analyse the system using smart technologies. The system introduced the idea automatic data collection and analysis. The mean average and deviation is used to analysis the result of the system. We have found that this approach often fails to detect the pollution properly. As later steps usually require the output from this step, a failure to extract a blob in this step means the later steps do not even get the chance to present their own evaluation, resulting in poorer overall accuracy. We have taken a more liberal approach to overcome this limitation by taking the vote of all the rules and segmenting the image based on air pollution detecting decision. This increases the accuracy of detecting gasses even for further analysis wherever needed. Another thing to take into account is that such detectors alone are not sufficient enough for detecting gasses in diverse environments. Many algorithms therefore incorporate other characteristics of fire gasses in order for more accurate identification. The model proposed in this paper incorporates normal emission and proposes an enhanced detection analysis of fire to eliminate the chances of producing air pollution as well as increasing the accuracy of detection. This approach has produced accuracy of temperature 94.34% and for humidity 98.43%.

CHAPTER-2
LITERATURE REVIEW

The project majorly consists of one main technologies that is Internet of Things which is described below:

2.1 Internet of Things

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data. IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally dumb or non-internet enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

The IoT's major significant trend in recent years is the explosive growth of devices connected and controlled by the Internet. The wide range of applications for IoT technology mean that the specifics can be very different from one device to the next but there are basic characteristics shared by most. IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions.

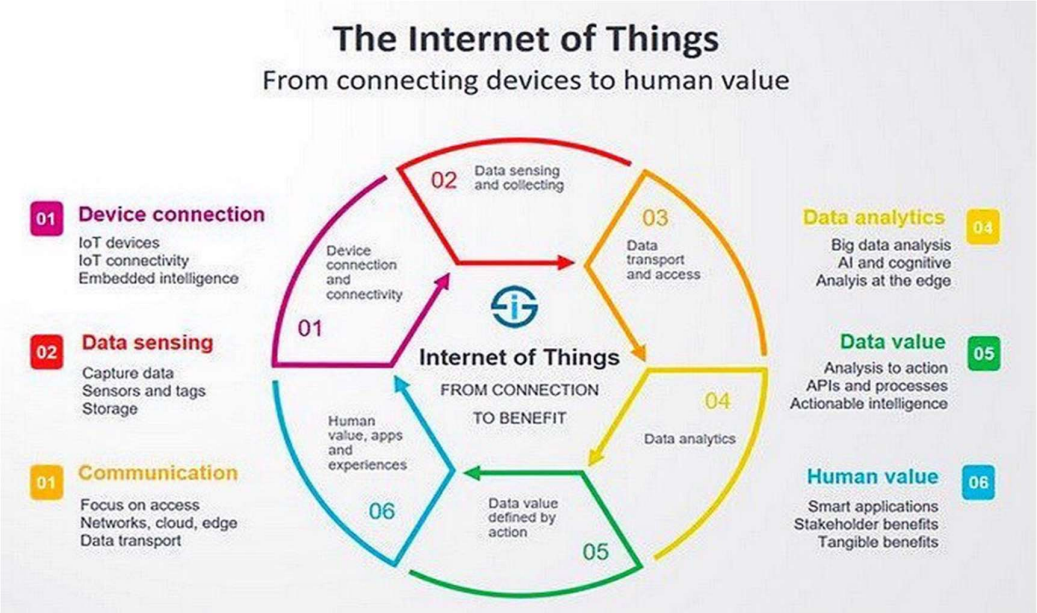


Figure 2.1 Various Application of IoT

Internet of Things (IoT) is a concept that encompasses various objects and methods of communication to exchange information. Today, IoT is more a descriptive term of a vision that everything should be connected to the Internet. IoT has become the basic choice of the future technology, which allows the man machine interaction that can be accessible through Internet. Idea is to connect and communicate with each other in the open environment. However, there are some security challenges that have to be taken under the consideration.

IoT application has provided the door for the new innovation research for the upcoming future technology. During the last decade, Internet of Things (IoT) has attracted intensive attention due to a wide range of applications in industrial, biomedical observation, agriculture, smart cities, environmental monitoring and other fields Figure 2.1. IoT is the network of the things that are connected with each other using standard communication architectures to provide services to end users. IoT technology provides better services to end users via real-time data processing, communications and visualization. It is envisioned that by 2020, the tens billions of smart objects/devices will be connected with the Internet. Objects include both virtual and physical objects, which are connected to IoT are categorize as-

1. Electronic devices (e.g. computers, mobile phones, televisions, machines, and robots)

2. Sensors (connected through devices or gateways)
3. Communicating includes different protocols and technologies for sending digital or analogue signals through nodes (e.g. Constrained Application Protocol, File Transfer Protocol, Hypertext Transfer Protocol, etc. in Local Area Networks, Wide Area Networks, Body Area Networks, Wi-Fi, Ethernet, fiber optic links, radio etc.)
4. Capabilities include, but are not limited to:-
   a) Gathering information,
   b) Processing information
   c) Storing information, and
   d) Presenting information.
5. A process could include:-
   a) Tracking health information,
   b) Room temperature your home,
   c) Lighting public streets, and
   d) Keeping track of assets.

The massive growths in the number of devices connected in billions are to the Internet hence open the new challenges for the research and also for the world in term of power consumption security etc. At present each of these devices connects to the IoT users their own architectures, data processing and their existing protocol stacks. They are all still at early stages of development. Hence, the communication between these objects is insecure, suffers from interoperability and integration issues. Furthermore, the sources of energy required to connect these devices is the initial issue. Some of the open challenges are the power consumption that is being used for development of IoT application.

Therefore, there is a need for comprehensive review of existing unconstrained and constrained devices protocols with the view of developing unified, dynamic, standardized, energy efficient and intelligent protocol used for IoT. These new challenges and concerns has been research topic for the researchers and companies for developing IoT applications.

2.2.1 Origin of Internet of Things

The term Internet of Things is 16 years old. But the actual idea of connected devices had been around longer, at least since the 70s. Back then, the idea was often called "embedded internet" or "pervasive computing". But the actual term "Internet of Things" was coined by Kevin Ashton in 1999 during his work at Procter & Gamble. Ashton who was working in supply chain optimization, wanted to attract senior management's attention to a new exciting technology called RFID. Because the internet was the hottest new trend in 1999 and because it somehow made sense, he called his presentation "Internet of Things". The popularity of the term IoT did not accelerate until 2010/2011 and reached mass market in early 2014. He concept of IoT started to gain some popularity in the summer of 2010.

2.1.2 Benefits of IoT

IoT allows devices to be controlled remotely across the internet, thus it created opportunities to directly connect & integrate the physical world to the computer-based systems using sensors and internet. The interconnection of these multiple embedded devices will be resulting in in nearly all fields and also enabling advanced applications. This is resulting in improved accuracy, efficiency.

2.1.3 Application of IoT

The term IoT is being used in different contexts, such as the body, homes, cities, industry, and the global environment. IoT can be used in practically all scenarios for public services by governments to make cities environment friendly. 1TSensor-enabled devices can help monitor the environmental impact on cities, collect details about sewers, air quality, and garbage. Such devices can also help monitor woods, rivers, lakes, and oceans.

Many environmental trends are so complex, that they are difficult to conceptualize. IoT is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will enable them to communicate not only with one another but also the users, becoming an integral part of the Internet and the environment.

IoT environmental monitoring applications usually use sensors to lend a hand in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource constrained devices connected to the Internet also means that other applications such as tsunami or earthquake early warning systems can also reported and used by emergency services to provide effective aid.

An urban IoT can provide means to monitor the quality of the air in crowded areas, parks, or fitness trails. The realization of such a service requires that air quality and pollution sensors be deployed across the city and the sensor data be made publicly available to citizens.

With this motivation, we develop IoT based Air Pollution Monitoring system which will automatically monitor the pollution level from anywhere using mobile or computer and send SMS alert to the user.

2.2 Literature Review

Pollution is increasing in an alarming rate every day. Air is the most sensitive element of the environment which is polluted momentarily by the elements emitted to air. To know the level of air pollution and air quality this proposed system is a wireless sensor network that works mainly monitoring the pollution happening in a smart city. It is a low budget monitoring system with cheap but efficient sensors. Some previous works like Smart environment monitoring system on vehicles was introduced on 2015. It basically figured out the emission rate of poisonous gasses which are responsible for air pollution. Industrial air pollution monitoring system for safety and health enhancement was introduced to know the hazardous gasses and their impact. Low cost air quality system was discussed on 2008 as because at that time the sensors were quiet expensive and also the system. By using mobile GPRS system air pollution could be detected. Wireless sensor network based pollution monitoring system in metropolitan cities was introduced to know the air quality. Pollution Dynamic Monitoring System is also done previously. By reviewing the future researches which has done before we can say that air pollution has increased in an alarming rate. If it is not stopped immediately the whole world is going to face a filthy and extreme weather for the future. There are more pollutions e.g. water pollution, noise pollution, plastic pollution, soil contamination but from the future studies we can say that air pollution is the most alarming issue and this should be studied for the sake of saving the world. The major outdoor pollution sources include vehicles, power generation, building heating systems, agriculture/waste incineration and industry. In addition, more than 3 billion people worldwide rely on polluting technologies and fuels (including biomass, coal and kerosene) for household cooking, heating and lighting, releasing smoke into the home and leaching pollutants outdoors. From 9 out of 10 people worldwide breathe polluted air. To prevent the air pollution there should be launched green energy. World Health Organization: WHO estimates that ambient pollution alone caused some 4.2 million deaths in 2016, while household air pollution from cooking with polluting fuels and technologies caused an estimated 3.8 million deaths in the same period. So, the idea was to make such a system

which will let people know what amount of toxic air is inhaled. This system includes the studies from previous research how much it is important to work on such a topic. To make such a device which will be portable and can easily be installed was the main idea. Android device user and internet user has increased tremendously. For ease of people the result of the device can be seen in a website as well as in android app.

By measuring pollution about air, water and sound on everyday life it would be great significance for the health of human if the level of pollution is measured. For detecting the air pollution different types of pollution monitoring gas sensors will be placed in different points of the city. The main priority will be the polluted area and the area that contains harmful particles to human. These sensors will collect practical data in real time from different affected areas on different gases (for air and water) which are present in the environment e.g. nitrogen dioxide (NO2), carbon monoxide (CO), methane (CH4) and humidity. It will also collect data about the pollution level of the sound inside the city. The proposed system allows monitoring mainly air quality, water quality, sound quality and the pollution condition of a smart city on a desktop/laptop computer through an application designed using graphical User Interface (GUI) programming that gives signal when pollution nature exceeds the acceptable levels.

2.3 Motivation

Not a single living thing can survive without air. Air is the most important element for living. According to the SDG (Sustainable Development Goals) by the UN (United Nations) there are seventeen goals to transform the world to clean, healthy and natural way to live in because at this time there are several problems in human life. According to SDG:

i) Ensure healthy lives and promote well-being for all at all ages.
ii) Ensure access to affordable, reliable, sustainable and modern energy for all.
iii) Ensure sustainable consumption and production patterns.
iv) Take urgent action to combat climate change and its impacts.
v) Conserve and sustainably use the oceans, seas and marine resources.
vi) Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss. These are the main reason why the topic was chosen for the project purpose.

CHAPTER-3
PROPOSED MODEL

3.1 Introduction

The Proposed model of the system is as follows. Figure 3.1 shows how the whole system will work. The block diagram of the system is showing that for a particular area selected how will it work. The device will be set up to take the environmental data and there will be a base standard value. The device will collect data and based on the set values it will show the output.

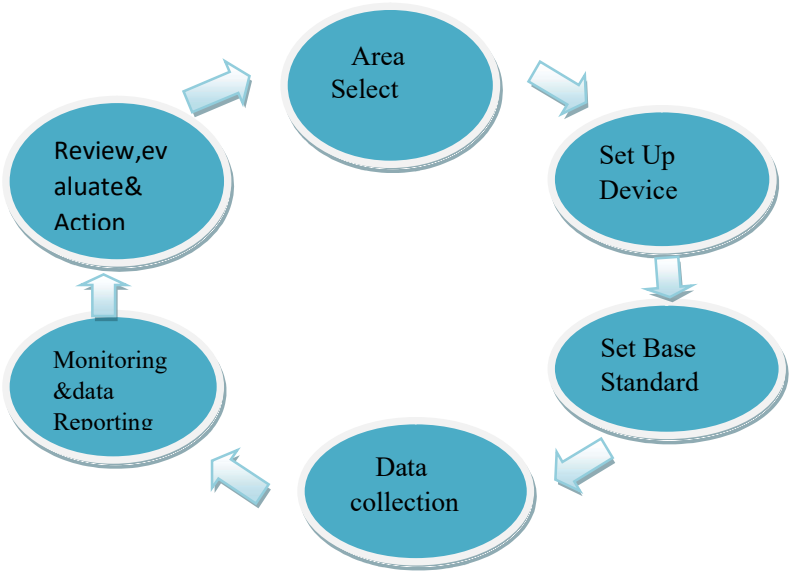


Figure 3.1: Proposed model of the system

In this project we are going to make an IOT Based Air Pollution Monitoring System in which we will monitor the air quality over a web server using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO2, CO, smoke, alcohol, benzene and NH3.It will show the air quality in count on the LCD and as well as on the webpage so that we can monitor it very easily.

Previously we have built the LPG detector using MQ6 sensor and Smoke detector usingMQ2 sensor but this time we have used MQ135 sensor which is best choice for monitoring Air Quality as it can detect the most harmful gases and can measure their amount accurately in count. In this IOT project, you can monitor the pollution level

from anywhere and can also trigger some device when pollution goes beyond some level, like we send the alert SMS to the user.

3.1.1 Block Diagram of Proposed System

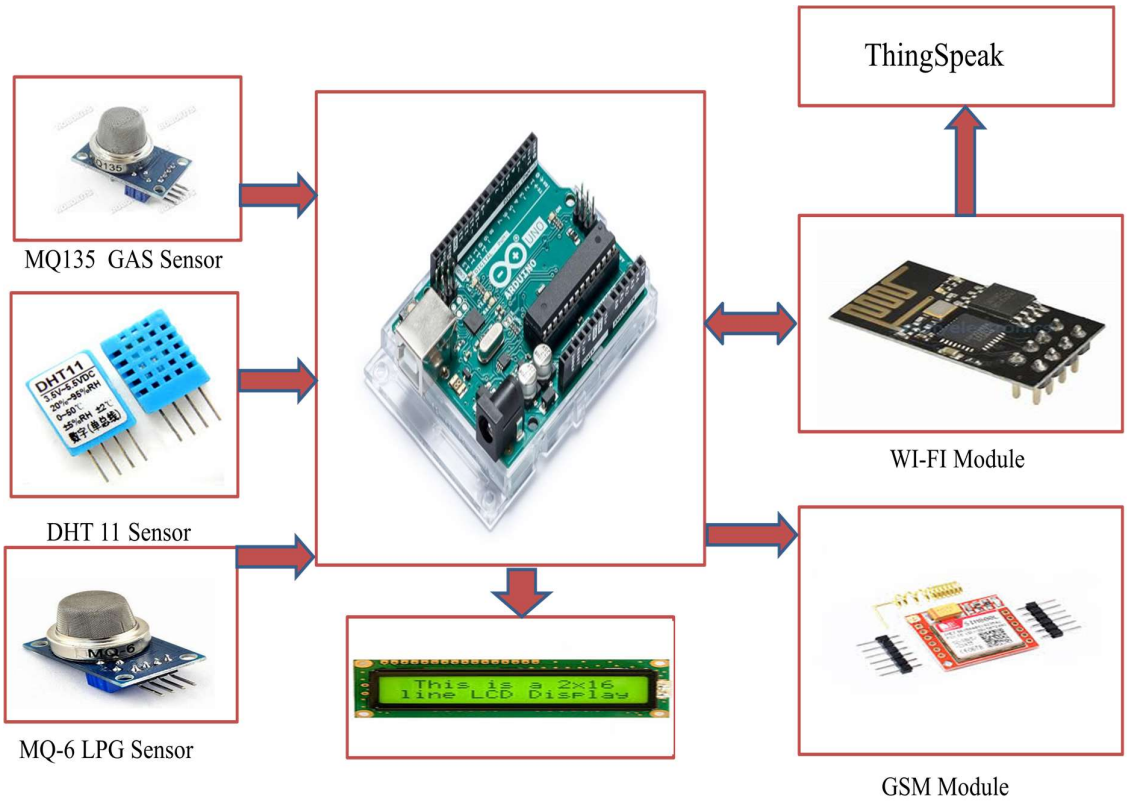


Figure3.2: Block Diagram for proposed model

Proposed System Flow Chart

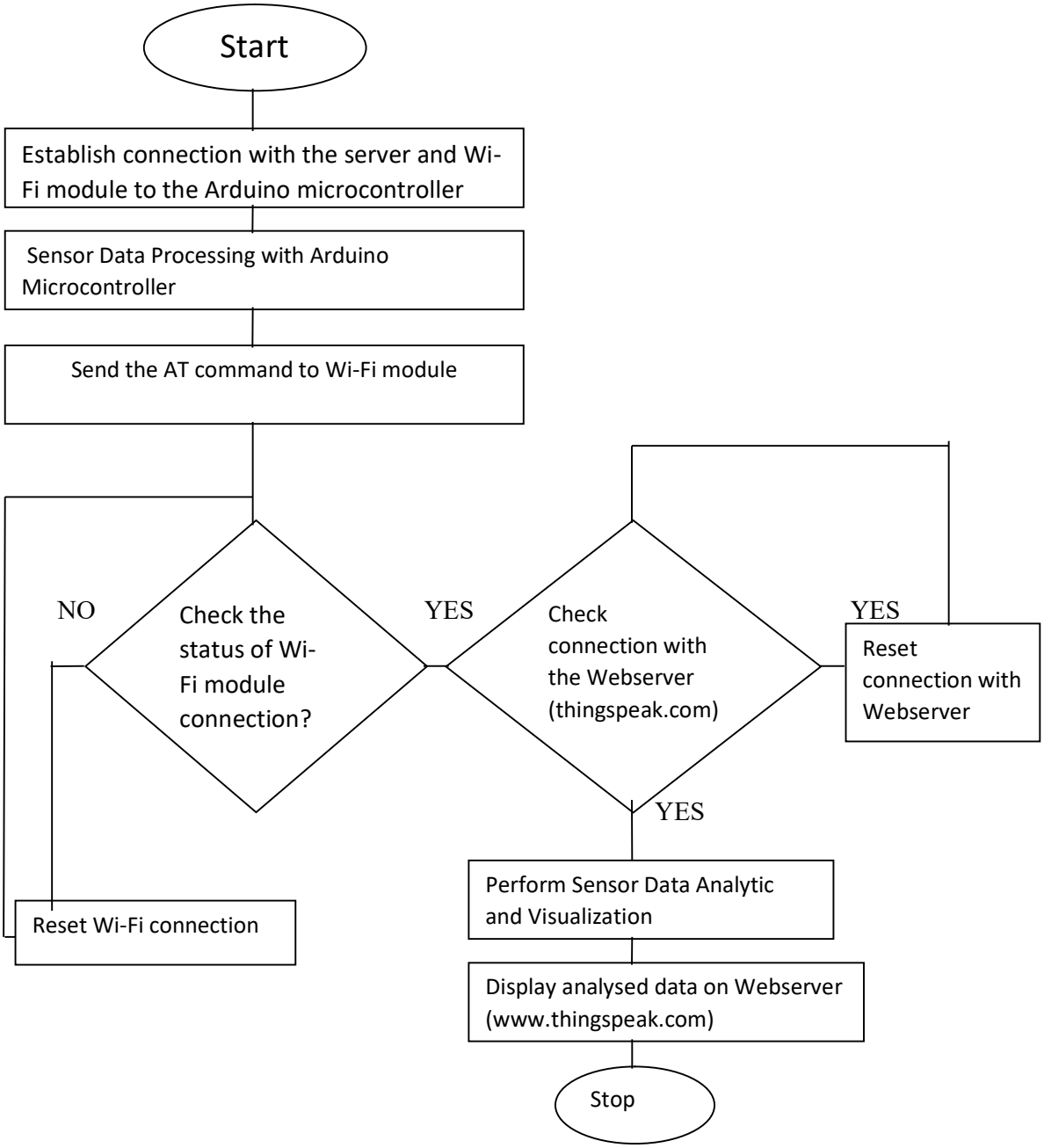


Figure3.3: Flow chart for the proposed model

3.2 System Requirements (Hardware Components)

The system, which we proposed, is built with various sensors and these sensors take data by sensing from the environment. The data which is taken from the surrounding environment has been selected for our project. The sensors takes analog data from the surrounding which is converted into digital with the help of Arduino UNO and upload to the server where all data's are stored. This system is consisting of the following components:

1. Arduino UNO
2. MQ135 Gas sensor
3. MQ06 LPG sensor
4. DHT 11 Temperature and Humidity sensor
5. GSM module
6. Wi-Fi module
7. LCD display

3.2.1 Arduino UNO

The Arduino UNO is an microcontroller based on microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The high-performance Microchip picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes.

The device operates between 1.8-5.5 volts. By executing powerful instructions in a single

clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Figure 3.4: Arduino UNO

There are many different types of Arduino boards which are available in the market and some of them are-

1. Arduino UNO
2. Arduino PRO
3. Arduino MICRO
4. Arduino NANO
5. Arduino MEGA
6. Arduino ZERO
7. Arduino DUE
8. Arduino YUN

The above listed Arduino boards are some of the most commonly used microcontroller.

Table 3.1: - Key Parameters of ARDUINO

Parameter	**Value**
Program Memory Type	Flash
Program Memory Size (KB)	32
CPU Speed (MIPS/DMIPS)	20

SRAM Bytes	2048
Data EEPROM/HEF (bytes)	1024
Digital Communication Peripherals	1-UART, 2-SPI, 1-I2C
Timers	2 x 8-bit, 1 x 16-bit
Operating Voltage Range (V)	1.8 to5.5
Pin Count	32
Low Power	Yes

3.2.1.1 Working of microcontroller Arduino

The basic working of the microcontroller is quite simple as to compared to other microcontroller as it is open source microcontroller and easy to program. It can be simply powered with the help of a battery to which a power jack is soldered or by the means of USB or by using an adapter. The microcontroller provides voltage of 1.8 to 5.5 volts and a source of ground so that it can be used to power-up the other hardware material used with it for other functions. ATmega-328 is an AVR microcontroller having twenty eight (28) pins in total.

3.2.1.2: -Atmega328P Microcontroller Pin Description:

ATmega-328 pins are divided into different ports which are given in below

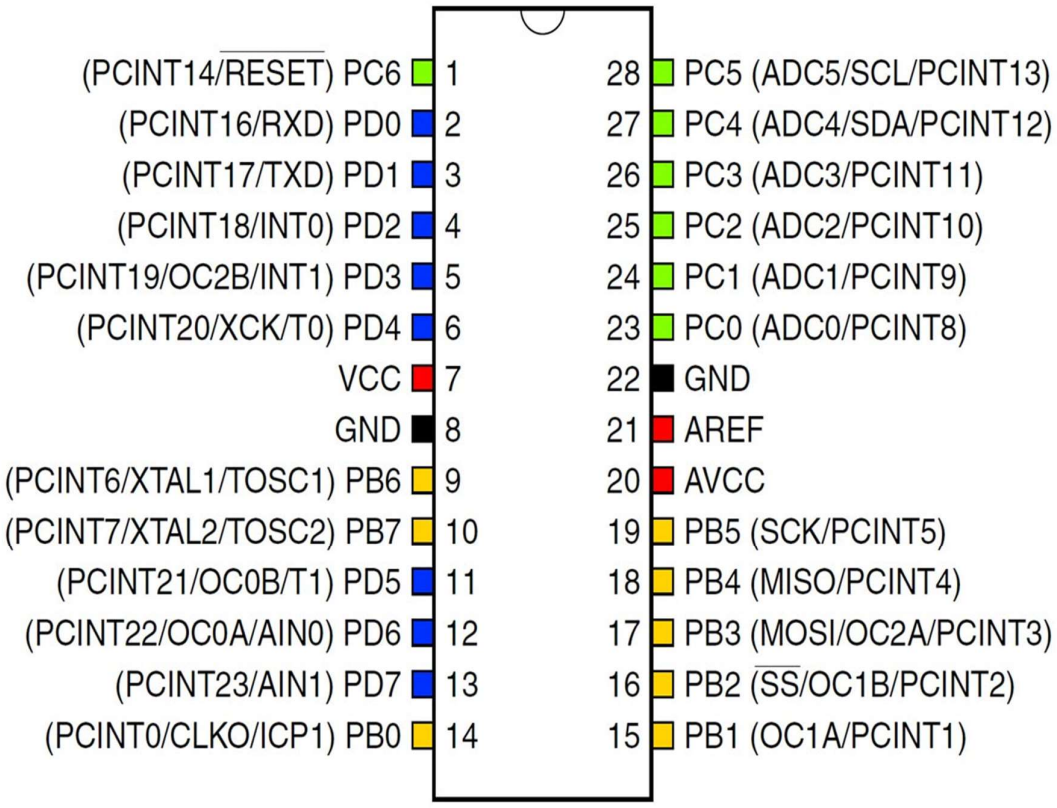


Figure 3.5: Atmega328P microcontroller pin description

- AVCC is a supply voltage pin for analog to digital converter.

- GND denotes Ground and it has a 0V.
- Port A consists of the pins from PA0 to PA7. These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, port A acts as an eight (8) bit bidirectional input/output port.
- Port B consists of the pins from PB0 to PB7. This port is an 8 bit bidirectional port having an internal pull-up resistor.

- Port C consists of the pins from PC0 to PC7. The output buffers of port C has symmetrical drive characteristics with source capability as well high sink.
- Port D consists of the pins from PD0 to PD7. It is also an 8 bit input/output port having an internal pull-up resistor.

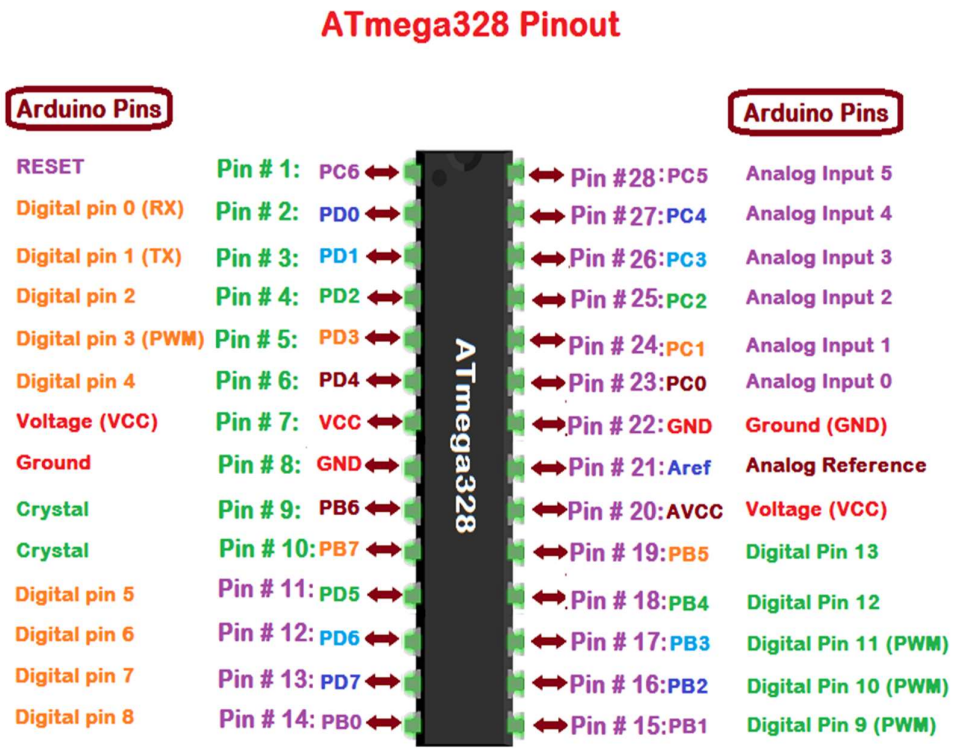


Fig 3.6: ATmega328P pinout

3.2.1.3 Atmega328P AVR Microcontroller Architecture:

ATmega328P architecture is shown in the figure given below:

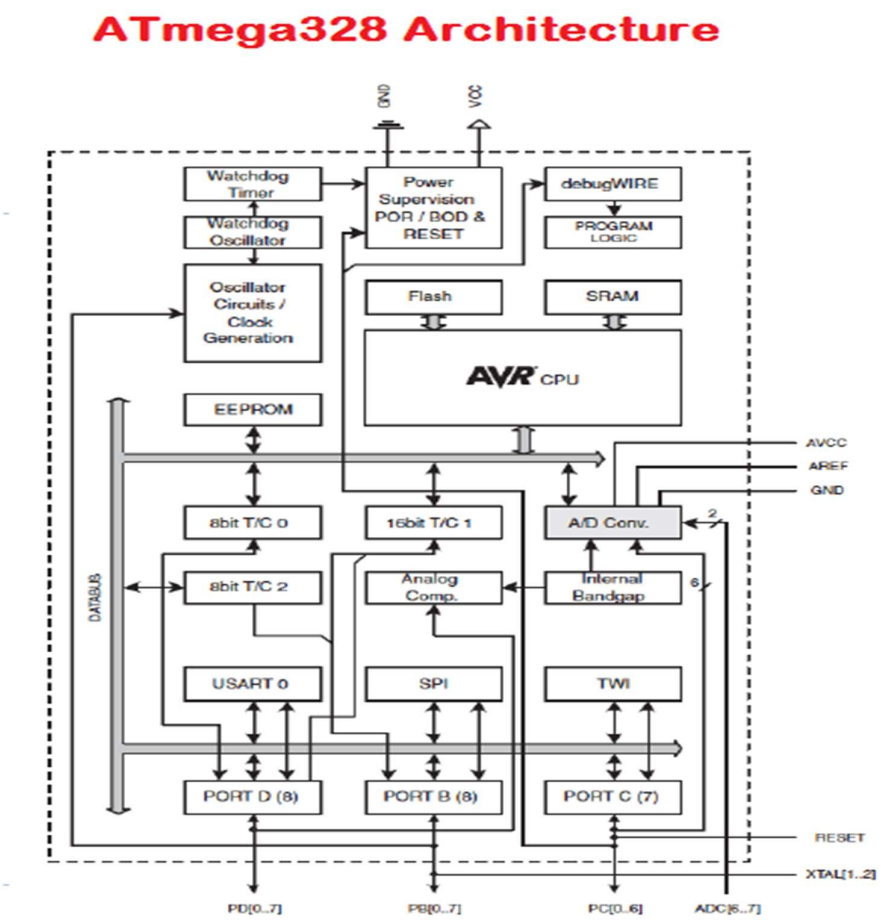


FIG 3.7: ATMEGA328P AVR Microcontroller Architecture

- ATmega328P has three types of memories e.g. EEPROM, SRAM etc.
- The capacity of each memory is explained in detail below.

Flash Memory has 32KB capacity. It has an address of 15 bits. It is a Programmable Read Only Memory (ROM). It is non -volatile memory

SRAM stands for Static Random Access Memory. It is a volatile memory i.e. data will be removed after removing the power supply.

EEPROM stands for Electrically Erasable Programmable Read Only Memory. It has a long term data.

3.2.1.4:- Uploading program

The programming of the microcontroller is written and compiled in the original Arduino 1.8.5 software. To upload the program to the microcontroller, the Arduino is connected to PC with the help of a USB connector specially designed for the micro-controller. The program is first compiled and verified and then the correct port and board (Arduino) is selected from the tools of the software.

Once the program is verified and if it is free of any error then the program was uploaded to the micro-controller board. At the time of uploading of code, the LED of Tx and Rx will flash few seconds and the LED indicator next to them will light up on successfully uploading the code.

3.2.2 MQ135 Gas sensor

The MQ135 sensor can sense NH3, NOx, alcohol, Benzene, smoke, CO2 and some other gases. It gives the output in form of voltage levels. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulphide and Benzene steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application.

Fig.ure 3.7: MQ135

Features of MQ135 Gas sensor

- It has Wide detecting scope
- It gives fast response and havinghigh sensitivity
- Stable and long life

- Operating Voltage is +5V
- Detect/Measure NH3, NOx, alcohol, Benzene, smoke, CO2, etc.
- Analog output voltage: 0V to 5V
- Digital output voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

3.2.3 MQ-6 LPG Gas Sensor

This is a simple-to-use MQ-6 Liquefied Petroleum Isobutane Propane Gas Sensor module, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm.

Figure 3.8: MQ-6 LPG Gas Sensor

This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The drive circuit is very simple; all you need to do is power the heater coil with 5V, add a load resistance, and connect the output to an ADC.

Sensitive material of MQ-6 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exists, The sensor's conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to the corresponding output signal of gas concentration.

MQ-6 gas sensor has high sensitivity to Propane, Butane, and LPG, also the response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application.

Features of MQ6 Gas sensor

- Operating Voltage is +5V
- Can be used to detect LPG or Butane gas
- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

Application

1. The domestic gas leakage detector
2. Industrial Combustible gas detector
3. Portable gas detector

3.2.4 DHT 11 Sensor

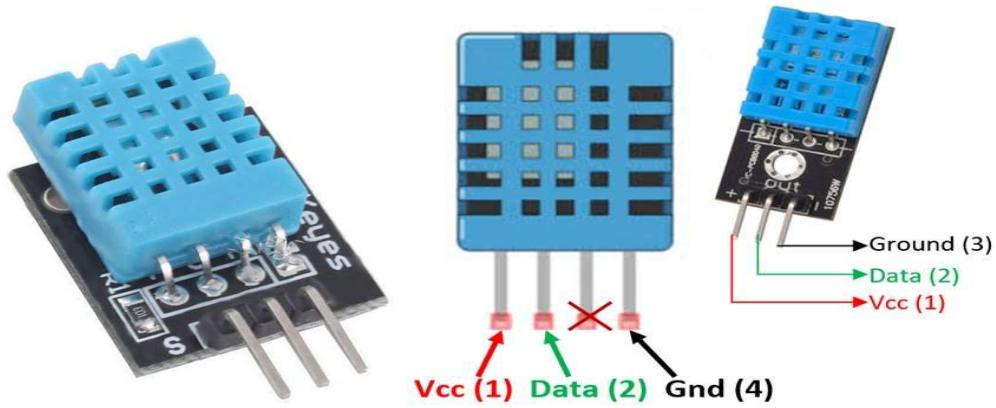
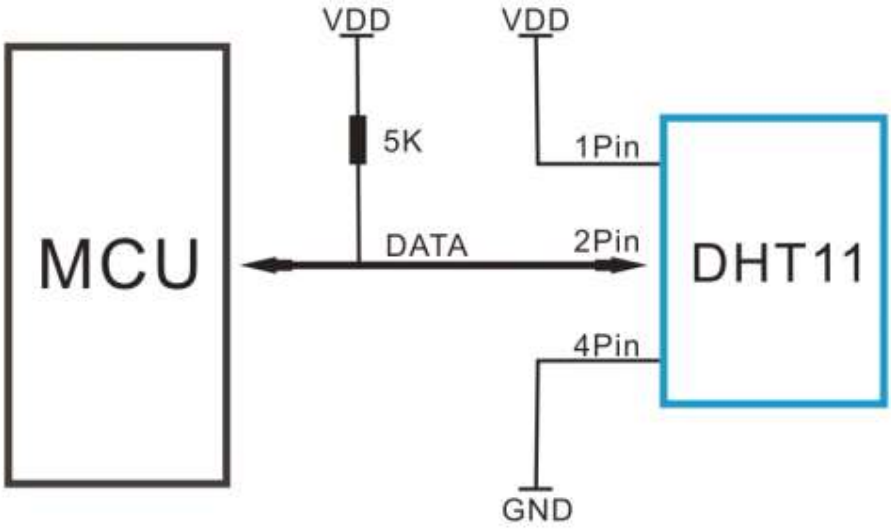


Figure 3.9: DHT 11 Sensor

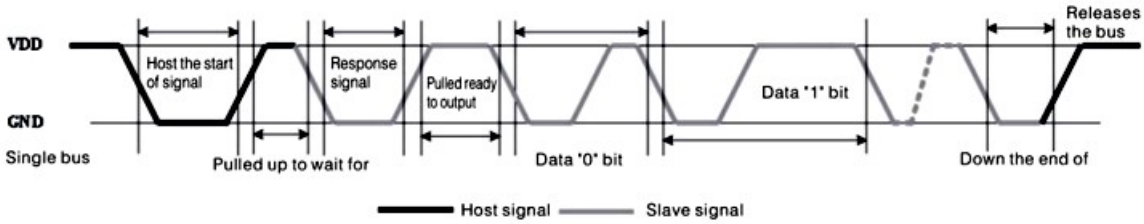
How to use DHT11 Sensor:

The DHT11 Sensor is factory calibrated and outputs serial data and hence it is highly easy to set it up. The connection diagram for this sensor is shown below.



As you can see the data pin is connected to an I/O pin of the MCU and a 5K pull-up resistor is used. This data pin outputs the value of both temperature and humidity as serial data. If you are trying to interface DHT11 with Arduino then there are ready-made libraries for it which will give you a quick start.

If you are trying to interface it with some other MCU then the datasheet given below will come in handy. The output given out by the data pin will be in the order of 8bit humidity integer data + 8bit the Humidity decimal data +8 bit temperature integer data + 8bit fractional temperature data +8 bit parity bit. To request the DHT11 module to send these data the I/O pin has to be momentarily made low and then held high as shown in the timing diagram below



The duration of each host signal is explained in the DHT11 datasheet, with neat steps and illustrative timing diagrams

Applications:

- Measure temperature and humidity
- Local Weather station
- Automatic climate control
- Environment monitoring

3.2.5 WIFI Module (ESP8266):

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability. It runs on 3.3V and gives our system access to Wi-Fi or internet. Fig. shows Wi-Fi Module (ESP8266). The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning,

you can simply hook this up to your Arguing device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution!

Note: The ESP8266 Module is not capable of 5-3V logic shifting and will require an external Logic Level Converter. Please do not power it directly from your 5V dev board.

Note: This new version of the ESP8266 Wi-Fi Module has increased the flash disk size from 512k to 1MB.

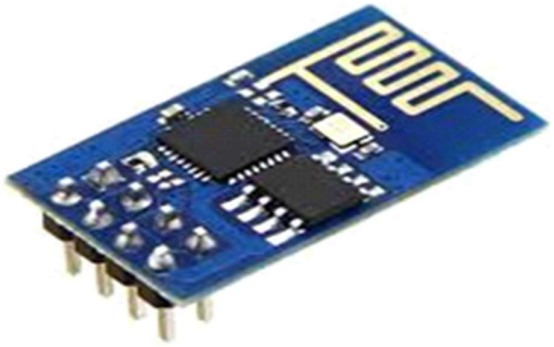


Figure3.10: Wi-Fi module

Specifications

- Integrated low power 32bit MCU.
- Integrated 10bit ADC.
- Integrated TCP/IP protocol stack.
- Operating temperature range : -40 ° C ~ 125 ° C.
- Frequency range : 2.4GHz - 2.5GHZ.
- Operating voltage : 3.0v~3.6v.
- Operating current: Average value 80mA.

3.2.5.1 ESP8266pin out

ESP8266 comes with eight pins named:

- RX
- VCC (+3.3 V; can handle up to 3.6 V)
- GPIO 0 General-purpose I/O No. 0
- RST, Reset
- CH_PD (Chip power-down)
- GPIO 2 General-purpose I/O No. 2
- TX
- GND

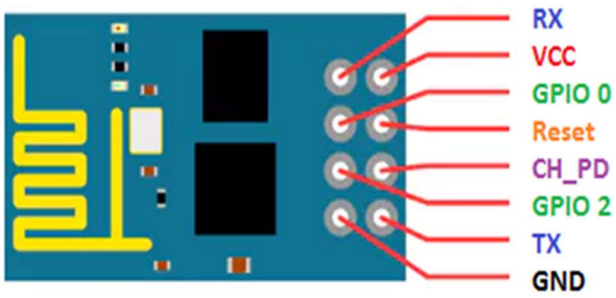


Figure 3.11: ESP8266 pinout

Each pin comes with a specific function associated with it where Vcc and GND are voltage source and ground respectively.RX and TX are used for communication where TX is dedicated for data transmission and RX is used receiving data.

3.2.5.2:- How to power up the module:

You can power up the device with PC port using USB to Serial adaptor. The 2 AA and LIPO batteries are equally handy for powering up the device.

It is advised to not power this device directly with 5V dev board. Doing so can severely affect the quality and overall performance of the device.

3.2.6 LCD (Liquid Crystal Display):

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an

instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. This is a basic (16x2) 16 character by 2 line display. Black text on Green background. It is used to indicate the Air and Humidity in PPM.

Figure 3.12: LCD

3.2.7 GSM Module:

GSM Module is used to establish communication between a computer and a GSM system. Global System for Mobile communication (GSM) is an architecture used for mobile communication.

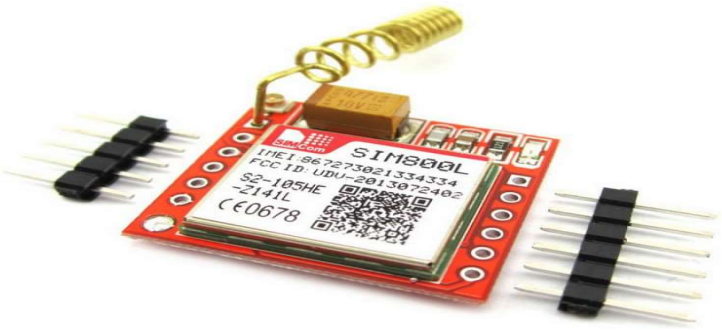
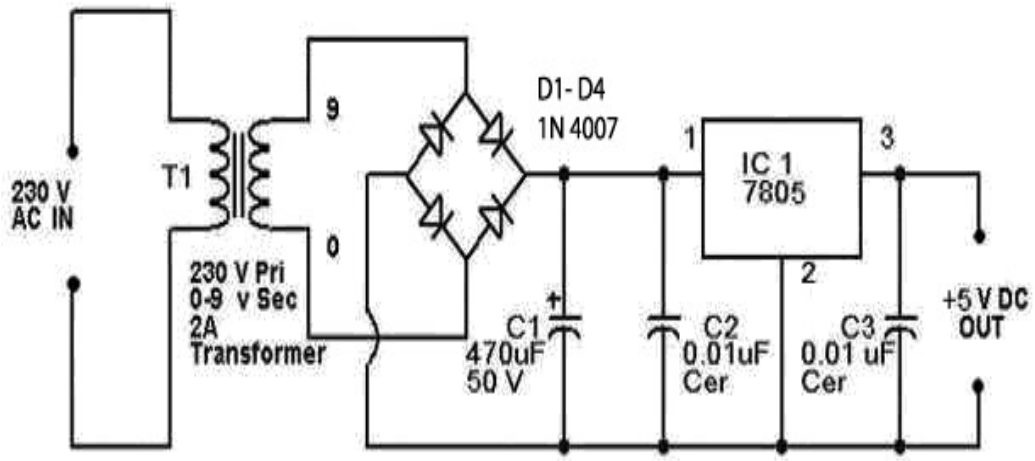


Figure 3.13: GSM Module

Features of GSM Module:

- Improved spectrum efficiency
- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialing number (FDN)
- Real time clock with alarm management
- High-quality speech
- Uses encryption to make phone calls more secure
- Short message service (SMS)

3.3 Power Supply



3.3.1 Working

This design is based around 4 main parts. A transformer, bridge rectifier, a smoothing capacitor and the LM7805 chip which contains a 'linear voltage regulator'. Transformer is used to convert 220 VAC to 18 VAC. Bridge rectifier is used to convert AC to ripple DC. Capacitor is used to filter ripples from dc. 7805 voltage regulator is used to regulate voltage to 5 VDC. LED is used for indication power supply is working or not.

3.3.2 Linear power supply

A linear regulated power supply regulates the output voltage by dropping excess voltage in a series dissipative component. They use a moderately complex regulator circuit to achieve very low load and line regulation. Linear regulated power supplies also have very little ripple and very little output noise. The above power supply is linear power supply.

3.3.3 The Basic Working Principle

The basic working principle of a transformer is simple, electromagnetic induction. According to this principle, a varying magnetic flux associated with a loop will induce an electromotive force across it. Such a fluctuating magnetic field can easily be produced by a coil and an alternating E.M.F (E_P) system. A current carrying conductor produces a magnetic field around it. The magnetic field produced by a coil will be as shown in the first part of Fig.2. With the fluctuating nature of the alternating current, the magnetic field associated with the coil will also fluctuate.

This magnetic flux can be effectively linked to a secondary winding with the help of a core made up of a ferromagnetic material. The linked magnetic flux is shown in the second part of Fig.2. This fluctuating magnetic field will induce an E.M.F in the secondary coils due to electromagnetic induction. The induced E.M.F is denoted by E_S.

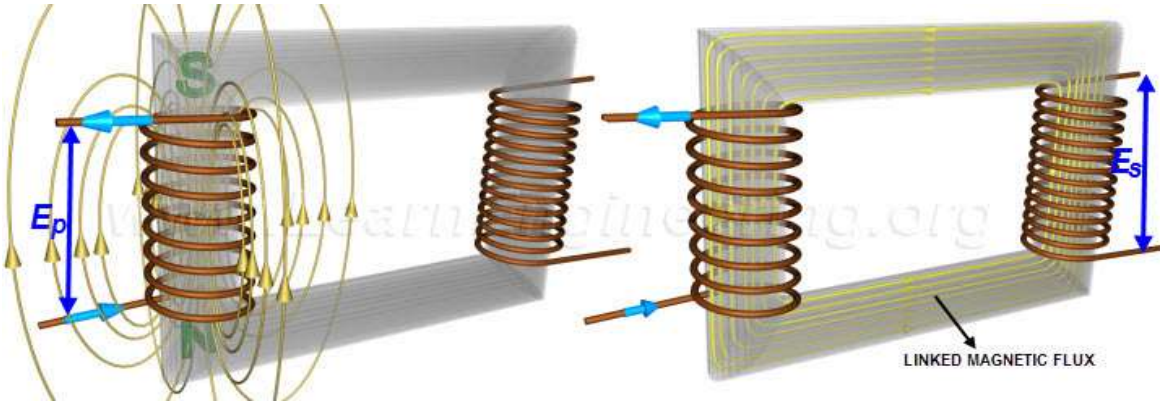


Figure 3.14: AC current in a coil produces a fluctuating magnetic field; this magnetic field can effectively linked to a secondary coil with the help of a core

Since the turns are arranged in a series, the net E.M.F induced across the winding will be sum of the individual E.M.Fs (e_S) induced in each turn. $N_s$represents, number of turns at the secondary winding.

$$E_S = e_S \times N_S$$

Since the same magnetic flux is passing through the primary and secondary coils, the EMF per turn for both the primary and secondary coils will be the same.

$$e_S = e_P$$

The E.M.F per turn for the primary coil is related to the applied input voltage as shown.

$$e_P = \frac{E_P}{N_P}$$

By rearranging the above equations, it can be established that, the induced E.M.F at the secondary coil is expressed as follows.

$$E_S = \frac{E_P}{N_P} \times N_S$$

This simply means that with fewer turns in the secondary than in primary, one can lower the voltage. Such transformers are known as step-down transformers. For the reverse case, one can increase the voltage (step-up transformer).

But since energy is conserved, the primary and secondary currents have to obey the following relationship.

$$I_P E_P = I_S E_S$$

3.3.4 Resistor

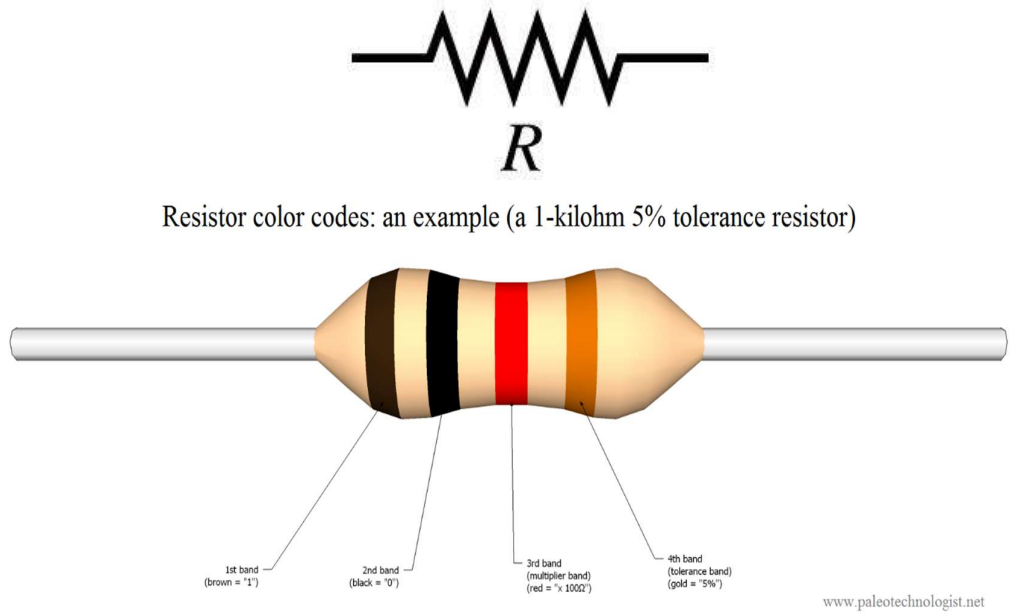


Figure 3.15: Resistor color code

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

3.3.5 Ohm's law

The behaviour of an ideal resistor is dictated by the relationship specified by Ohm's law:

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R). For example, if a 300 ohm resistor is attached across the terminals of a 12 volt battery, then a current of 12 / 300 = 0.04 amperes flows through that resistor.

Practical resistors also have some inductance and capacitance which affect the relation between voltage and current in alternating current circuits.

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon Ohm. An ohm is equivalent to a volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 mΩ = 10^{-3} Ω), kilo ohm (1 kΩ = 10^{3} Ω), and mega ohm (1 MΩ = 10^{6} Ω) are also in common usage.

3.3.6 Capacitor

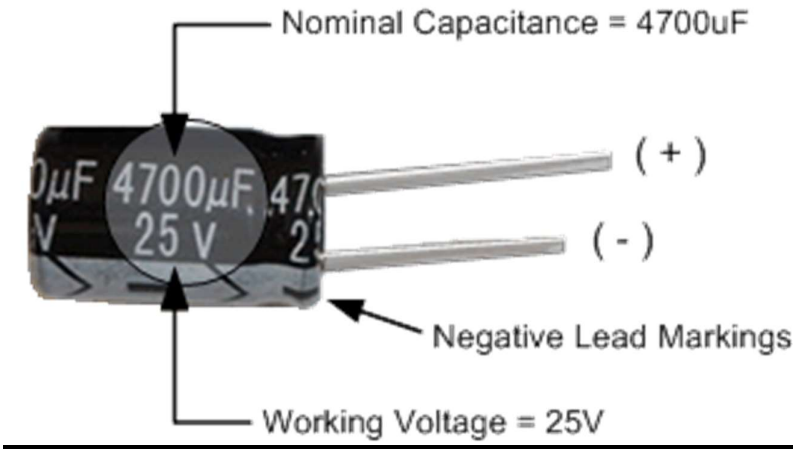


Figure 3.16: Capacitor

A **capacitor** is a passive two-terminal electrical component that stores electrical energy in an electric field. The effect of a capacitor is known as self-capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was there for historically first known as an electric **condenser**.

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. The conductors may be foils, thin films, or sintered beads of metal or conductive electrolyte. The no conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide_layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.

When two conductors experience a potential_difference, for example, when a capacitor is attached across a battery, an electric_field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric; instead, the effect is a displacement of charges through the source circuit. If the condition is maintained sufficiently long, this displacement_current through the battery seizes. However, if a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

Capacitance is defined as the ratio of the electric charge Q on each conductor to the potential difference V between them. The unit of capacitance in the International_System of Units (SI) is the farad (F), which is equal to one coulomb per volt (1 C/V). Capacitance values of typical capacitors for use in general electronics range from about 1 pF (10^{-12} F) to about 1 mF (10^{-3} F).

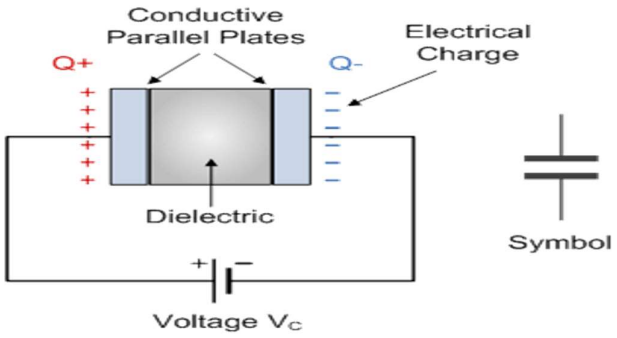


Figure 3.17: Parallel Plate Capacitor

The parallel plate capacitor is the simplest form of capacitor. It can be constructed using two metal or metallized foil plates at a distance parallel to each other, with its

capacitance value in Farads, being fixed by the surface area of the conductive plates and the distance of separation between them. Altering any two of these values alters the value of its capacitance and this forms the basis of operation of the variable capacitors.

Also, because capacitors store the energy of the electrons in the form of an electrical charge on the plates the larger the plates and/or smaller their separation the greater will be the charge that the capacitor holds for any given voltage across its plates. In other words. larger plates, smaller distance, more capacitance.

By applying a voltage to a capacitor and measuring the charge on the plates, the ratio of the charge Q to the voltage V will give the capacitance value of the capacitor and is therefore given as: C = Q/V this equation can also be re-arranged to give the more familiar formula for the quantity of charge on the plates as: Q = C x V.

3.3.7 Voltage Regulator 7805

The **78xx** (sometimes **L78xx**, **LM78xx**, **MC78xx**...) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the *xx* is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx line is positive voltage regulators: they produce a voltage that is positive relative to a common ground. There is a related line of **79xx** devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit.

78xx ICs have three terminals and are commonly found in the TO220 form factor, although smaller surface-mount and larger TO3 packages are available. These devices support an input voltage anywhere from a few volts over the intended output voltage, up to a maximum of 35 to 40 volts depending on the make, and typically provide 1 or 1.5 amperes of current (though smaller or larger packages may have a lower or higher current rating).

Advantages

- 78xx series ICs do not require additional components to provide a constant, regulated source of power, making them easy to use, as well as economical and efficient uses of space. Other voltage regulators may require additional components to set the output voltage level, or to assist in the regulation process. Some other designs (such as a switched-mode power supply) may need substantial engineering expertise to implement.
- 78xx series ICs have built-in protection against a circuit drawing too much current. They have protection against overheating and short-circuits, making them quite robust in most applications. In some cases, the current-limiting

features of the 78xx devices can provide protection not only for the 78xx itself, but also for other parts of the circuit.

Disadvantages

- The input voltage must always be higher than the output voltage by some minimum amount (typically 2.5 volts). This can make these devices unsuitable for powering some devices from certain types of power sources (for example, powering a circuit that requires 5 volts using 6-volt batteries will not work using a 7805).
- As they are based on a linear regulator design, the input current required is always the same as the output current. As the input voltage must always be higher than the output voltage, this means that the total power (voltage multiplied by current) going into the 78xx will be more than the output power provided. The difference is dissipated as heat. This means both that for some applications an adequate heatsink must be provided, and also that a (often substantial) portion of the input power is wasted during the process, rendering them less efficient than some other types of power supplies. When the input voltage is significantly higher than the regulated output voltage (for example, powering a 7805 using a 24 volt power source), this inefficiency can be a significant issue.

Individual devices in the series

TS7805 linear voltage regulator in a TO-220 variant package with electrically isolated tab.

There are common configurations for 78xx ICs, including 7805 (5 volt), 7806 (6 volt), 7808 (8 volt), 7809 (9 volt), 7810 (10 volt), 7812 (12 volt), 7815 (15 volt), 7818 (18 volt), and 7824 (24 volt) versions. The 7805 is common, as its regulated 5 volt supply provides a convenient power source for most TTL components. Each device in this series has minimum input voltage to be maintained to get regulated output.

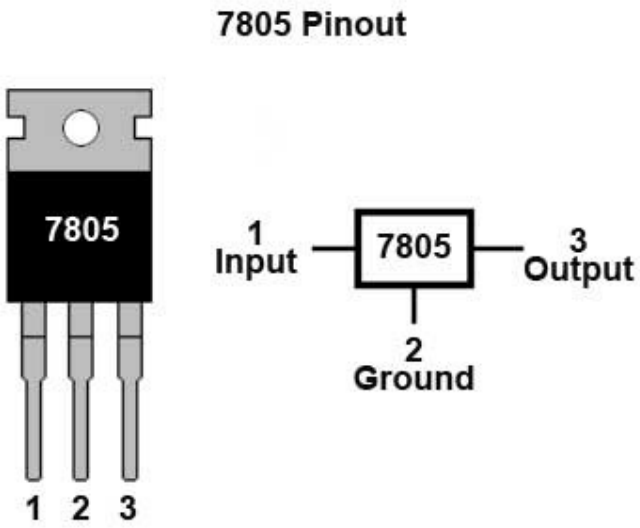


Figure 3.18: Voltage Regulator

3.3.8 CONNECTING WIRES (JUMP WIRES)

A jump wire, could be a short electrical wire with a solid tip at every finish (or generally merely "tinned"), that is often accustomed to interconnect the parts in a board. PE: among others, they're accustomed transfer electrical signals from anyplace on the board to the input/output pins of a microcontroller.

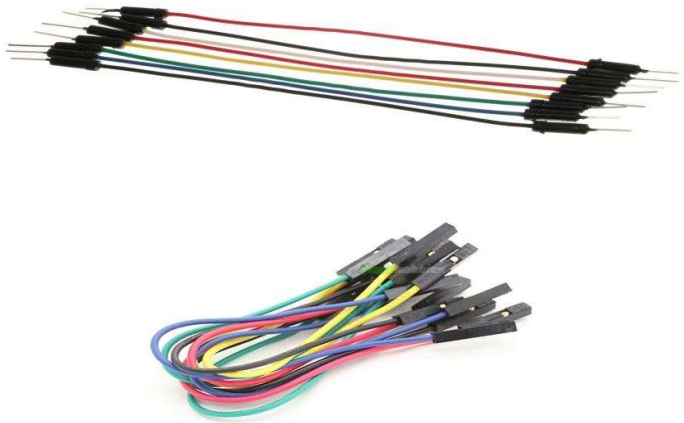


FIG 3.19: JUMP WIRES

Jump wires square measure fitted by inserting their "end connectors" into the slots provided within the board, that to a lower place its surface features a few sets of parallel plates that connect the slots in terms of rows or columns betting on the world. The "end connectors" square measure inserted into the board, while not attachment, within the specific slots that require to be connected within the specific epitome.

When exploitation those with "insulated solid tips" the arrangement of the weather and simple insertion of the insulated "Jump wire connectors" on the breadboards permits increasing the mounting density of each -components and jump wires- without concern of short-circuits.

3.4 Software

The software part consists of programming the Arduino using embedded c language. The software used for this purpose is the Arduino software (IDE). This software is an open source software which makes it easy to code and to transfer it into the Arduino. The software is developed in java platform. This software can be used to burn the program in any Arduino board. The graphical user interface i.e the android application is designed through the MIT app inventor tool. This is an open source tool for developing android applications without using codes. The mit app inventor is developed in a java platform.

Software used/required are:

1. Arduino software(IDE)

3.4.1 Arduino Software(IDE)

The software part consists of programming the Arduino using embedded c language. The software used for this purpose is the Arduino software(IDE). This software is an open source software which makes it easy to code and to transfer it into the Arduino. The software is developed in java platform. This software can be used to burn the program in any Arduino board.

3.5 SYSTEM DESIGN

The term design describes a final system and the process by which it is developed. It refers to the technical specifications that will be applied in implementations the candidate system. The design may be defined as the process of applying various techniques and principles for the purpose of defining a device, a process or a system in sufficient details to permit its physical realization. The designer's goal is how the output is to be produced and in what format samples of the output and input are also presented. Second input data and database files have to be designed to meet the requirements of the proposed output. The processing phases are handled through the program Construction and Testing. Finally, details related to justification of the system and an estimate of the impact of the candidate system on the user and the organization are documented and evaluated by management as a step toward implementation. The importance of software design can be stated in a single word Quality". Design provides us with representationsof software that can be assessed for quality. Design is the only way that we can accurately translate a customer's requirements into a finished software product or system without design we risk building an unstable system, that might fail it small changes are made or may be difficult to test, or on who's quality can't be tested. So it is an essential phase in the development of a software.

3.6 Working Model

Proposed Air Pollution Monitoring System is based on the block diagram as shown in Fig.1. The data of air is recognized by MQ135 gas sensor and MQ6 LPG gas sensor. The MQ135 sensor can sense NH3, NOx, alcohol, Benzene, smoke, CO2. So it is dynamic gas sensored for our Air pollution Monitoring system. When it will be connected to Arduino then it will sense all gases, and it will give the Pollution level in count. MQ135 gas sensor will give the output in form of count and we have to convert it into PPM. So for converting the output in PPM, we have used a library for MQ135 gas sensor and MQ6 sensor.

Sensor is giving us value of 1023 count when there is no gas near it and the air quality safe level is up to 500 count and it should not reduced from 500 count. When it will reduce below the limit of 500 counts, it will cause Headaches, sleepiness and stagnant, stuffy air. If it reduced beyond 300 counts then it will cause increased heart rate and many different diseases. When the value will be more than 500 count, then the LCD and webpage will display "Fresh Air". When the value will decreases from 500 counts, then the message will send to the mobile and the LCD and webpage will display "Poor Air, Open Windows". It will contain temperature and humidity so it will possibly show the current temperature and humidity of the air. For both we have used DHT 11 which measure both temperature and humidity.

According to the model the three sensors works as input data, they transmit data for knowing which gas it is, what is the temperature and humidity. LCD is the output

devices. LCD shows the data of the gases in counts and message is send when counts crosses below a threshold limit i.e. 500 counts.

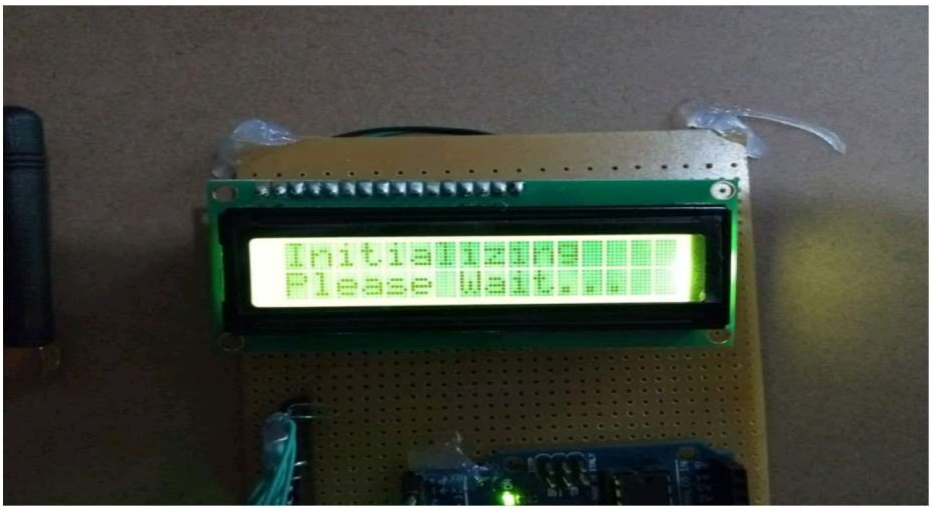


Figure 3.20: Connection of LCD display with PCB

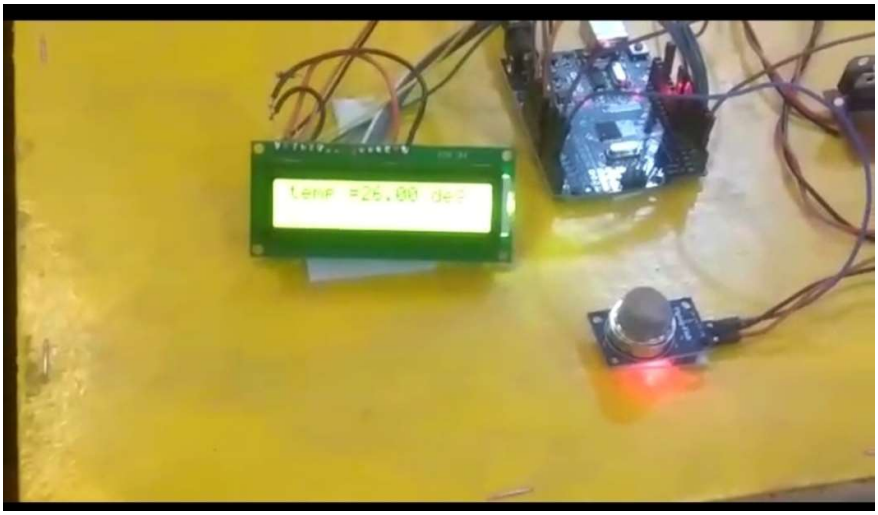


Figure 3.21: Detect Temperature in Degree

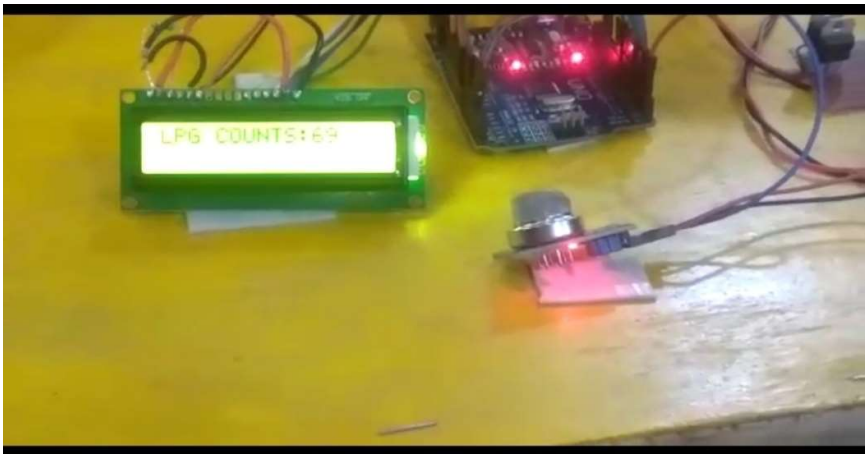


Figure 3.22: Showing LPG gas in count

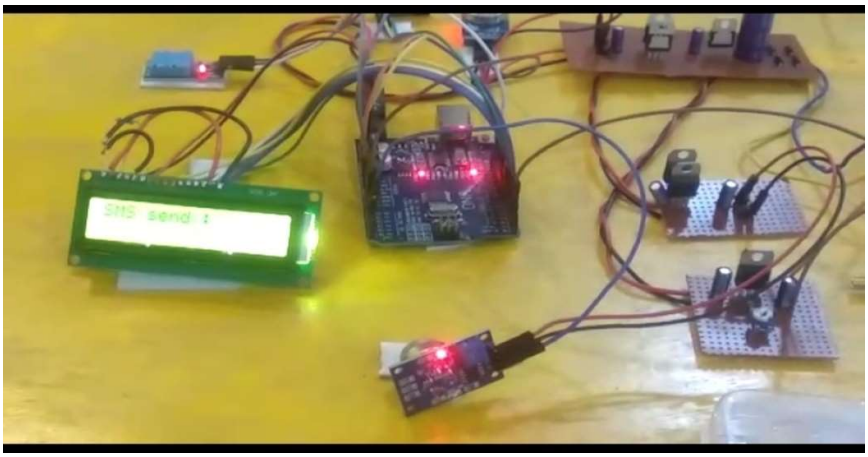


Figure 3.23: Sending SMS alert

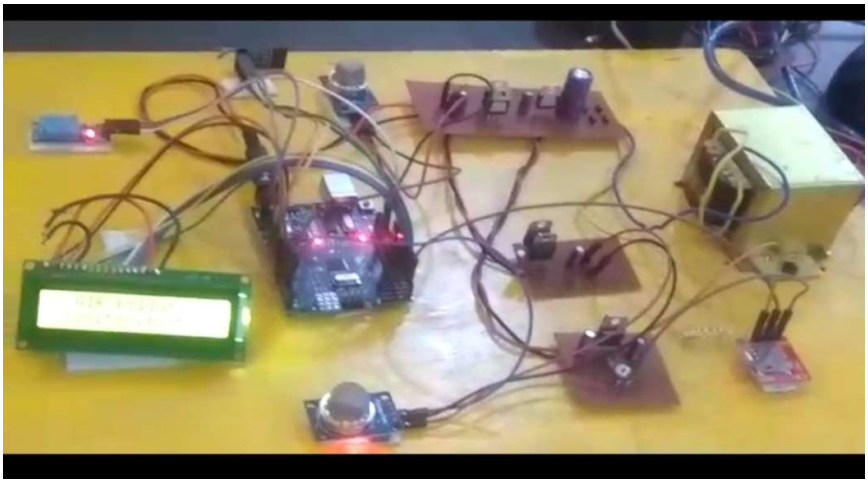


Figure 3.24: Overall Working Model

CHAPTER-4

AIR POLLUTION MONITORING AND ITS IMPORTANCE, CHALLENGE and OPPORTUNITY

4.1 Air Pollution Monitoring and Its Importance

Air is one of the most basic and important elements for human being to survive. Clean and Sound air is the key to a good and healthy life. But now days in city life it has become the most threatened factor. Pollution of air has become the most concerned and affected issue now for us. A variety of air pollutants have known or suspected harmful effects on human health and the environment. In most areas, these pollutants are principally the products of combustion from space heating, power generation or from motor vehicle traffic. Pollutants from these sources may not only prove a problem in the immediate locality of these sources but can travel long distances.

Generally if someone is young and in a good state of health, moderate air pollution levels are unlikely to have any serious short term effects. However, higher levels and long term exposure to air pollution can lead to more serious symptoms and conditions causing human health. This not only affects the respiratory and inflammatory response systems, but can also lead to more serious conditions such as heart disease and cancer. People with lung or heart conditions may be more susceptible to the effects of air pollution. Air pollution has also been recognized by doctors as one of the world's greatest 10 killers seeing some 29,000 premature deaths in UK and 430,000 worldwide in one year.

Air pollution can cause both short term and long term effects on health and many people are concerned about pollution in the air that they breathe. These people may include:

i) People with heart or lung conditions, or other breathing problems, whose health may be affected by air pollution.
ii) Parents, careers and healthcare professionals who look after someone whose health is sensitive to pollution.
iii) People who want to know more about air pollution, its causes, and what they can do to help reduce it.

Monitoring air quality is essential for local authorities as well as for major public and private industries to understand and prevent air pollution and measure emission sources, in order to preserve health and contribute to the fight against the greenhouse effect. Industrial operators use air quality monitoring equipment to cost effectively monitor and manage emissions on their perimeter, which helps them improve relationships with regulators and communities. With air quality regulation shifting the burden from publicly funded monitoring to monitoring funded by industry, it has been increasingly important for businesses to acquire their own quality monitoring equipment. To get the best results from the environment about the pollution level of air, toxicity and harmfulness for human, air quality monitoring device is vastly used.

An air quality monitor is a device that measures the level of common air pollutants. Monitors are available for both indoor and outdoor settings. Indoor air quality monitors are typically sensor based instruments. Some of them are able to measure ppb levels and come as either mixed gas or portable units. Sensor based instruments and air quality monitoring systems are used widely in outdoor ambient applications.

4.1.1 Air Quality Index (AQI) and Safety Level of elements of Air

An air quality index (AQI) is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. Different countries have their own air quality indices, corresponding to different national air quality standards.

There are many elements in the air that become dangerous and harmful for human if they increase in numbers. For our, project purposes we have considered four elements here CO, LPG, temperature and humidity. They can damage a real good to human if increased immensely in numbers. Here some of the safety levels of gases and AQI are given:

Table 4.1 Toxicity levels of CO and its effect on human

9 ppm	CO Max prolonged exposure(ASHRAE standard)
35 ppm	CO Max exposure for 8 hour work day(OSHA)
800 ppm	CO Death within 2 to 3 hours
12,800 ppm	CO Death within 1 to 3 minutes

This table shows the toxicity levels of CO in the air and their danger limits. CO is a very dangerous gas for human being. Here we can see that even 9ppm can damage real good to a healthy human being. The more the toxicity level, the higher the chance to be dead. If it is over 35ppm and close to 800 and people can die within 2-3 hours and if this level crosses 800 ppm then it becomes so dangerous that people can die within 1-3 minutes.

Table 4.2 Toxicity levels of CO2 and its effect on human

250-350ppm	Normal background concentration in outdoor ambient air
350-1,000ppm	Concentrations typical of occupied indoor spaces with good air exchange
1,000-2,000ppm	Complaints of drowsiness and poor air.
2,000-5,000 ppm	Headaches, sleepiness and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.
5,000 ppm	Workplace exposure limit (as 8-hour TWA) in most jurisdictions.
>40,000 ppm	Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death.

Here in this table the toxicity level of CO2 is shown. We can see that below 1000ppm it is acceptable and is not harmful but when it is over 2000ppm it becomes danger for the human being and after that of its rising over 5000ppm may lead to serious health issue such as permanent brain damage, coma, even death.

4.2 The Challenge

In 2013 the World Bank reported that premature deaths due to air pollution cost the global economy about $225 billion in lost labour income and about $5.11 trillion in welfare losses, a cost that is roughly equivalent to the gross domestic product of Japan. That study showed that air pollution is not just a health risk; it is also an economic burden. By causing illness and premature death, pollution reduces the quality of life, by causing a loss of productivity, pollution reduces global output and incomes.

Air pollution can have a lasting effect on productivity in other ways, such as by stunting plant growth which reduces agricultural productivity. It can also make cities less attractive to talented workers, thereby reducing a cities' competitiveness. For example,

some Indian cities are reporting a reverse migration trend from the city back to the country as citizens take steps to avoid high pollution. Governments also face fines for non-compliance to regional air pollution legislation. Many countries across Europe including the UK, Germany, France, Italy and Spain face the prospect of huge fines arising from persistent failures to comply with European air pollution laws. The UK has been threatened with a $400M fine and cities including London, Berlin, Lyon and Barcelona have all been highlighted by regulators for their unacceptably high air pollution levels.

Many governments, knowing the financial and societal impacts of air pollution, are investing huge sums in policies and solutions to improve air quality. The Chinese government has committed $277 billion to improving air quality and the Mayor of London has a budget of over $1 billion to tackle air pollution. The United States has legislated to control air pollution, with California demonstrating how effective regulatory approaches can be, with every dollar invested in air pollution control since 1970 reported to yield $30 in benefits, giving an impressive $1.5 trillion return for a $65 billion investment.

Governments are encouraging citizens to be more aware of air pollution and are promoting changes to behaviours and purchasing choices. For example, the November 2017 UK budget, announced that higher vehicle tax charges will be levied from April 2018 for diesel fueled vehicles that don't meet a specified emission standard. The revenue raised from this new vehicle tax being allocated to a $300M clean air fund.

Reinforcing this "polluter pays approach" the Mayor of London has introduced measures to levy an additional $13 per day charge on users of older, more polluting vehicles within central London.

In most cities today, there is no opportunity for citizens to understand the levels of pollution they are experiencing in their daily lives or for them to avoid or reduce their risks from poor air quality conditions. The information available from Government funded environmental monitoring networks is not published in real time and is geographically very sparse due to the high costs of the fixed monitoring stations

.

4.3 The Opportunity

A new generation of lower-cost sensor devices, benefiting from advances in communications and sensor technologies have recently appeared in the market. These IoT connected devices sense the environment several times a minute and typically deliver a one minute average value to a connected analytics solution, creating an opportunity for mobile operators to offer air pollution monitoring and control services that deliver dynamic, local information to stakeholders.

Whilst not intended to fully replace established monitoring networks, these low cost, easy-to-deploy IoT solutions provide additional benefits. These include enhanced visibility and situational awareness and early indications of pollution hotspots, giving

citizens the opportunity to avoid those areas. These new products and services help cities connect their infrastructure, regulatory stakeholders and citizens, to address the current air quality challenge.

There are strong forecasts for the air quality monitoring and control market, which lies at the intersection of several technologies including Air Pollution Monitoring and Control equipment, IoT sensors and IoT solutions, each of which have considerable independent growth potential.

CHAPTER-5
RESULT AND ANALYSIS

5.1 Result and Discussion

Last step after wiring all parts to PCB board is covering all parts on the wooden cardboard. All sensors must be connected to the air directly. And then, the all parts seem good looking with the wooden cardboard. Fig 5.1 shows the front and rear view of the board. It can be seen, the cardboard is not too small nor too big as well, so the board is easy to carry anywhere.

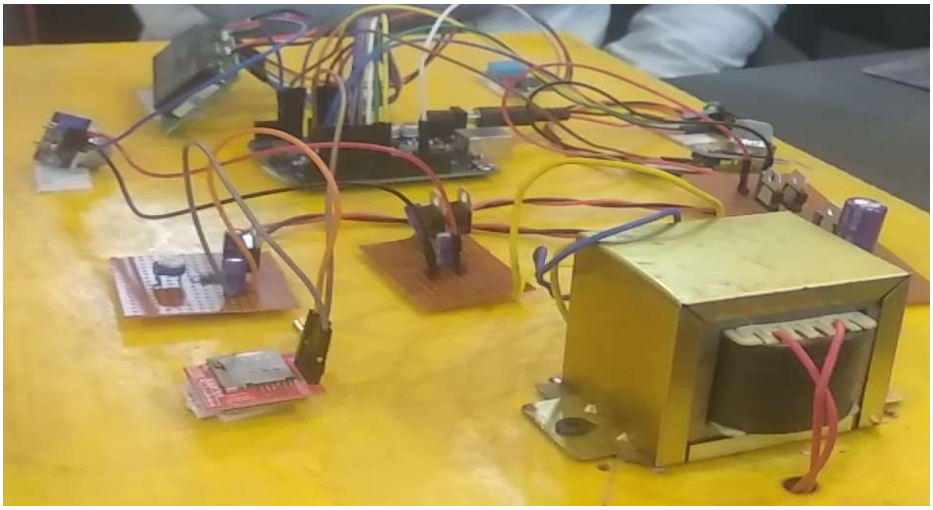


Figure 5.1 Front and Rear view of the model.

Now we will illustrate the result of the measurement from sensors. The data is taken from the measurement of the LPG lighter.

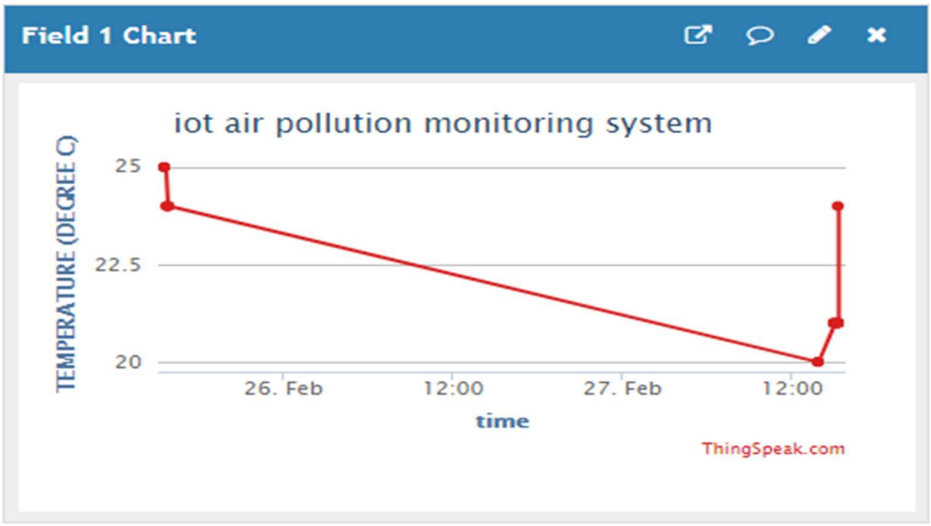


Figure 5.2 Temperature reading results

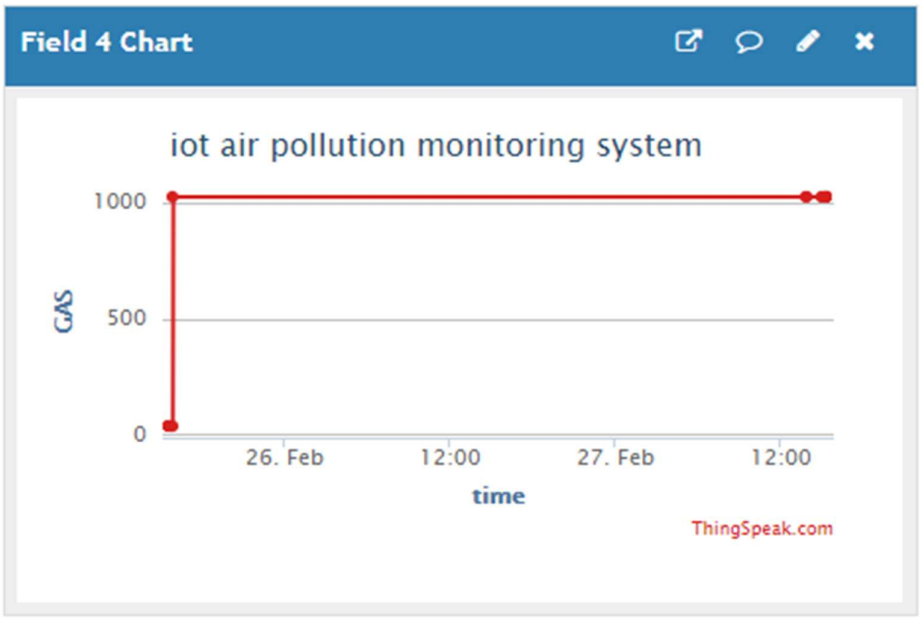


Figure 5.3 Carbon monoxide reading results

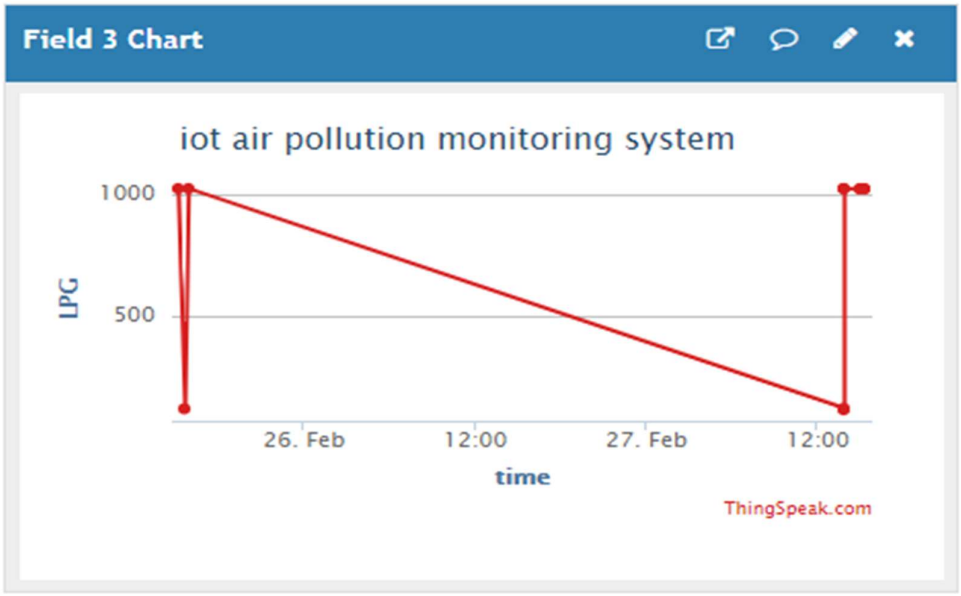


Figure 5.4 LPG gas reading results

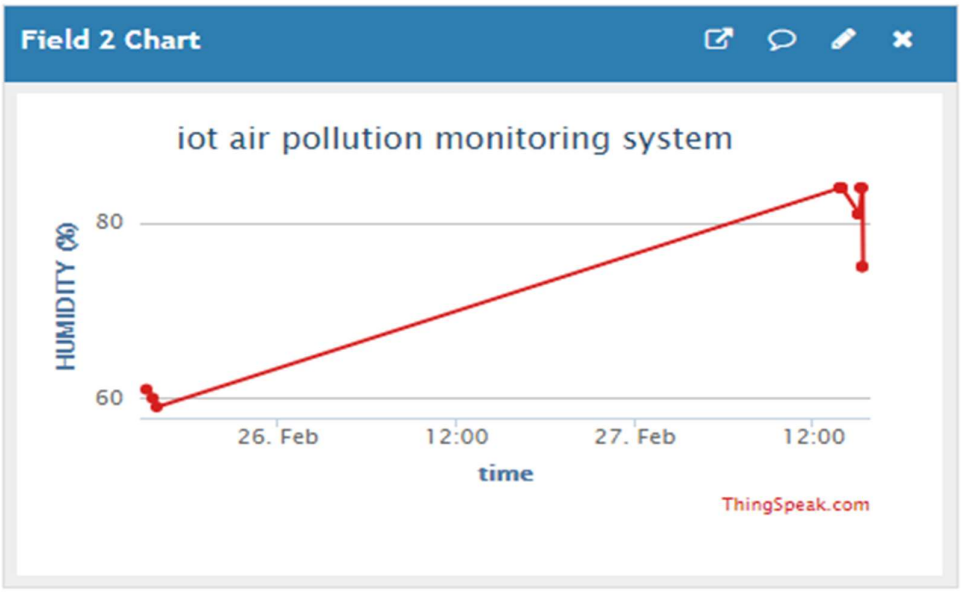


Figure 5.5 Humidity reading result

The results show that if the red line is upward, the level of air pollution is negligible. Sensor is giving us value of 1023 count when there is no gas near it and the air quality safe level is up to 500 count and it should not reduced from 500 count. When it will reduce below the limit of 500 counts, it will cause Headaches, sleepiness and stagnant, stuffy air. If it reduced beyond 300 counts then it will cause increased heart rate and many different diseases. When the value will be more than 500 count, then the LCD and webpage will display “Fresh Air”. When the value will decreases from 500 counts, then the message will send to the mobile and the LCD and webpage will display “Poor Air, Open Windows”. It will contain temperature and humidity so it will possibly show the current temperature and humidity of the air. For both we have used DHT 11 which measure both temperature and humidity. The data will be collected in the respective Thingspeak channels by means of Ethernet shield and this data is available in live through SMS alert shown below:

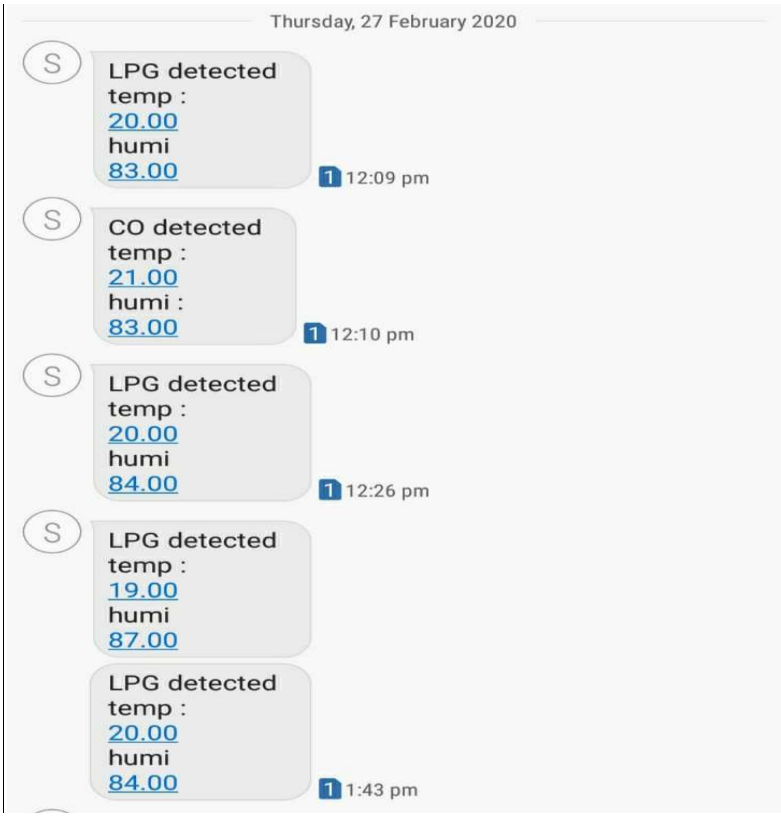


Figure 5.6 Result displayed through SMS

Applications

1) Industrial perimeter monitoring.

2) Indoor air quality monitoring.

3) Site selection for reference monitoring stations.

4) Making data available to users.

Advantages

1) Easy to Install

2) Updates On mobile phone directly

3) Accurate Pollution monitoring

4) Remote location monitoring.

Limitations

The system is network dependent.

CHAPTER-6
CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

The smart way to monitor environment and air as well as sound pollution being a low cost but efficient and embedded system is presented in this paper. In the proposed architecture functions of different sensors and their working procedure were discussed. How they work, their functionality, their optimal uses and their data taking procedures and comparison with standard base data's are also discussed here. The noise and air pollution monitoring system was tested for monitoring the gas levels on different parts of the country. It also sent the sensor parameters to the data server. Our project device showed that it is effective and cheap and with some highly working sensors it can really be a reliable one to everybody and its data's will be a key to take some necessary steps for the betterment of the society as it will help to identify the affected area so that we can take early steps to reduce damages for the next generation.

The system to monitor the air of environment using Arduino UNO microcontroller, IOT Technology is proposed to improve quality of air. With the use of IOT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this model. Here, using the MQ135 and MQ6 gas sensor gives the sense of different type of dangerous gas and arduino is the heart of this project. Which control the entire process. Wi-Fi module connects the whole process to internet and LCD is used for the visual Output.

We designed a low cost pollution monitoring system. The semiconductor gas sensors can be successfully used to monitor the target gas concentrations. The usage of the semiconductor sensors adds several advantages to a system such as low cost, continuous measurements, etc. One major advantage provided by the system is small size. The

gateway node of Wireless Sensor Network, database server and web server all are packed into a single compact credit sized micro-computer Raspberry Pi. This makes the system very portable. In addition, this system allows us to integrate other hardware components. System can be upgraded by adding more sensing nodes. The detailed design and measurement results demonstrate the usefulness of this system. The prototype can be realized as a handheld mobile device for pollution monitoring.

6.2 Future Work

Our work can demonstrate vast opportunities to work on the device, on the app and also on the field using the device that we have worked with. The device can be used any time efficiently in different locations of a city and then research with the achieved data for that particular area in that city. The device can be updated with additional sensors that can sense data from the existence of other gases such as O2 and H2. These gases will provide the condition of the atmosphere and authority can take into further decisions accordingly. The sensors that we have been worked with can also be reset according to most recent time update. The android app which we have developed for turning on and off the device can be updated with newer features by implementing necessary codes. In future time, our device can be kept testing for checking whether the sensors still runs properly and give real time data. The webpage that we have designed, there is more opportunities to add options like related tables, pie chart, diagram that will be implemented by back-end programming(server side) so that those options can be visible to the administrator and user as well. With the future plan programmer can add PHP programs to create additional tables to show amount of O2 or H2 and pie chart to show which colour represents which particular gas and also diagram that can show relations with gas and time. Like Through-out the year on which time the amount of gases are in what level and also the increase and decrease level and rates of the gases. Related app can notify when it is actual time to take data reading by sending the notification to user that will be programmed on the server-side by PHP language. Also other language can be used. In the hardware device it can be added light system. Light system will be work like automatic way. Such as, there are four lights for four types of gases. While a particular sensor detects the gas for that sensor, the related light beside that gas will be on and while the sensor stops getting that particular gas the light will be off automatically. For this matter, there will be necessity of PHP back-end code implementation also that is must.

6.3 References

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Appendix

Source Code

```
#include <SoftwareSerial.h>//////////////////////air
#include <LiquidCrystal.h>

#define RX 2
#define TX 3
String AP = "12345678";       // CHANGE ME
String PASS = "12345678"; // CHANGE ME
String API = "3ISG9WEYPDKECLGU";   // CHANGE ME
String HOST = "api.thingspeak.com";
String PORT = "80";

String field1 = "field1";
String field2 = "field2";
String field3 = "field3";
String field4 = "field4";

int countTrueCommand;
int countTimeCommand;

boolean found = false;
float valSensor = 1;
SoftwareSerial esp8266(RX,TX);
```

```
const int rs = 9, en = 8, d4 = 7, d5 = 6, d6 = 5, d7 = 4;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

#include "dht.h"
#define dht_apin A0// Analog Pin sensor is connected to

dht DHT;

const int x_out = A1; //
int x_adc_value;
const int y_out = A2; //
int y_adc_value;
const int z_out = A3; //
int z_adc_value;



void setup()
{

// set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  // Print a message to the LCD.
 lcd.setCursor(1, 0);
  lcd.print("AIR  monitor..");
  delay(10);
```

```
 lcd.setCursor(0, 1);
 lcd.print("  system");
// delay(1000);

  Serial.begin(9600);
  esp8266.begin(9600);
  sendCommand("AT",5,"OK");
  sendCommand("AT+CWMODE=1",5,"OK");
  sendCommand("AT+CWJAP=\""+ AP +"\",\""+ PASS +"\"",20,"OK");

}
void loop() {


  DHT.read11(dht_apin);

  lcd.clear();
  lcd.print("temp =");
  lcd.print(DHT.temperature);
  lcd.print(" degC");
  delay(1000);

 valSensor =DHT.temperature;

 String getData1 = "GET /update?api_key="+ API +"&"+ field1
```

```
+"="+String(valSensor);
 sendCommand("AT+CIPMUX=1",5,"OK");
 sendCommand("AT+CIPSTART=0,\"TCP\",\""+ HOST +"\","+ PORT,15,"OK");
 sendCommand("AT+CIPSEND=0," +String(getData1.length()+4),4,">");
 esp8266.println(getData1);
 delay(1500);
 countTrueCommand++;
 sendCommand("AT+CIPCLOSE=0",5,"OK");
//////////////////////////////////////////////////

delay(3000);

  lcd.clear();
  lcd.print("humi(%) =");
  lcd.print(DHT.humidity);
  lcd.print(" %");
valSensor = DHT.humidity;
 String getData2 = "GET /update?api_key="+ API +"&"+ field2
+"="+String(valSensor);
 sendCommand("AT+CIPMUX=1",5,"OK");
 sendCommand("AT+CIPSTART=0,\"TCP\",\""+ HOST +"\","+ PORT,15,"OK");
 sendCommand("AT+CIPSEND=0," +String(getData2.length()+4),4,">");
 esp8266.println(getData2);
 delay(1500);
 countTrueCommand++;
 sendCommand("AT+CIPCLOSE=0",5,"OK");

////////////////////////////////////////////////// LPG gas
```

```
   delay(3000);

   x_adc_value = analogRead(x_out);

   lcd.clear();
   lcd.print("LPG counts:");
   lcd.print(x_adc_value);
   delay(1000);

   valSensor = x_adc_value;

 String getData3 = "GET /update?api_key="+ API +"&"+ field3 +"="+String(valSensor);
 sendCommand("AT+CIPMUX=1",5,"OK");
 sendCommand("AT+CIPSTART=0,\"TCP\",\""+ HOST +"\","+ PORT,15,"OK");
 sendCommand("AT+CIPSEND=0," +String(getData2.length()+4),4,">");
 esp8266.println(getData2);
 delay(1500);
 countTrueCommand++;
 sendCommand("AT+CIPCLOSE=0",5,"OK");

//////////////////////////////////////////////////////LPG
////////////////////////////////////////////mq135/// 1

   delay(3000);
   y_adc_value = analogRead(y_out);

   lcd.clear();
   lcd.print("MO :");
   lcd.print(y_adc_value);
   delay(1000);
```

```
   valSensor = y_adc_value;
 String getData4 = "GET /update?api_key="+ API +"&"+ field4 +"="+String(valSensor);
 sendCommand("AT+CIPMUX=1",5,"OK");
 sendCommand("AT+CIPSTART=0,\"TCP\",\""+ HOST +"\","+ PORT,15,"OK");
 sendCommand("AT+CIPSEND=0," +String(getData2.length()+4),4,">");
 esp8266.println(getData2);
 delay(1500);
 countTrueCommand++;
 sendCommand("AT+CIPCLOSE=0",5,"OK");
//////////////////////////////////////////////////LPG
}
void sendCommand(String command, int maxTime, char readReplay[])
 {

  Serial.print(countTrueCommand);
  Serial.print(". at command => ");
  Serial.print(command);
  Serial.print(" ");
  while(countTimeCommand < (maxTime*1))
  {
    esp8266.println(command);//at+cipsend
    if(esp8266.find(readReplay))//ok
    {
      found = true;
      break;
    }
    countTimeCommand++;
  }
  if(found == true)
```

```
{
  Serial.println("OYI");
  countTrueCommand++;
  countTimeCommand = 0;
}
if(found == false)
{
  Serial.println("Fail");
  countTrueCommand = 0;
  countTimeCommand = 0;
}
found = false;
}
```