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IoT and GSM based five type gas detector

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Abstract

According to ABS-CBN news 2017 that from January to June last 2017, the BFP has recorded a total of 2,522 fire and accident incidents. It was traced that LPG and other gases are the major cause of fire and accident during that year where half of the total which is 1,253 beside from the electrical causes. Worldwide societies of scholars, performers, programmers, and specialists have assembled around this open-source program. Their knowledge about the said matter contributions a lot to help the society in this subject area. The project entitled "IoT and GSM based 5 Type Gas Leakage Detector", will be a great help in terms of preventing any danger caused by gas leakage. The purpose of this project is to detect the presence of LPG, Methane, CNG, Carbon Monoxide and Hydrogen leakage as a part of a safety system. Apart from sound alarm, an SMS alert and email with real-time mobile notification will inform the authorized person. Descriptively, we use 5 gas sensors to monitor LPG, Methane, CNG, Carbon Monoxide and Hydrogen. If the gas leak reaches beyond the normal level. This proposed project will trigger the sound alarm. In addition, the authorized person will be informed about the leakage via SMS alert and email and mobile notification. The people can be saved from a potential explosion caused by gas leakage.

Keywords: Gas leakage incident, LPG and other gases, fire prevention

1. Introduction

Fire accidents are a common incident in factories, houses, markets in every country. Due to poor fire extinguishing arrangement, lack of adequate fire alarm and emergency exit, it increases death and wreck. When it comes to security issues, we cannot take it for granted. Security is the level of protection against danger and loss. Nowadays, in a world that is full of technology, people need the help of technology to provide early warning alerts to ensure they have enough time to avoid danger. In designing this project, the dangerous sources that have been highlighted are about gas leakage and fire. This is because both of these can become a huge disaster if the security procedure is not taken early. To minimize fire accidents our project will act as a sentinel which is control from a central console room. For detection we used a high sensitive smoke detector by which the microcontroller will get a high pulse at the input pin which is preprogrammed for our desired output signal. This project is about producing an alert warning system based on the Global System for Mobile (GSM) network and Internet of Thing (IOT). It will be used to detect the presence of natural gases as well as fire. Whenever gas leakage or fire occurs, the sensors used in the circuit will detect it and the GSM modem will send out an SMS alert to the user and also to the nearest fire station and also IOT give notification. The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction

With the system that provides a real-time notification, it increases the response time of the owner. This will provide immediate aid to the situation. This system can be installed in kitchens, Liquefied Petroleum Gas (LPG) storage rooms, near the Natural Gas Vehicle (NGV) tank in mobile cars or any places that are required. The aim of this project is to present such a design that can automatically detect five types of gas leakage in vulnerable premises and notify about that to the owner or responsible person through the internet and email and SMS. In particular gas sensors have been used which has high sensitivity for LPG (Liquefied Petroleum Gas), CNG (Compressed Natural Gas), Alcohol, Hydrogen Gas and Carbon Monoxide Gas. And at the same time if fire will on then it also send a fire alarm sms.

1.1 Literature Review

A gas detector is a device that detects the presence of gas in an area, often as a part of safety system. This type of equipment is used to detect gas leak or other emissions and can interface with a control system so a process can automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them opportunity to alert. These types of devices are important because there are many harmful gases that can be harmful to organic life such as humans and animals. Gas detectors can be used to detect flame-able, combustible and toxic gases and oxygen depletion. This type of device is widely used in industry and can be found in locations such as oil rigs, to monitor manufacture process and emerging technologies such as photovoltaic. Gas leak detection methods become concern after the affects of harmful gases on human health is discovered. Before modern electronic sensors Manas Halder is a second year UG student of Computer Science and Engineering from JIS College of Engineering, Kalyani, Nadia, West Bengal. India Mr. Sumanta Chatterjee is presently working as an Assistant Professor of JIS College of Engineering, Kalyani, Nadia, West Bengal early detection methods relied on less precise detectors. Though the 19 and 20th centuries coal miners would bring canaries down to the tunnels with them as an early detection system against life-threatening gases such as carbon dioxide, carbon monoxide and methane. The first gas detector in industrial age was the safety lamp or day lamp was invented by Hunpohry Davy (Of England) in 1815 to detect the presence of methane gas in the underground coal mines. The flame safety lamp consisted of an oil flame adjusted to specific height in the fresh sir. To prevent ignition with the lamps flame was contained within a glass sleeve with a mess flame arrestor. The flames height varied depending on the presence of methane or the lack of the oxygen. To this day in certain parts of the world flame safety lamp are still in service. The modern era of gas detection started in 1926-1927 with the development of

catalytic combustion (LEL) sensor by Dr. Oliver Johnson. Dr. Johnson was an employee of standard oil company in California (now chevron), he begun to research and development on a method to detect combustible mixtures in air to help prevent explosions in fuel storage tanks. A demonstration model was developed in 1926 and denoted as model A. The first practical-electric vapour indicator meter begun production in 1927 with the release of model B. The world's first gas detection company Johnson-williams instruments (Or JW instruments) was formed in 1928 paloalto, CA by Dr. Oliver Johnson, Phil Williams. A J-W instrument was first recognized as the first electrical company in Silicon-valley. Over the next 40 years J-W instruments pioneered many-firsts in the modern age of gas detection, including making instruments smaller and more portable, development of portable oxygen detector as well as the first combination instrument that could detect combustible gases as well as oxygen. Before the development of electronic house-hold carbon monoxide detectors in 1980s and 1990s, carbon monoxide detectors presence was detected with a chemically infused paper that turned brown when exposed to the gas. Since then many electronic technologies and devices has been developed to detect, monitor and alert the leak of a wide array of gases. As the cost and performance of electronic gas sensors was improved, they have been incorporated into wider range of system. Their use in automobiles was initially for engine emission control, but now gas sensors may also be used ensure passenger comfort and safety. Carbon dioxide sensors are being installed into buildings as part of demand control ventilation systems. Sophisticated gas sensor systems are being researched for use in medical diagnostic, monitoring and treatment system, well beyond their initial use in operating rooms. Gas monitors and alarms for carbon monoxide and other harmful gases are increasingly available for office and domestic use, and are becoming legally required in some jurisdictions.

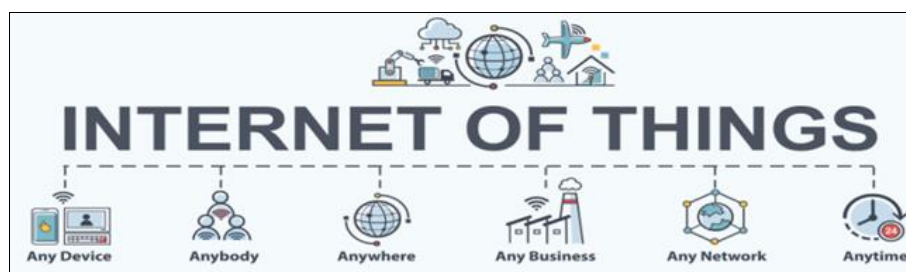


Fig 1: IoT Connection Process

1.2 Objective of this Project 2

1. To layout and acquire project that will perceive gas outflow like Methane, CNG, and LPG, Carbon Monoxide, Hydrogen gases leak, or any such petroleum centered on gaseous substance that can be discovered using MQ2, MQ3, MQ4, MQ7, MQ8 device
2. To layout and set up an SMS and email and real-time notification centered Alert method send them alert missives to restrict mobile number enter inside the Arduino and nodemcu program.
3. To layout and acquire a project that will fabricate a sound alarm during gas outflow.

4. Show status in an LCD using a 20×4 LCD component.

1.3 Organization of the Project Book: This book consists of six chapters.

1. **Chapter 1:** Gives a brief discussion of the project introduction, project objectives, project motivation and history.
2. **Chapter 2:** Focuses on system design and theoretical background.
3. **Chapter 3:** Focuses on hardware we used, their theoretical background and applications.
4. **Chapter 4:** Focuses on experimental result.

- 5. **Chapter 5:** Focuses on the limitation and the future improvement.
- 6. **Chapter 6:** Concludes overall the project.
- 7. **Chapter 2:** System Design

2. Introduction

This type gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized or reduced. The amount of current produced is determined by how much is oxidized at

the electrode, indicating the concentration of the gas. Manufactures customized electrochemical gas detectors by changing the porous barrier to allow for the detection of certain concentration range. Also since the diffusion barrier is a physical/mechanical barrier, the detector tended to more stable and reliable over the sensor’s duration and thus required less maintenance than other early detector technologies.

2.1 Block Diagram

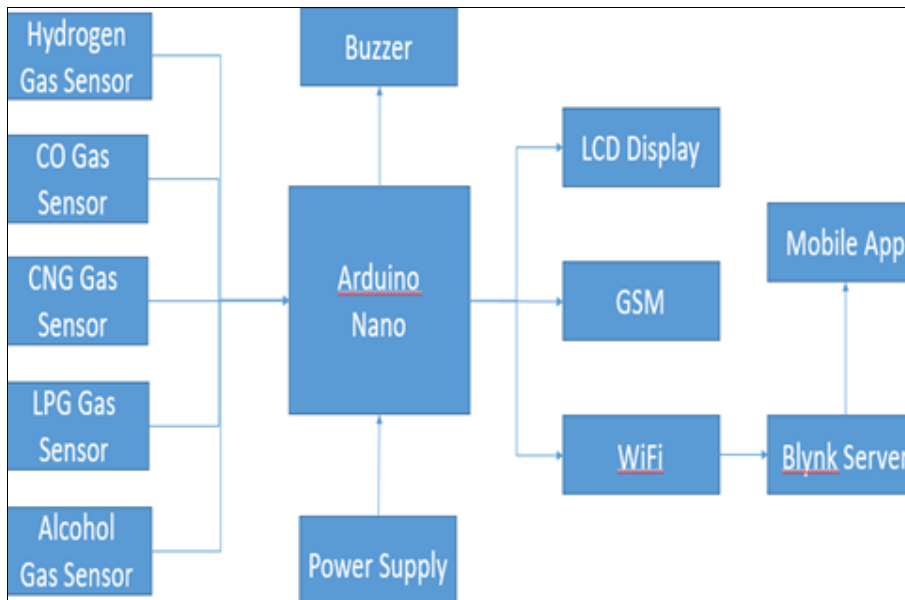


Fig 2: Block Diagram of GSM and IoT based gas leakage detector.

2.2 Flow Chart

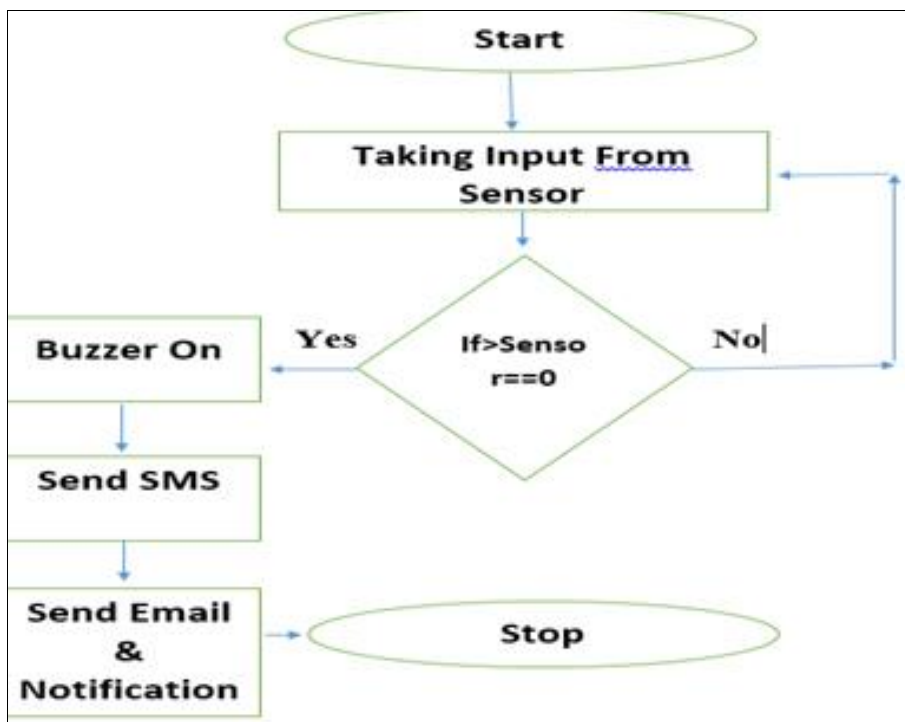


Fig 3: Flow Chart of GSM and IoT based gas leakage detector.

2.3 IoT?

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines,

objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-

computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver

when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.



Fig 4: IoT

2.4 GSM

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). GSM is an

open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

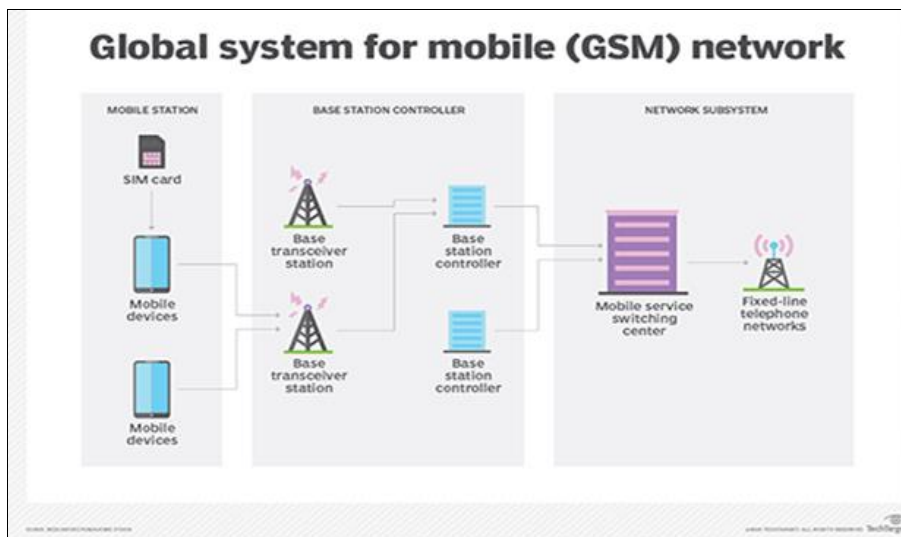


Fig 5: GSM

2.5 What is Gas detector?

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is

important because there are many gases that can be harmful to organic life, such as humans or animals.

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacturing processes and emerging technologies such as photovoltaic. They may be used in firefighting.

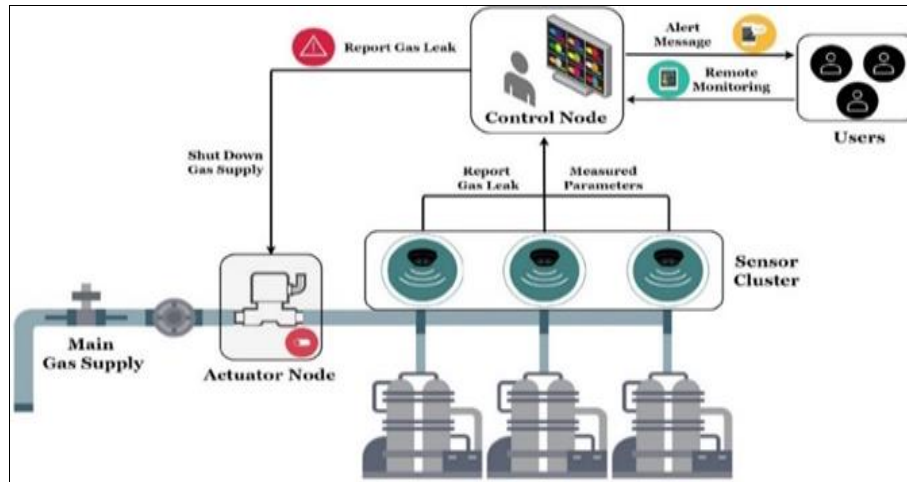


Fig 6: Gas detector

2.6 What is IoT and GSM Based Gas Detector?

The Internet of things (IoT) is a futuristic technology where interconnection of devices and the internet is proposed. As safety is an important concern, the proposed gas detection system makes use of IoT to detect the leakage and alert the user for preventing the leakage and The system detects the leakage of the LPG (Liquefied Petroleum Gas) using a gas sensor and uses the GSM to alert the person about the gas leakage via SMS. When the LPG concentration in the air exceeds a certain level, the gas sensor senses the gas leakage and the output of the sensor goes low. IoT and GSM based gas detectors are safer than other kind detectors and it able to give you notification of emergencies in both processes.

gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detect

3. Hardware Description

3.1 Required Components: The required components to complete our project are following.

1. MQ 2 SENSOR.
2. MQ 3 SENSOR.
3. MQ 4 SENSOR.
4. MQ 7 SENSOR.
5. MQ 8 SENSOR.
6. Arduino UNO.
7. Node Mcu.
8. SIM 800L.
9. Buzzer.
10. Bread Board.
11. Jumper Wire.
12. Power Supply.



Fig 7: MQ2 Gas sensor

3.2.1.2. Features

- Operating Voltage is +5V
- Can be used to Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane
- 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

3.2.1.3: Pin Configuration

3.2 Description of the Components

3.2.1.1 MQ 2 sensor: MQ2 is one of the commonly used

Table 1: Pins of MQ2

Pin No	Pin Name	Description
1.	Vcc	This pin powers the module, typically the operating voltage is +5V
2.	Ground	Used to connect the module to system ground
3.	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4.	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas

3.2.2.1 MQ 3 sensor

MQ3 Alcohol Gas Sensor detects the concentrations of alcohol gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of 0.04

mg/L to 4mg/L. The concentration sensing range is suitable for breathalyzers. The sensor can operate at temperatures from -10 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. 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 200 kΩ.

3.2.2.2 Features

- Operating Voltage is +5V.
- Can be used to Measure or detect Alcohol.
- 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.

3.2.2.3. Pin Configuration



Fig 8: MQ3 Gas Sensor

Table 2: Pins of MQ3

Pin No	Pin Name	Description
1.	Vcc	This pin powers the module, typically the operating voltage is +5V
2.	Ground	Used to connect the module to system ground
3.	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4.	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas

3.2.3.1 MQ 4 Sensor

Sensitive material of MQ-4 gas sensor is SnO₂, which has lower conductivity in clean air. When the target flammable gas exists, the sensor’s conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond to output signal of gas

concentration through a simple circuit.

MQ-4 gas sensor has high sensitivity to methane, also has anti-interference to alcohol and other gases. It is widely used in domestic gas leakage alarms, industrial flammable gas alarms and portable gas detectors.



Fig 9: MQ4 Gas Sensor

3.2.3.2 Features

- Operating Voltage is +5V
- Can be used to Measure or detect CNG
- 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

2.3.3.3. Pin Configuration

Table 3: Pins of MQ4

Pin No	Pin Name	Description
1.	Vcc	This pin powers the module, typically the operating voltage is +5V
2.	Ground	Used to connect the module to system ground
3.	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4.	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas

3.2.4.1 MQ 7 Sensor

This is a simple-to-use Carbon Monoxide (CO) sensor, suitable for sensing CO concentrations in the air. The MQ-7 can detect CO-gas concentrations anywhere from 10 to 500 pm.

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.



Fig 10: MQ7 Gas Sensor

3.2.4.2: Features

- Operating Voltage is +5V
- Can be used to Measure or detect Carbon Monoxide
- 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

3.2.4.3 Pin Configuration

Table 4: Pins of MQ7

Pin No	Pin Name	Description
1.	Vcc	This pin powers the module, typically the operating voltage is +5V
2.	Ground	Used to connect the module to system ground
3.	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4.	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas

3.2.5.1 MQ 8 Sensor

Sensitive material of MQ-8 gas sensor is SnO₂, which has lower conductivity in clean air. When hydrogen gas exists, the sensor's conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond to output signal of gas concentration through a simple circuit.

MQ-8 gas sensors have high sensitivity to hydrogen gas, and also have anti-interference to other gases. This sensor can detect hydrogen, especially city gas. It is a kind of low-cost sensor for kinds of applications.

It is widely used in domestic gas leakage alarms, industrial flammable gas alarms and portable gas detectors.



Fig 11: MQ8 Gas Sensor

3.2.5.2 Features

1. Operating Voltage is + 5V.
2. Can be used to Measure or detect Hydrogen.

3. Analog output voltage: 0V to 5V.
4. Digital Output Voltage: 0V or 5V (TTL Logic).
5. Preheat duration 20 seconds.

- 6. Can be used as a Digital or analog sensor.
- 7. The Sensitivity of Digital pin can be varied using the potentiometer.

3.2.5.3 Pin Configuration

Table 5: Pins of MQ8

Pin No	Pin Name	Description
1.	Vcc	This pin powers the module, typically the operating voltage is +5V
2.	Ground	Used to connect the module to system ground
3.	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4.	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas

3.2.6.1 Arduino Nano R3

Arduino Uno is a microcontroller board based on ATmega328 which has 14 digital I/O and 6 analog pins. It has everything that is needed to support the microcontroller. Simply connect it to the computer with a USB cable to get

started with the Arduino Uno board. It is flexible, easy to use hardware and software. Arduino Uno can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators.



Fig 12: Arduino Nano R3

3.2.6.2 Specification of Arduino Nano

Table 6: Specifications of Arduino

Pin Category	Pin Name	Details
Power	Vin	Input voltage to Arduino when using an external power source.
	5V	Regulated power supply used to power microcontroller and other components on the board.
	3.3V	3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA.
	GND	Ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.

3.2.7.1 Nodemcu

NodeMCU is an open source Lua based firmware for the ESP8266 WiFi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK. The

firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.

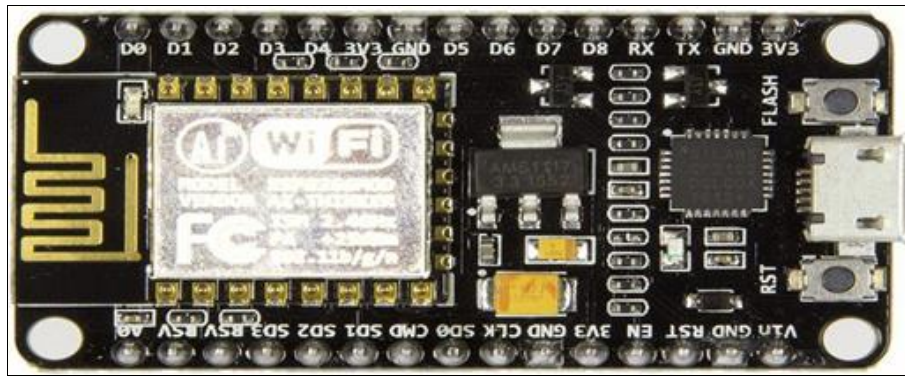


Fig 13: Node MCU

3.2.7.2 Pin description of Node MCU

General-purpose input/output (GPIO) is a pin on an IC (Integrated Circuit). It can be either input pin or output pin, whose behavior can be controlled at the run time. NodeMCU Development kit provides access to these GPIOs

of ESP8266. The only thing to take care is that NodeMCU Dev kit pins are numbered differently than internal GPIO notations of ESP8266 as shown in below figure and table. For example, the D0 pin on the NodeMCU Dev kit is mapped to the internal GPIO pin 16 of ESP8266.

Table 7: Pin of Node MCU

Pin Names on NodeMCU	ESP8266 GPIO Pin number
D0	GPIO16
D1	GPIO5
D2	GPIO4
D3	GPIO0
D4	GPIO2
D5	GPIO14
D6	GPIO12
D7	GPIO13
D8	GPIO15
D9/RX	GPIO3
D10/TX	GPIO1
D11/SD2	GPIO9
D12/SD3	GPIO10

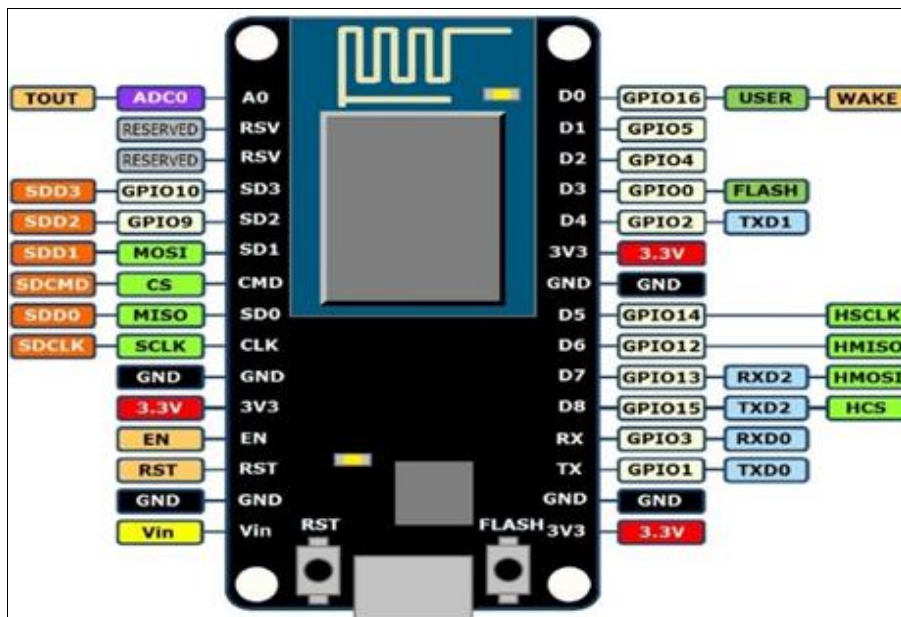


Fig 14: Pins of Node MCU

3.2.7.3 Communication system of Node MCU

There are three types of communications that Node MCU use commonly and they are UART
 UART stands for Universal Asynchronous Reception and

Transmission and is a simple communication protocol that allows the NodeMCU to communicate with serial devices. The UART system communicates with digital pin 0 (RX), digital pin 1 (TX), and with another computer via the USB

port. This peripheral, found on all NodeMCU boards, allows the NodeMCU to directly communicate with a computer thanks to the fact that the Arduino has an onboard USB-to-Serial converter. Therefore, programs written on a Windows, Mac, or Linux OS can be used with an NodeMCU connected to a USB port as if it was a serial port (Serial port communication is trivial compared to USB communication). I2C, which stands for inter-integrated-circuit, is a serial communications protocol specially designed for microcontrollers.

While this peripheral is almost never used for PC-device communication, it is incredibly popular with modules and sensors, making it useful for projects that require many parts working together. In fact, I2C allows you to potentially connect up to 128 devices to your main board!

When connecting two circuits to one another, think of the main device as the “master” and the connected devices-such as sensors, pin expansions, and drivers-as “slaves”. I2C makes it possible to connect multiple masters and slaves to your board while maintaining a clear communication pathway.

Maintaining a clear communication pathway is possible because I2C uses an address system and a shared bus,

meaning many devices can be connected to the exact same wires. However, the NodeMCU must first select a specific device by transmitting a unique address before sending data. This provides each slave device with what it needs while also supporting multiple masters. I2C uses fewer wires and all data is transmitted on a single wire, keeping your pin count low. The tradeoff for this simplified wiring is slower speeds than SPI.

SPI stands for Serial Peripheral Interface. Like I2C, SPI is a different form of serial-communications protocol specially designed for microcontrollers to talk to each other. However, it has some key differences from its I2C counterpart.

The most notable difference right off the bat is that, while you can use multiples masters and slaves with I2C, SPI allows a single master device with a maximum of four slave devices. SPI is typically much faster than I2C due to the simple protocol and, while data/clock lines are shared between devices, each device requires a unique address wire. SPI is commonly found in places where speed is important such as with SD cards and display modules, or when information updates and changes quickly, like with temperature sensors.

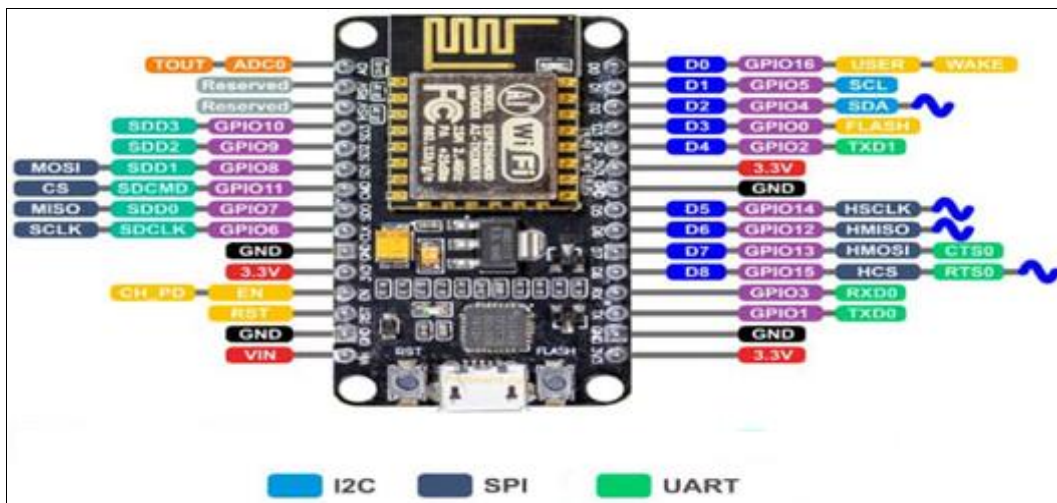


Fig 15: Communication Pins of Node MCU

3.2.7.4 Applications of NodeMCU

NodeMCU is mainly used in the Wi-Fi Applications which most of the other embedded modules fail to process unless incorporated with some external Wi-Fi protocol. Following are some major applications used for NodeMCU.

- Internet Smoked Alarm
- VR Tracker
- Octopod
- Serial Port Monitor
- ESP Lamp
- Incubator Controller
- IoT home automation
- Security Alarms.

3.2.8.1 20*4 LCD Display with I2C Communication module

The LCD1602 16x2 I2C Blue LCD Display provides a 16 character x 2 line LCD with I2C interface for easy control by a Microcontroller.



Fig 16: LCD with I2C Module

3.2.8.2 Features

- 20 character x 4 line Blue LCD
- I2C interface
- Adjustable backlight intensity and contrast
- 5V operation

These displays are straightforward to use and are a great

way to provide a user interface on many projects where you need more info than simple LED indicators or 7-Segment displays can provide since these are full alphanumeric displays with 2 lines of 16 characters each. For an interactive display, pairing this type of display with a rotary encoder to navigate and select menu items on the display can provide a very nice user interface.

3.2.8.3 LCD Display

The display is composed of a 20 character x 4 line LCD display with a blue backlight and white characters. Each of the characters are composed of a 5 x 8 dot matrix for good character representation.

The backlight has a potentiometer for adjustment of the contrast of the display for best viewing.

The backlight intensity is not directly controllable though the I2C interface, however there is a jumper on the I2C board that supplies power to the backlight. That jumper can be removed and a voltage applied to the header pin nearest the 'LED' markings on the board to provide power to the backlight separately.

The backlight can go down to about 3V before it goes out. It is not known what the safe upper limit is for driving the LCD backlight so it is probably best not to exceed 5V by too much. At 5V, the backlight draws about 20mA, so it should also be possible to drive it with a PWM pin off a microcontroller to allow the display to be dimmed via software if desired.

3.2.8.4 I2C Interface

This display incorporates an I2C interface that requires only 2 pins on a uC to interface with and it has good library support to get up and running fast. The I2C interface is a daughter board attached to the back of the LCD module.

The I2C address for these displays is either 0x3F or 0x27. The address is marked on the bag that the module comes in.

If you need to adjust I2C address to avoid a conflict, this can be done on the I2C adapter board on the back of the module. There are 3 address jumper locations marked A0, A1, A2. Normally these lines are pulled high. If you bridge these pads, it grounds that address line. If you were to bridge all 3 to ground, the address would be 0x38 (or 0x20) depending on which version you have. The range of all possible addresses spans from 0x38 – 0x3F or 0x20 – 0x27

If you are unsure of the I2C address of this or any other device, it is easy to find out what it is. Just refer to this blog post.

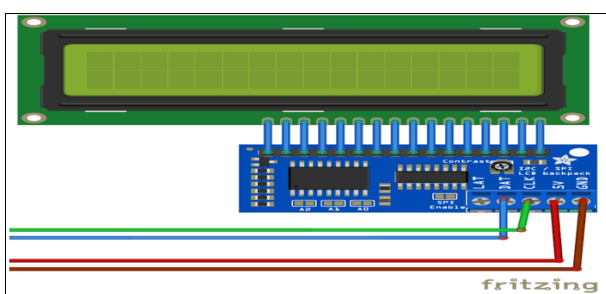


Fig 17: 20*4 LCD and I2C Connection

3.2.8.5 I2C Module Connections

Connection to the display is via a 4 pin header.

1 x 4 Header

GND – Connect to system ground. This ground needs to be in common with the uC.

- VCC – Connect to 5V. This can come from the uC or be a separate power supply.
- SDA – Connect to the I2C / SDA pin on the uC.
- SCL – Connect to the I2C / SCL pin on the uC

3.2.9 Connecting Wires

A jump wire (Also known as jumper, jumper wire, jumper cable, DuPont wire, or DuPont cable – named for one manufacturer of them) is an electrical wire, or group of them in a cable, with a connector or pin at each end (Or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment. There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors.

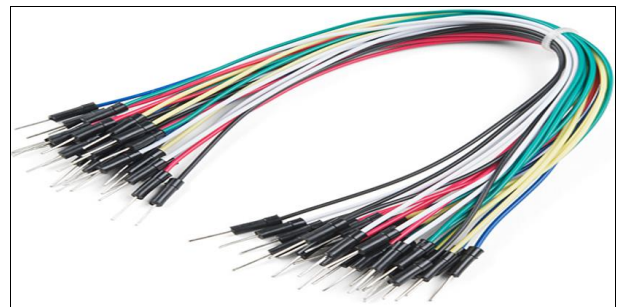


Fig 18: Connecting Wires

3.2.10 Bread Board

Breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode).

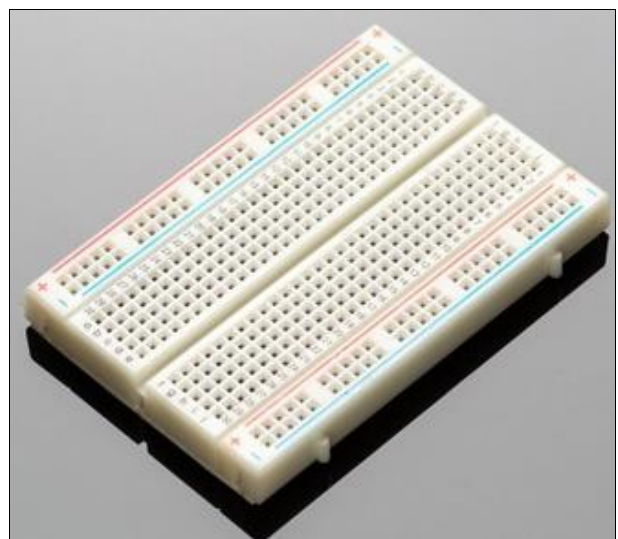


Fig 19: Bread Board

3.2.11.1 Sim800L GSM Module: SIM800L is a miniature

cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login

automatically. On board LED displays connection state (No network coverage - fast blinking, logged in - slow blinking).

Notice: Be prepared to handle huge power consumption with peek up to 2A. Maximum voltage on UART in this module is 2.8V. Higher voltage will kill the module.

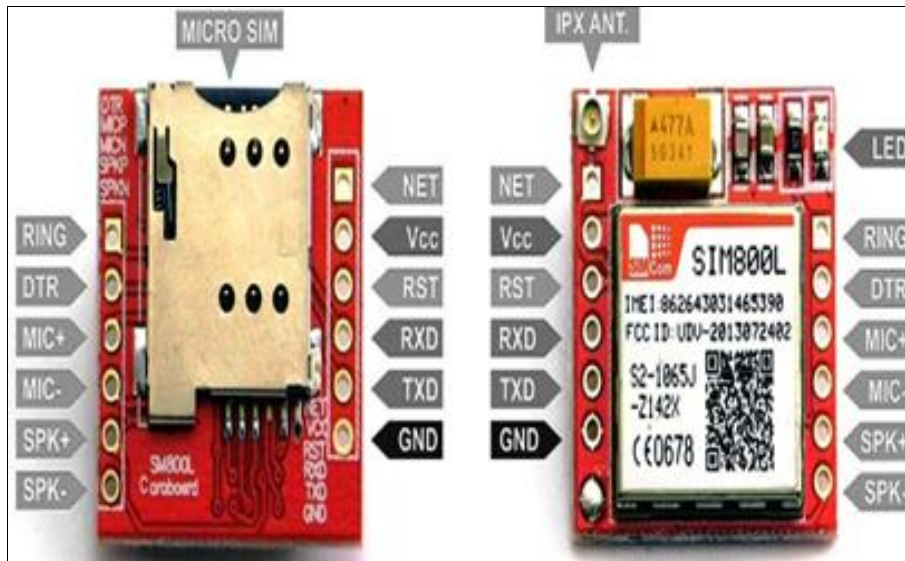


Fig 20: Sim800L GSM Module

3.2.11.2 Specification

- Supply voltage: 3.8V - 4.2V.
- Recommended supply voltage: 4V.
- Power consumption.
- sleep mode < 2.0 mA.
- idle mode < 7.0 mA.
- GSM transmission (avg): 350 mA.
- GSM transmission (peek): 2000 mA.
- Module size: 25 x 23 mm.
- Interface: UART (max. 2.8V) and AT commands.
- SIM card socket: microSIM (bottom side).
- Supported frequencies: Quad Band (850 / 950 / 1800 /1900 MHz).
- Antenna connector: IPX.
- Status signaling: LED.
- Working temperature range: -40 do + 85 °C.

3.2.12 Power Supply

We used a 9v step down transformer with rectifier and 5V 7805 voltage regulator IC.

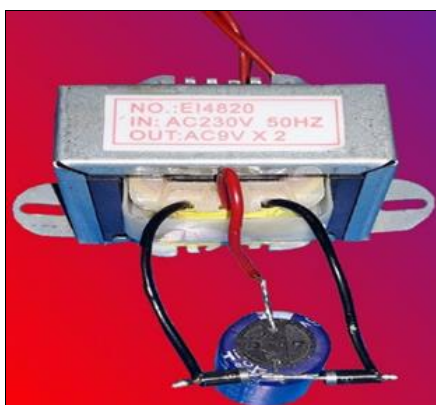


Fig 21: 9V 1A Power Supply

3.2.13 Buzzer

A buzzer or beeper is an audio signaling device, which is mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Fig 22: Buzzer

3.3 Circuit Diagram

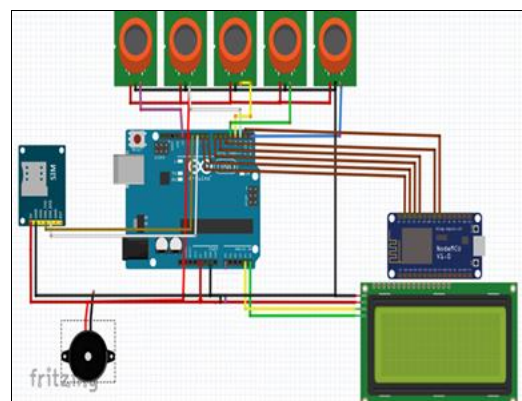


Fig 23: Circuit Diagram for IoT and GSM Based as Detector

3.3.1 Circuit Connection: Circuit connection is same as like as the circuit diagram. 1st we program the nodemcu and then we connect the 5V and 12V power supply to the Arduino and Sensors and then we connect 5 gas sensors and one flame to arduino. Sensors are for detecting gas and flame. When they detect desire gas and flame then they send a signal to arduino. And then arduino open a burzer for alarm and at a time arduino send a signal to gsm module for sending SMS and also arduino send a signal to Wifi Module for sending real time notification and email.

3.4 Required Software and their Setup Process

To complete our project, we need many types of software, most important of them are following.

1. Arduino IDE-1.8.9.
2. Blynk Android App.

3.4.1 Software

The software that is used to program the microcontroller is

open-source-software and can be downloaded for free on www.arduino.cc. With this “Arduino software” we can write little programs with the microcontroller. These programs are called “Sketch”.

In the end the sketches are transferred to the microcontroller by USB cable. More on that later on the subject “programming”.

3.4.1.1 Arduino IDE Installation

Now one after another the Arduino software and the USB driver for the board have to be installed.

3.4.1.2 Installation and setup of the Arduino software

We have downloaded the Arduino software from www.arduino.cc and installed it on the computer (This was NOT connected to the PC). After that we opened the software file and installed the program named arduino.exe.

Two set ups on the program are important and should be considered.

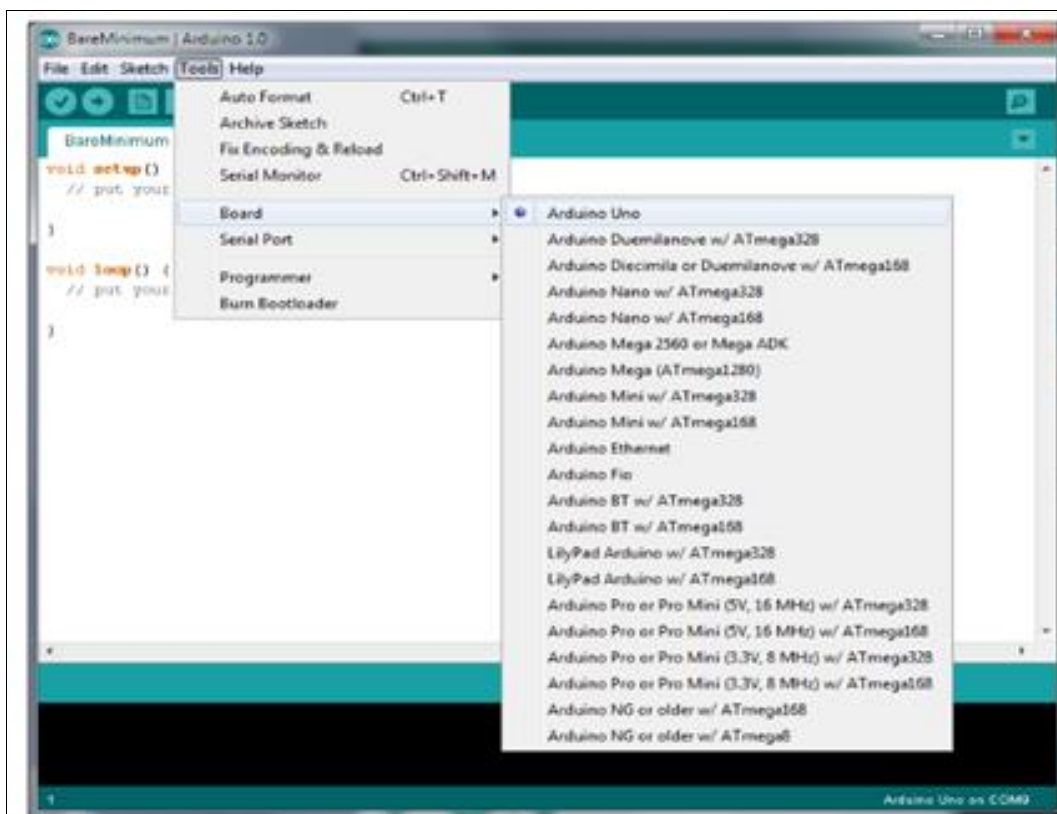


Fig 24: Program installation process -1

The board that we want to connect has to be selected on the arduino software. The “Arduino Uno” is here known as “Arduino / Genuino Uno and NodeMCU”.

b) We have to choose the right “Serial-Port”, to let the Computer know to which port the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way:

At the moment the Arduino wasn’t connected to the PC. If we now choose “Port”, under the field “Tool”, we will already see one or more ports here (COM1/ COM2/ COM3...). The quantity of the shown ports doesn't depend on the quantity of the USB ports on the computer. When the board gets connected to the computer, we will find one more port.

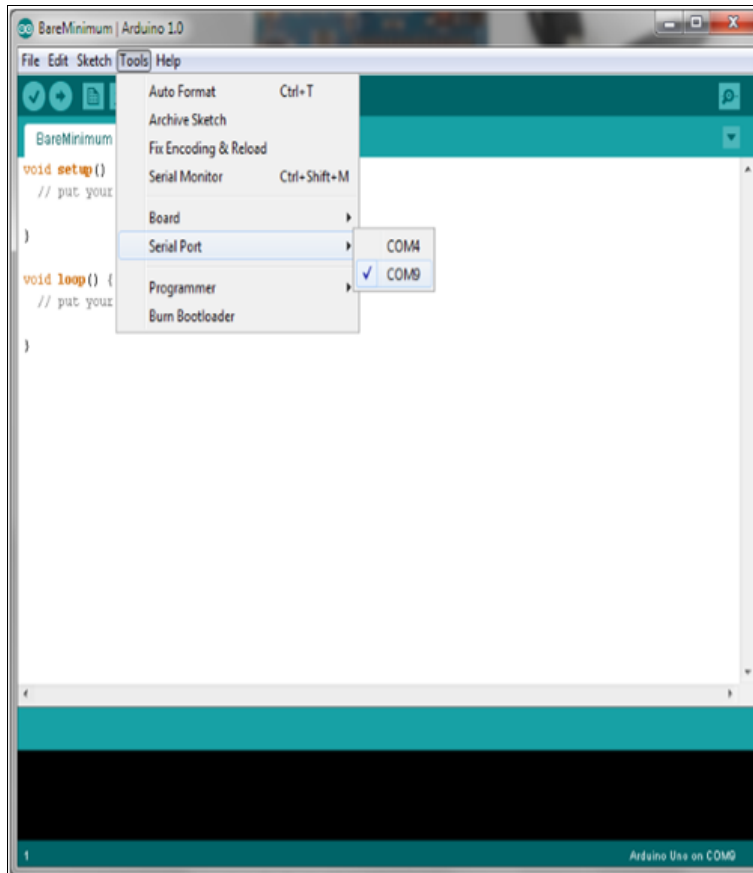


Fig 25: Program installation process-2

3.4.2 Blynk Android App

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After

downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen

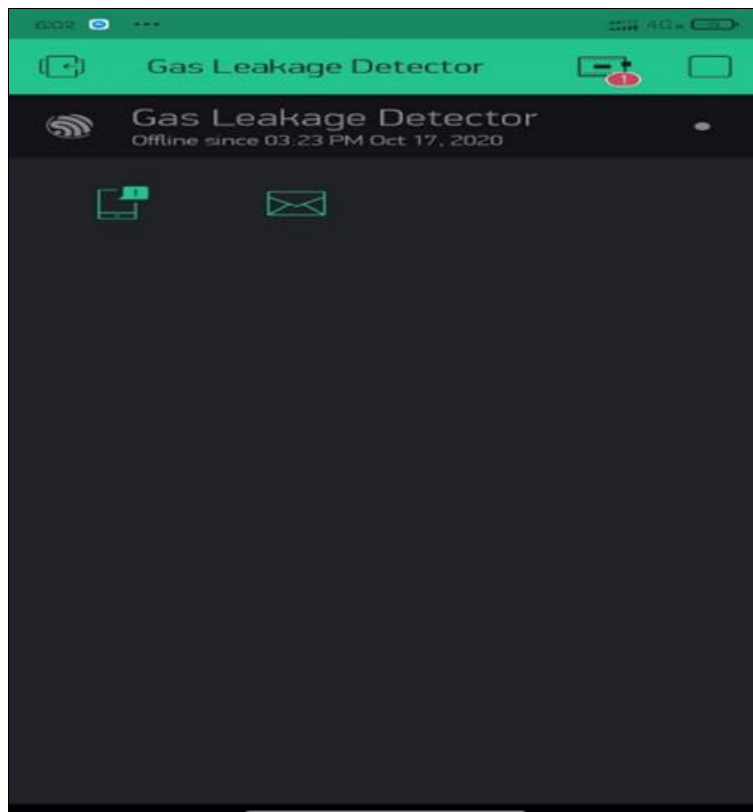


Fig 26: Blynk App

3.5 Programming: The development cycle is divided into 4 phases.

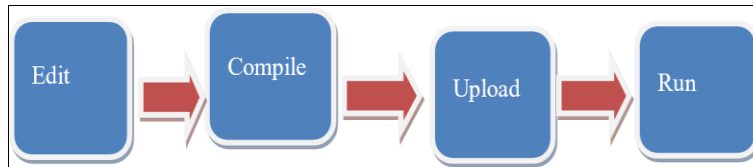


Fig 27: Flowchart of the compiling process

Compile: Compile means to translate the sketch into machine language, also known as object.

Code Run: Arduino sketch is executed as soon as terminates the step of uploading on the board.

- Void loop ().
- Setup () runs first and once.
- Loop () runs over and over, until power is lost or a new sketch is loaded.

3.5.1 Arduino Program Development

- Based on C++ without 80% of the instructions.
- A handful of new commands.
- Programs are called 'sketches'.
- Sketches need two functions.
- Void setup ().

4. Experimental Result

4.1 Result

The final result of our project is if any gas leakage or fire is on the we got notify at the time by email, sms and mobile notification without any issue. And here is the picture about our final result

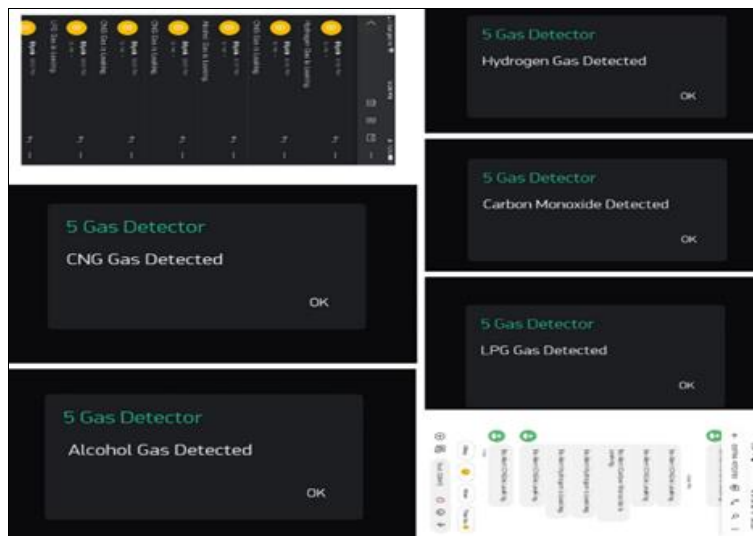


Fig 28: Final Result

4.2 Project Outlook: This is how our prototype project look like.

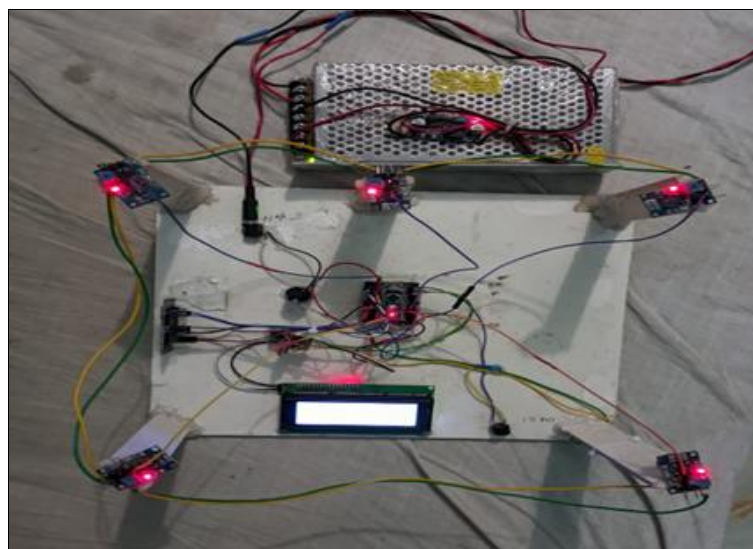


Fig 29: Project picture

5. Limitation and Future Improvement

5.1 Limitations

Basically this is a prototype project and also we don't have any funding so there are some limitations in our project.

5.1.1 Network

In our country there is a huge problem in mobile network and internet. And we don't have anything about this issue. For this issue our project sometimes gives some delay to send notifications and signal.

5.1.2 Automatic fire prevention

Our project do not have any fire protection system. Only it gives notification about gases and fire.

5.1.3 Low Cost

It sounds weird that low cost is a limitation. But yes for minimize the cost we had to use poor sensors which accuracy is not so good.

5.2 Future Improvement

1. In future we can add automatic fire prevention system.
2. If we will get any funding then we will upgrade our system security.
3. In future we can use high accuracy sensors.
4. We will use network booster that our project won't get any network issue will happen.
5. In Future we will use AI (Artificial Intelligence) to make our project smarter than any other devices.

6. Conclusion

1. The prototype gas detector was effective in detecting the abnormal presence of LPG and smoke in an enclosed area with its corresponding color of concentration. However, the intelligent machine encountered some differences of time detection during the experiments because it mainly depends on the concentration of both LPG and smoke present.
2. As the distance increase up to 5 cm, the relationship of distance and reaction time are directly proportional for all sensors. It also showed the same conclusion on gas test on 5cm up to 10 cm but the smoke's test on 5 cm up to 10 cm showed the reaction time between 12 to 17 seconds.
3. The GSM 800 was slightly effective since it has 33.3% chance of receiving text messages to the assigned number.

6.1 Advantages

1. Low cost.
2. Low power consumption.
3. It also detects alcohol so it is used as liquor tester.
4. The sensor has excellent sensitivity combined with a quick response time.

6.2 Cost Analysis

This is a low cost project. The costing of our project is following.

Table 8: Cost of This Project

Equipment	Price
Arduino	1180
Nodemcu	680
MQ2	280
MQ3	300
MQ4	280
MQ7	400
MQ8	510
GSM Module	870
Buzzer	180
Bread Board	160
I2C Module	280
LCD	850
Power Supply	600
Others	800
Total	7370 Taka

7. References

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