



IoT based LPG Gas Leakage Detection and Prevention System

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Abstract: Gas leakage is a very common problem these days. To prevent the destruction from gas leakage we need some solution. In this paper, we are going to introduce a solution IoT-based LPG Gas Leakage Detection and Prevention System. We will mainly focus in LPG. LPG (Liquefied Petroleum Gas), is produced from natural gas that has been liquefied (hydrocarbon gas) under extreme pressure and then containerized in a metal cylinder. LPG is too much sensitive to fire and can result in a huge destruction. The main attraction of LPG which makes us choose this to cook and any other needs because of its availability than other natural gas. Because of this, gas leakage is a huge issue these days. The main aim is to introduce an IoT-based system that will help us to prevent this issue to happen. This device can detect gas leakage and fire by using two separates. It has an alert system to make the user aware of the situation by using GSM technology. This system also has another feature to reduce the amount of gas that has already leaked by pushing the air outside using an exhaust fan.

Keywords: Liquefied Petroleum Gas; LPG; MQ-6 Gas Sensor; Alarm Buzzer; LED (light); Fire or Flame Detection Sensor; Gas detection system; Arduino UNO; Fire detection.

Introduction

Living in this modern age, our life has been included with so many modern technologies and features. Some of them are invented to live a safe and secure life. In this paper, we are talking about a security feature to prevent any kind of flop from LPG leakage. LPG (Liquefied Petroleum Gas) is a gas made up of flammable hydrocarbon gasses that is used as a cooking and restaurant fuel as well as for transportation. It is a mixture of half butane, 48% propane, and 2% of pentane. It is stored in a metal cylinder and the use of this metal cylinder which contains LPG is growing day by day. Especially in an urban area, it is the main source of cooking fuel. Also, the availability and the low price make it more attractive to the users. But the main point is that a huge number of the users of LPG are not aware of the danger of LPG leakage. Also, they don't have any prior knowledge to prevent this issue. Most accidents occur due to irregular maintenance. It is too sensitive to fire and can result in a huge disaster if it's exposed. To address this issue, users need a solution and here in this paper, we are going to introduce the solution which is called the IoT-based LPG Gas Leakage Detection and Prevention System. This system is integrated with the network by GSM technology to make SMS alerts during any issue that occurs. Meanwhile, the exhaust fan feature will turn on to remove the air outside to reduce the amount of gas. This system includes two sensors and is MQ6 gas sensor and a YG1006 flame sensor. This is what makes the device capable of detecting fire and gas separately. The structure of the device is made to capable the device to respond fast. And the last thing is that it is affordable for the users to implement in their target area.

LITERATURE REVIEW

Many authors have proposed ideas to prevent and detect gas leakage in the past. They also have their unique features and functions. There are numerous benefits and drawbacks to each of them. Below are several descriptions of them.

[1] Shamsudin et al (2021). proposed IoT-based LPG Leakage Detector System with Safety Alert Mechanism. They used components Like ESP Wi-Fi MODULE (ESP8266), MQ-2, ATmega328(Arduino UNO), Load cell, Blynk mobile application, As a result, the technique and goal of this work is to create a gas leak detecting gadget that uses IoT and has many ways to alert users to the presence of a gas leak. The circuit's principle is based on a gas sensor that can detect gas leakage in percentages and parts per million (ppm).

[2] Shobha et al (2021). proposed Internet of Things based Hazardous Gas leakage Detection System in this paper they used, MQ2 Gas Sensor, Arduino Uno, Gas Detection, Ethernet Shield, the Proposed IoT Based if hazardous gas leakage noticing system that list and groups As a result, whether it is a gas leak has occurred in the pipe is determined by the content of the feedback as positive or negative. It can be used to identify fires in houses, guest houses, health facilities, factories, and other public places. The 'IoT-based Hazardous Gas Leakage Detection System' is used in this paper to prevent fires and take preventative measures against fires.

[3] Srikanth Sai et al (2020). Designed IoT Based LPG Leakage Detection and Booking System with Customer SMS Alert In this paper they used MQ2 Gas Sensor, Load Cell, AWS server, GSM Modem This system detects a fuel leak automatically and sends a text message to the user. If the user is busy and does not respond in a timely manner, the system reserves the characteristics of LPG gasoline and replaces the reservation data on the server robotically using the AWS server.

[4] Manichandana et al. (2019). Presented their work on GAS leakage detection and inspection of leakage spots in GAS pipes in this system They provided several models that utilized the SCADA I/F model This model was introduced on GAS leakage detection and inspection of leakage spots in GAS pipes in this system. They provided several models that utilized the SCADA I/F model. In less than three seconds, the technology can deliver correct data from the GAS pipeline to a dedicated simulation. This module, which communicates with SCADA, collects dynamic parameters every 30 seconds. Simulation Model This model uses numerical-based approaches to simulate transient flow using reliable data. Prospective variables are offered in that system in order to obtain the average temperature and systole pressure.

[5] Shilpa et al (2019). Proposed LPG Gas Measurement Detection using GPS They used components like Load cell, Arduino, Signal amplifier, LPG, MQ6 sensor, GPS, and Signal amplifier. This device keeps track of the gas cylinder's level. If the threshold level falls below 2kgs, the user will receive an alert SMS, and the leakage level will be determined.

[6] Rameswari et al (2018). presented. Smart gas assistant for a perfect kitchen. In this paper, they used Wi-Fi, GSM Module, Arduino, Online Tool, Mobile Application, Internet of Things. This system calculates the amount of LPG in the cylinder It will book itself. the cylinder depending on the registration number in addition, an alert message was sent also, inform the customer about the amount of gas in the cylinder.

[7] Jebamalar et al (2017) designed LPG Gas Leakage Detection and Alert System. In this paper, they used Voltage Regulator IC 7805, Resistor, MQ2, Gas sensor, Liquid petroleum gas. This paper discussed a system for detecting and alerting LPG leaks. When LPG leakage is detected, this device activates an LED and a buzzer to inform people. This technique is both simple and efficient.

[8] Iruansi et al (2014). presents their work. Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shutoff System in their project they used a buzzer, gas sensor, microcontroller, gas leakage detection, and solenoid valve. The purpose of the research is to develop a system that can detect gas leaks and warn the subscriber via an alert and a status monitor, as well as the ability to shut it down off the gas supply valve as a primary safety measure.

PROPOSED SYSTEMS

MQ6 Sensor

This MQ6 sensor is used to detect LPG, butane, propane, and LNG. It can also avoid the noise of alcohol and cigarette smoke. Because of these reasons we are using this sensor in our smart system to make it capable of detecting LPG, butane, and propane. The features of this sensor is high sensitivity to LPG, propane, butane, LNG and small sensitivity to alcohol and smoke, fast response, stable and long life, and a simple drive circuit.

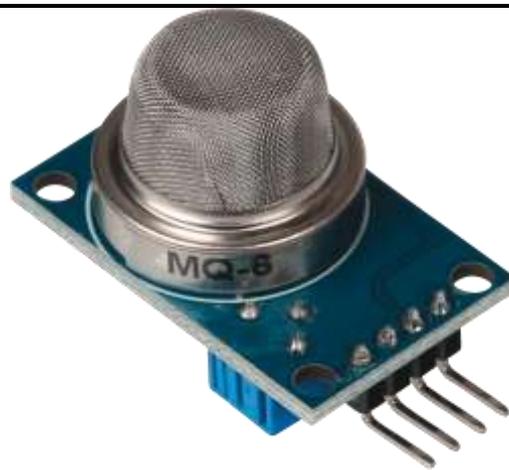


Figure 01. MQ2 Sensor

Arduino UNO



Figure 02. Arduino Uno Board

The Arduino Uno is an ATmega328P-based microcontroller board. It contains 14 input and output pins, with 6 pins for PWM outputs and 6 pins for analogue inputs, as well as a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a type b port USB connection, a power jack and a reset button. It contains so many things that you need to support the microcontroller and by connecting it to a computer with a type-b USB cable or powering it with a 7-12V adapter or battery for getting started. It's an open-source microcontroller board, and the Arduino website has a reference setup for it.

ESP Wi-Fi MODULE (ESP8266)



Figure 03.ESP Wi-Fi MODULE (ESP8266)

ESP Wi-Fi MODULE is integrated with TCP/IP protocol, which can give Wi-Fi access to the microcontroller. We are utilizing this project using an MQ-6 gas sensor to detect gas leakage. Users will be notified about the amount of gas available in the cylinder and any incident if it occurs by using this Wi-Fi module. Also, the other functionality of this

module is the buzzer. This buzzer will get turned on when needed. It gives a signal to the ESP module to activate the micro-controller. We are using The ATmega328P (Arduino UNO) and Proteus Suite Application to implement

Flame Sensor



Figure 04. Fire or Flame Detection Sensor

The fire sensor is intended to distinguish fire or fire around this sensor and as well as it will answer the event of fire or fire. This sensor incorporates a LED flicker framework which will be ready when it distinguishes fire or fire. The fire recognition time and answering time can fluctuate as per the various kinds of sensor systems. This sensor can recognize fire sources or a few other light sources which have a particular recurrence, the extent of 760nm-1100nm. This sensor was built by a high-speed and sensitive (NPN) silicon phototransistor YG1006 sensor. This sensor is sensitive to infrared radiation because of its dull epoxy. Utilizing infrared radiation, the sensor can deal with the covering of water fume, oil, residue, or ice. Its Working voltage is begun at 3.3v to 5.2v DC with a sign of a computerized yield signal. It has three pins, VCC, GND, and D0(output).

SIM800L GSM Module



Figure 05. GSM SIM800L Module

SIM800L module is a tiny cellular part that can execute GPRS/GSM transmission, sending, and receiving SMS. It can create voice calls and receive voice calls. This module is generally utilized for little optimal ventures. This product is also cost-efficient. It can support quad-band frequency which can make this parts an ideal model solution for any projects which needs a long-range connectivity. It works at a 2 Amps peak current. The shallow capacity consumption property is available in this part that swallows only 1mA current when it's in nap mode. It takes 3.7v-4.2v as shown in the datasheet. If the power provider is given more than 4.7 v, it can be damaged.

16*2 LCD Display



Figure 06. LCD 16*2 Display

16*2 LCD displays are very primary and ordinary modules for several devices and circuits. This module is frequently used in tiny projects. A 16*2 LCD display is used to show any messages which have 16 nature and 2 lines. Every single line has a discrete 16 characters. In 16*2 LCD display, each character is monitored in a 5*7-pixel matrix. A solitary 16*2 display has a complete of $16*2*5*7=1120$ pixel or dot. It is able to displaying 224 different characters or sign. It has two resistors, command and data. A command resistor is used to store many commands which are given to monitor and a data resistor is used to store the data which can be displayed.

Buzzer



Figure 07. Buzzer

The buzzer is a tiny and logical part to add sound or alarm to any system or project. It can produce electromechanical or piezoelectric sound. The buzzer is available in two types. The first is can make a non-stop beeping sound and another is a ready-made buzzer which can make a beep. beep sound and shoot up with time.

Exhaust fan

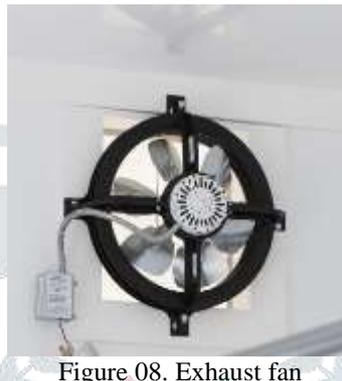


Figure 08. Exhaust fan

The exhaust fan can make the air remove out of the room. It is also known as the process of ventilation. Frequently, this fan is in the kitchen, bathroom, and bedroom to control the heat and make a better ventilation system.

Lipo Battery



Figure 09. Lithium-ion Battery 3.7V

A 3.7v lithium polymer battery is known as a lipo battery. It is a rechargeable battery. This battery is frequently used in several types of tiny projects or drones. The advantage of applying this battery is that this is narrow, lightweight, and powerful.

Methodology

The methodology that has been proposed is as follows:

The proposed system is called the " IoT-based LPG Gas Leakage Detection and Prevention System." capable of detecting fire and detecting gas leaks and notification of the owner to take action immediately of safety precautions. There's a Flame Sensor and a Gas Sensor here. The exhaust fan is linked to a sensor (MQ6) with the Arduino UNO, which comes with a microcontroller ATMEGA328 microcontroller. These Sensors gather information about the environment Input. A GSM interface module is the SIM800L. able to connect to a cellular network. GAS The sensor (MQ6) detects gas leakage by counting the threshold(ppm). The Owner should be contacted through SMS as soon as it detects a high concentration of LPG gas, and the buzzer should activate as an alerting mechanism so that he or she can take the appropriate action. The intensity of the fire or flame automatically dials the pre-programmed phone number to notify the owner of an emergency, and the buzzer also activates. We're using an exhaust fan to do this to reduce the

amount of GAS in the kitchen where the place of the LPG cylinder was present, Expulsion risk should be minimized. Automatically All sensors' responses are recorded.

Project flow chart

When power is on, the system the sensors will activate. A fire detection sensor and gas (MQ-6) sensor will enable to checking and detection of the environment. The MQ6 sensor will read gas sensor value and read flame sensor value. If the gas sensor detects the value of gas threshold initially SMS will send to its owner. During this time, the Exhaust fan will automatically turn on and normalize the condensation. The flame sensor will read the redundancy of the fire and if it's detecting it will alert via phone call and the buzzer will start.

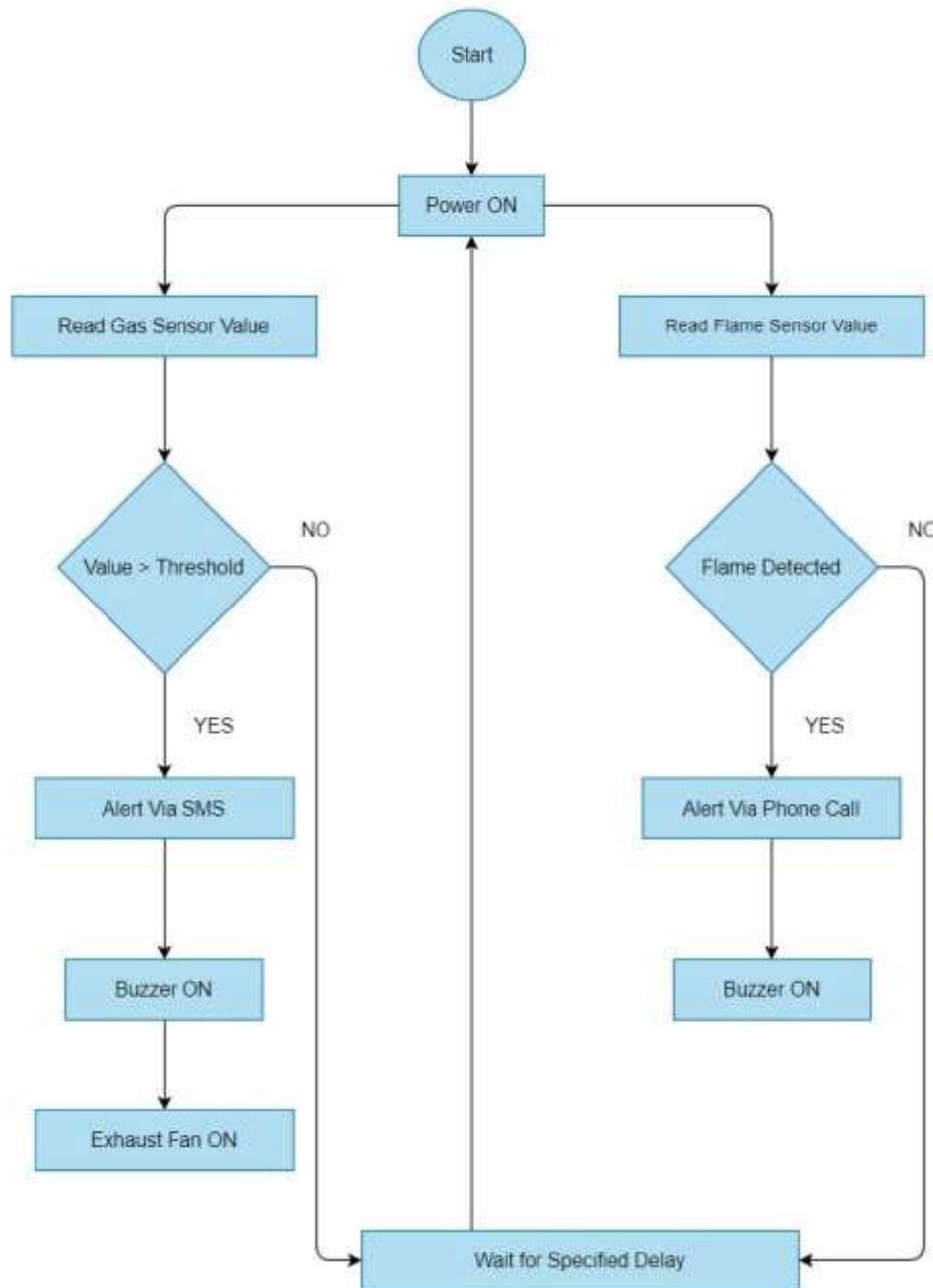


Figure 10. Flow chart for the System

Block diagram

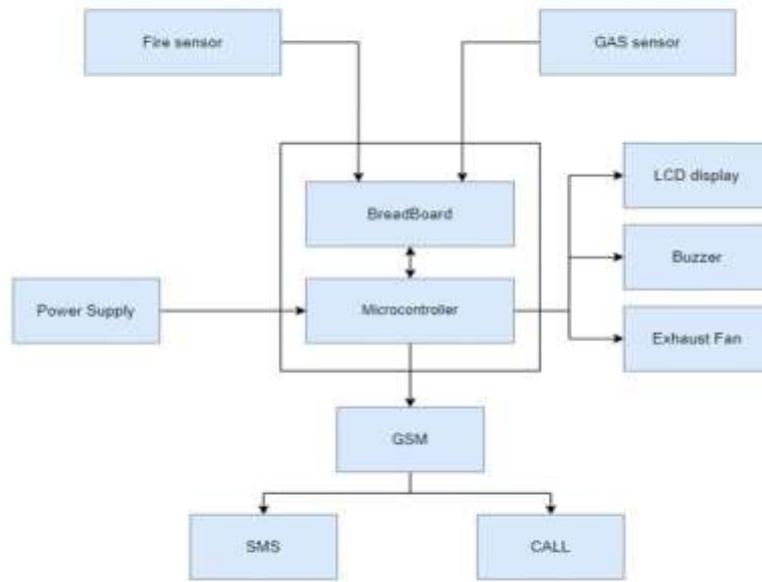


Figure 11. Block Diagram

System Analysis and design

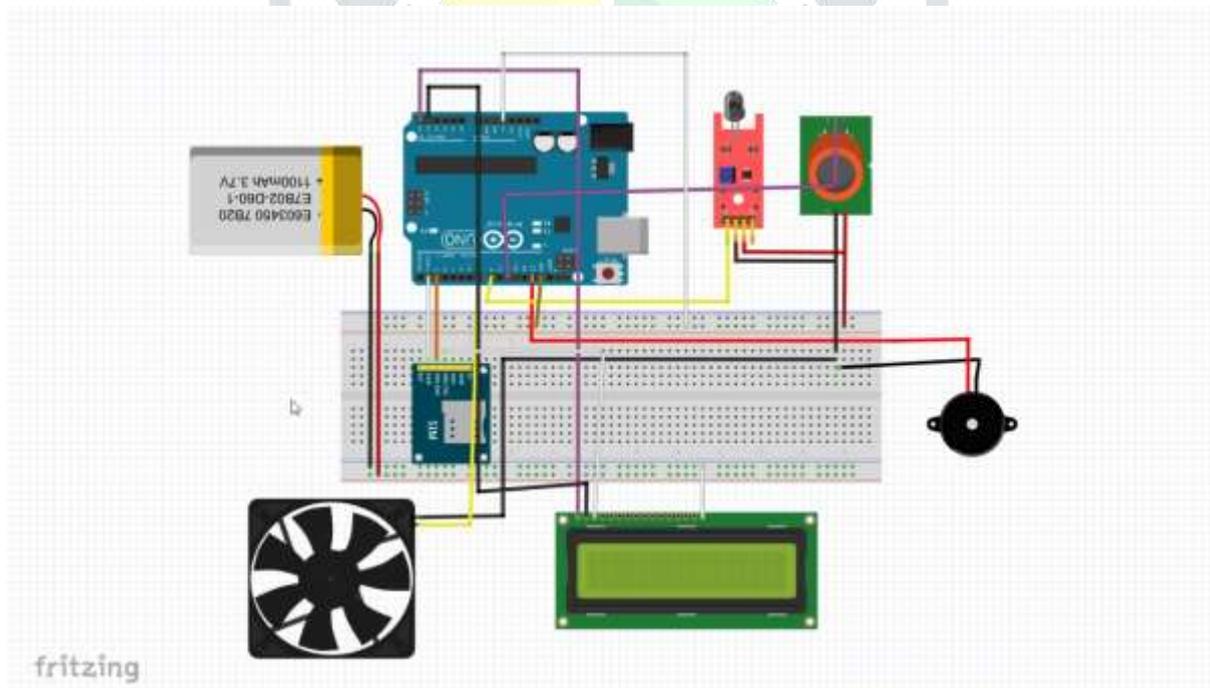


Figure 12. Flow chart for the System

The system connection explains. The system's major component is Arduino. From Arduino getting all the inputs and outputs in the sensor.

Arduino IDE Program

An IDE is available on the official website of the Arduino microcontroller which is <https://www.arduino.cc>. We can download the software and program for the microcontroller according to the system need from this website. In this system, we use the SIM800L module and add the SIM800L library in the IDE program for sending messages and Emergency phone calls.

System prototype

In this part, smart LPG GAS leakage and fire detection system comprising of a number Of components connected are explained below:

1. Arduino UNO is the main controller which is connected with all the components.
2. The breadboard is used as a connector that makes the connection between one another components.
3. MQ6 sensor detects the intensity of gas, from the LPG cylinder a linkage or not.
4. A flame detection sensor is placed next to the gas detection sensor to detect any fire from the LPG cylinder.
5. SIM800L GSM module is used to send emergency messages and call for gas leaking and fire detection.
6. When any incident will occur then the buzzer will buzz up.
7. The Exhaust fan function is used for the gas intensity reducer. Only if gas leakage is found then the exhaust fan will work.
8. To the connect all the components together we used a jumper cable

SMS & Call Delivery Scheme

When the input sensors detect a certain trigger, they send an analogue signal to the Arduino Uno microcontroller. To operate the sensors, programming was done as usual in Arduino. And the GSM Module serves as a gateway for sending emergency SMS and phone calls to the owner or user. For safety concerns, the buzzer will sound and the exhaust fan will switch on. Figure 12 shows the allocation of SMS and emergency calls. We used RX and TX pins to interface GSM SIM800L modules with Arduino, and a valid SIM card must be present in the module.

Result & Discussion



Figure 13 a). SMS Alert System

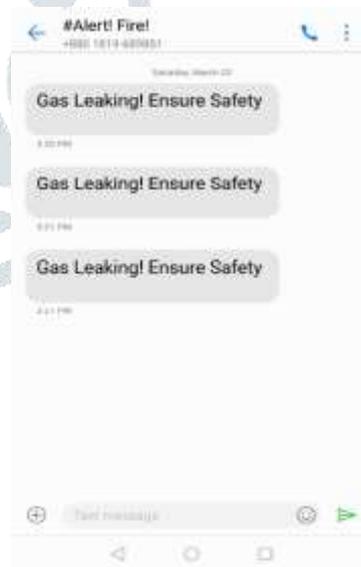


Figure 13 b). SMS Alert System

The working style of IoT Gas Leakage Detection and Prevention System The component in this project is designed to detect gas leakage from the LPG. the MQ-6 Gas sensor detects gas leakage. this sensor is highly sensitive to butane, propane, and LPG gas and smoke. the Arduino Uno is the main part of the system. the MQ6 is connected to the Arduino Uno once the sensor detects the presence of gas leakage and the Arduino sends a signal to ESP Wi-Fi MODULE (ESP8266) that can give Wi-Fi access to the Arduino UNO. The outputs of the sensors are shown on the LCD display

monitor. the time leakage of LPG has been detected the buzzer turns on, the message will be sent to the user's contact number every 20 seconds. and the exhaust fan will turn on for removing or transporting the air outside the house to prevent any blast to happen. when smoke and fire When smoke and fire are detected, the GSM module will begin phoning the user to notify them that a fire is going to break out or has already broken out, The alarm system for both types of calls, as well as SMS, will remain in place until action is done to manage a gas leak or smoke/fire.

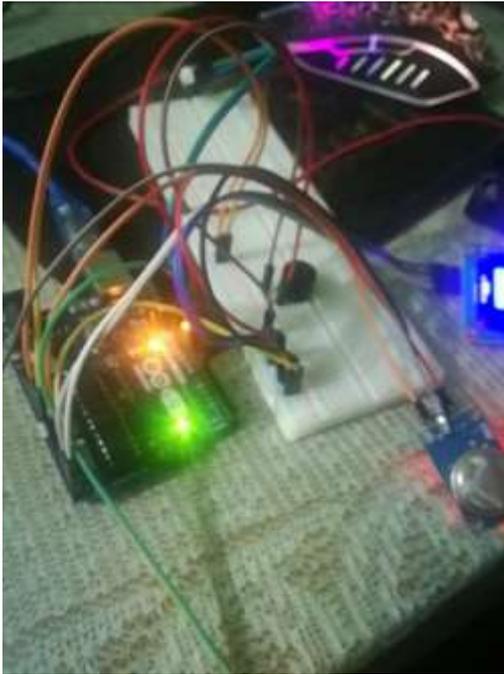


Figure 15 a). Proposed System



Figure 15 b). Proposed System

Future Work

In the future, instead of using AC power, the gas leakage detecting system might be created using photovoltaic panels with a battery as a backup power supply to give a continuous supply, as opposed to the current use of AC power. The protection system employs a combination of MQ6 gas sensors, DHT22 temperature sensors, load sensors, smoke and flame sensors, and PIR sensors. A number of sensors must be calculated, taking into account the room's volume, installation position, and other factors. This system assures that if a gas leak happens, it can be tracked more effectively and that occupants may be notified ahead of time, regardless of whether the leak is visible or not, whether the house is vacant or occupied. The best recommendation for a monitoring system is to utilize a WiFi module that allows the user to monitor the gas level in real-time and automate direct management of the safety device system if an unanticipated occurrence occurs. Finally, the safety device employed was the most vital and important aspect. We also suggested that a tripper circuit be built, which would automatically turn off the (MSB) in the event of a fire, and turn off the gas regulator valve via a solenoid valve either from the cylinder from the main switchboard, If an incident occurs, it automatically can switch on the exhaust fan to suck gas to the outside house and sound an alarm and audio buzzer to inform the user or persons around and the user can opening the window, This device monitors the gas and detects any leaks in order to keep people safe.

CONCLUSION

Gas leaks cause serious disasters that result in property damage and human injuries. The main causes of gas leaks are poor equipment upkeep and a lack of public awareness. As a result, detecting LPG leaks is critical for avoiding accidents and saving human lives. This paper discussed a system for detecting and alerting LPG leaks. Whenever LPG leakage is detected, this device activates an LED and a buzzer to inform people. This approach is straightforward but dependable.

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