K.G. ENGINEERING INSTITUTE

PROJECT REPORT SUMMERY

(GAS LEAKAGE DETECTOR AND SAVER)

UNDER SUPERVISION OF:

Mr. Abhijeet Sett

CERTIFICATE

TO WHOMSOEVER IT MAY CONCERN

This is to certify this project report entitled GAS LEAKAGE DETECTOR AND SAVER is submitted by this group in partial fulfilment of the requirement for the degree Diploma in Department of Electrical Engineering of K.G. Engineering Institute, this record candidates own work carried out by them under our own supervision.

Head of the department

REPORT ABOUT FINAL YEAR PROJECT

Project name: Gas Leakage Detector and Saver

Under the supervision of: Mr. Abhijeet Sett

Submitted in project fulfilment of the requirements for the degree of:

DIPLOMA IN ENGINEERING

(ELECTRICAL ENGINEERING)

DEPERTMENT OF ELECTRICAL ENGINEERING

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BISHNUPUR, BANKURA, 722122

SUBMITED BY

- SUSHANTA LOHAR
- PRITI BAGDI
- RITIKA DEY
- RONEE DEY
- DIPTENDU KARMAKAR
- GOBINDA GUIN

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Date Signature

Place:

K.G. ENGINEERING INSTITUTE

Bishnupur, Bankura, 722122

Abstract

Gas leakage is a major problem with industrial sector, residential areas and gas driven vehicles like CNG (Compressed Natural Gas) buses, cars etc. One of the preventive methods to stop accidents related with the gas leakage is to install a gas leakage detection device at permeable places. The aim of this project is to develop such a device that can automatically detect and stop gas leakages in those permeable areas. The system detects the leakage of the LPG (Liquefied Petroleum Gas) using a gas sensor and Arduino UNO. At normal condition Green LED keeps lighted on. When the LPG concentration in the air exceeds a predetermined level, the gas sensor senses the gas leakage, and the output of the sensor goes HIGH. This is detected by the Arduino UNO and the Red and Green LEDs are turned ON and OFF respectively.

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Chapter 1: Introduction

The Liquefied petroleum gas (LPG), or propane, is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, and vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and less harm to the environment. Liquid petroleum gas (LPG) is highly inflammable and can burn even at some distance from the source of leakage. This energy source is primarily composed of propane and butane which are highly flammable chemical compounds. These gases can catch fire easily. In homes, LPG is used mainly for cooking purposes. When a leak occurs, the leaked gases may lead to an explosion. Gas leakage leads to various accidents resulting in both material loss and human injuries. Home fires have been occurring frequently and the threat to human lives and properties has been growing in recent years. The risks of explosion, fire, suffocation are based on their physical properties such toxicity, flammability, etc. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. The Bhopal gas tragedy in 1984, is an example of accidents due to gas leakage. Major gas accidents that happened listed below,

Sl. No.	Place of Accident	Date	Casualties
1.	Bombay Docks Explosion	April 14, 1944	800 people died in the explosion and some 80,000 were made homeless.
2.	Chasnala Mining Disaster	December 27, 1975	372 miners dead.
3.	The Union Carbide Gas Tragedy	December 3, 1984	estimate around 20,000 to 25,000 deaths
4.	Korba Chimney Collapse	September 23, 2009	45 people lost their lives
5.	Jaipur Oil Depot Fire	October 29, 2009	killing 12 people and injuring at least 130.

6.	Mayapuri Radiolgical Accident	2010	one person was killed and 8 others hospitalised
7.	Visakhapatnam HPCL Refinery Blast	August 23, 2013	23 people were killed
8.	Nagaram GAIL pipeline explosion	June 2014	18 people were killed
9.	Bhilai Steel Plant Gas Leak	2014	6 people were killed and over 40 injured
10.	Tughlakabad Gas Leak	2017	200 school students admitted to hospitals.
11.	Kanpur Ammonia Gas Leak	March 15, 2017	5 people were killed and 9 others injured
12.	Belur Chlorine Gas Leak	May 2017	More than 10 people hospitalized
13.	Bhilai Steel Plant Pipeline Blast	2018	death of 9 people while injuring 14 others

The reason for such explosions is due to substandard cylinders, old valves, no regular checking of gas cylinders, worn out regulators and a lack of awareness of handling gas cylinders. Therefore, the gas leakage should be detected and controlled to protect people from danger. An odorant such as ethane thiol is added to LPG, so that leaks can be detected easily by most people. However, some people who have a reduced sense of smell may not be able to rely upon this inherent safety mechanism. A gas leakage detector becomes vital and helps to protect people from the dangers of gas leakage.

Chapter 2: About the Model

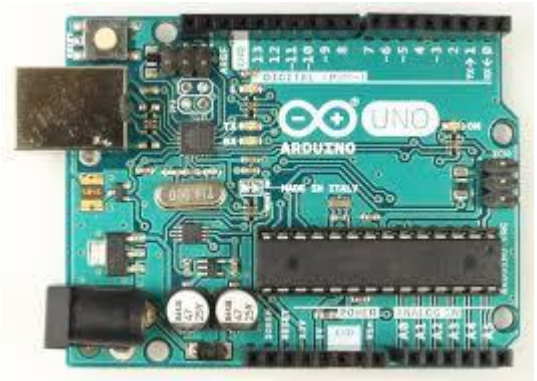
The proposed model uses the following components and technology**.**

- **Arduino UNO R3:**

The Arduino UNO R3 is frequently used microcontroller board in the family of an Arduino. This is the latest third version of an Arduino board and released in the year 2011. The main advantage of this board is if we make a mistake, we can change the microcontroller on the board. The main features of this board mainly include, it is available in DIP (dual-inline-package), detachable and ATmega328 microcontroller. The programming of this board can easily be loaded by using an Arduino computer program. This board has huge support from the Arduino community, which will make a very simple way to start working in embedded electronics, and many more applications.

Specification:

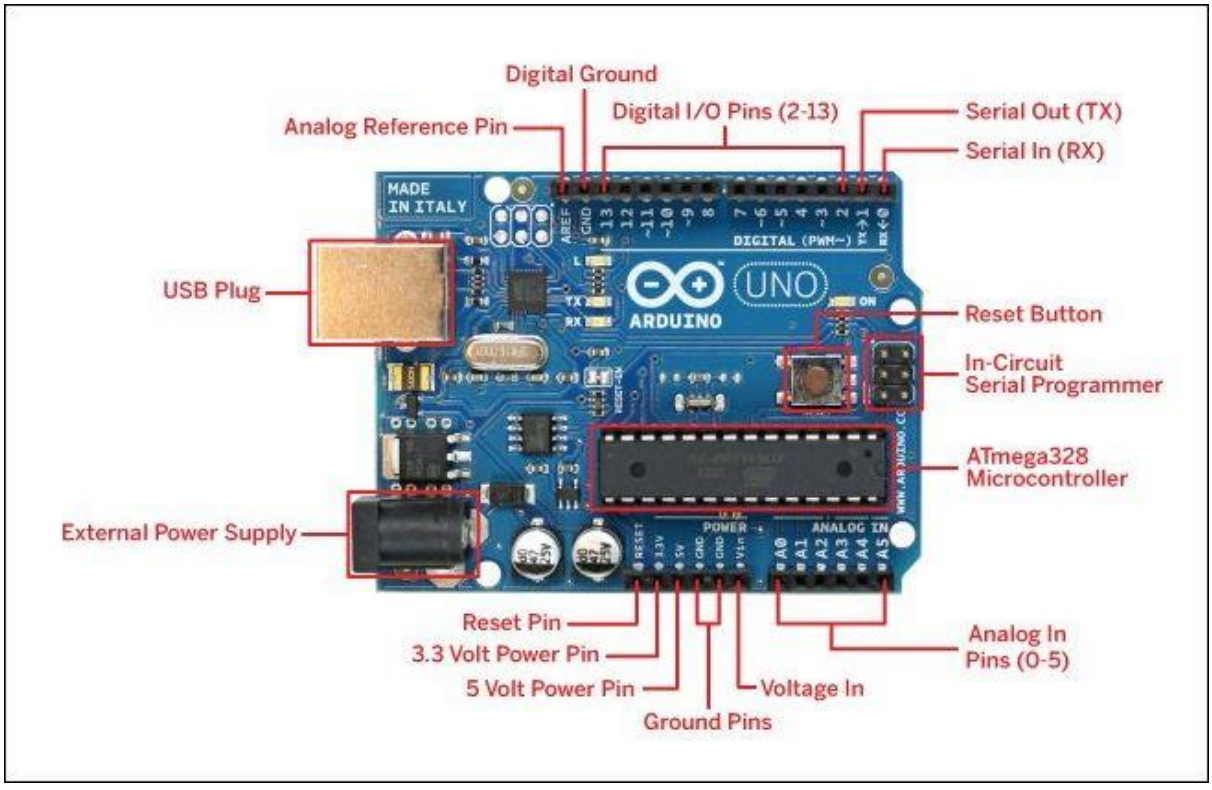
The Arduino Uno R3 board includes the following specifications.



- It is an ATmega328P based Microcontroller
- The Operating Voltage of the Arduino is 5V
- The recommended input voltage ranges from 7V to 12V
- The i/p voltage (limit) is 6V to 20V
- Digital input and output pins-14
- Digital input & output pins (PWM)-6
- Analog i/p pins are 6
- DC Current for each I/O Pin is 20 mA

- DC Current used for 3.3V Pin is 50 mA
- Flash Memory -32 KB, and 0.5 KB memory is used by the boot loader
- SRAM is 2 KB
- EEPROM is 1 KB
- The speed of the CLK is 16 MHz
- In Built LED
- Length and width of the Arduino are 68.6 mm X 53.4 mm
- The weight of the Arduino board is 25 g

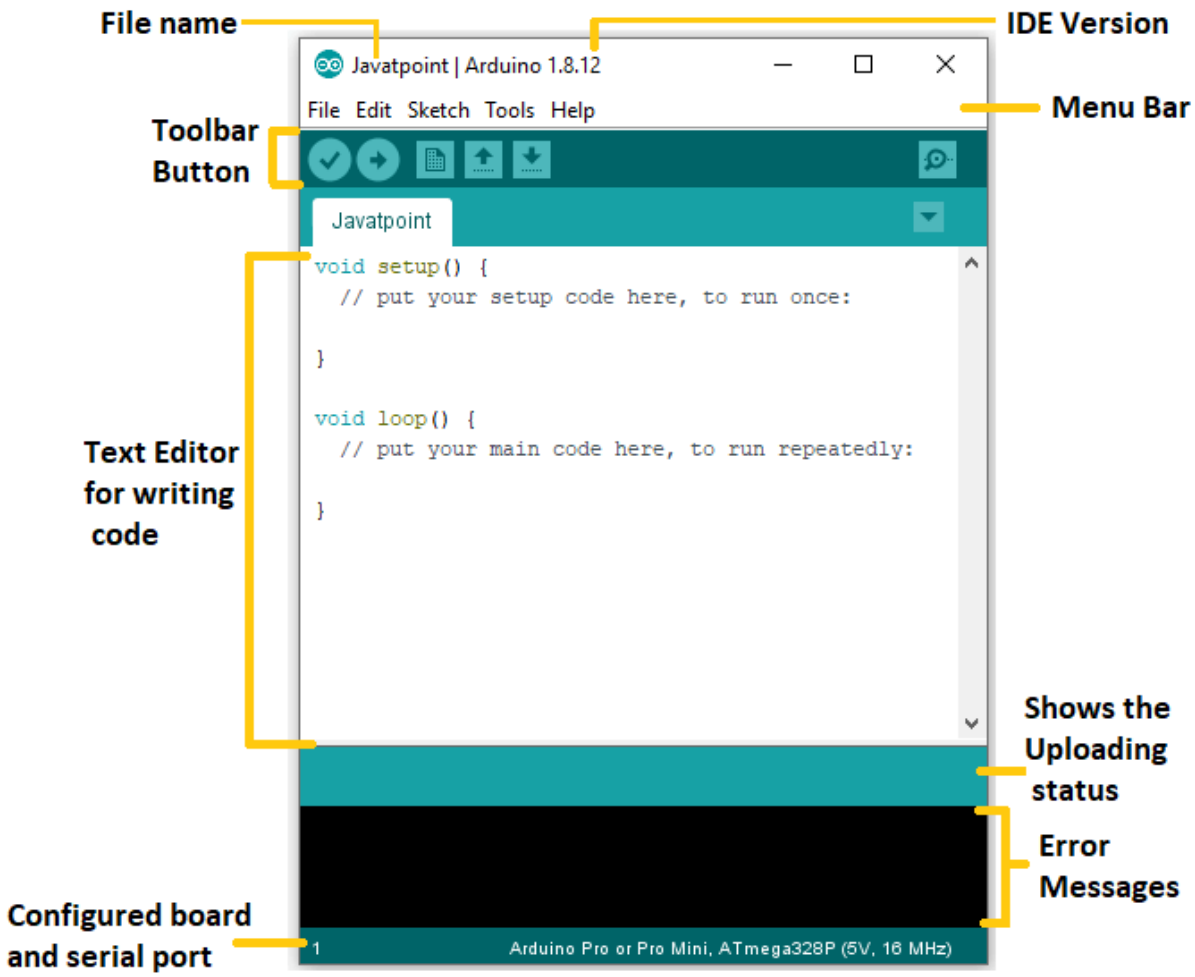
Pin Diagram:



- **Arudino IDE:**

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

We are working on 1.8.19 version to compile and upload the programme.



- **MQ6 Sensor:**

The MQ-6 module is used in gas leakage detecting equipment in family and industry, This module has high sensitivity to LPG, iso-butane, propane and LNG. It can also be used to detect the presence of alcohol, cooking fumes, and cigarette smoke.The module gives out the concentration of the gases as a analog voltage equivalent to the concentration of the gases. The module also has an onboard comparator for comparing against an adjustable preset value and giving out a digital high or low. It can be easily interfaced with your Arduino or Raspberry Pi.

Development Sources: Arduino Code

Features:

- Voltage: 5V
- Detecting concentration :
- 200-10000 ppm LPG
- iso-butane
- propane
- LNG
- Analog and Digital Output
- Digital Out is High or Low based on a adjustable preset threshold

Pins:

1. Vcc – this pin powers the module typically the operating voltage is +5V
2. GND – used to connect the module with system ground
3. DO – used to get digital output from this pin
4. AO – this pin outputs 0-5V analogue voltage based on the intensity of gas

Working Principle:

The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm.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 exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electrocircuit, Convert change of conductivity to correspond output signal of gas concentration.MQ-6 gas sensor has high sensitity to Propane, Butane and LPG, also 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.

The Gas sensor has a sensing element, a base and a cap. The sensing element has a sensing material (Usually a Semiconductor) and a heater to heat up the sensing material. The different sensing materials used are Tin Oxide, Tungsten oxide etc. depending on the type of gas to be sensed. In principle, when the Tin Oxide is heated to high temperature, it adsorbs oxygen on its surface with a negative charge. Then the donor electrons from the Tin oxide crystals passes into the adsorbed oxygen leaving the positive charge in a space charge layer. This creates a surface potential which prevents electron flow. Inside the sensor, the current flows through the boundary of Tin oxide crystals. In the boundary of the crystals, the adsorbed oxygen forms a barrier to prevent the free movement of carriers. This potential barrier gives the electrical resistance to the sensor.

So in the standby mode the electrical resistance of the sensor is high. In the presence of a De-Oxidizing gas, the surface density of the adsorbed negatively charged oxygen decreases leading to a reduction in the size of the barrier. This reduced barrier decreases the electrical resistance of the Sensor.

- ## Servo Motor:

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor.

For this tutorial, we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

- ## Working Principle:

It consists of three parts:

a. Controlled device
b. Output sensor
c. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

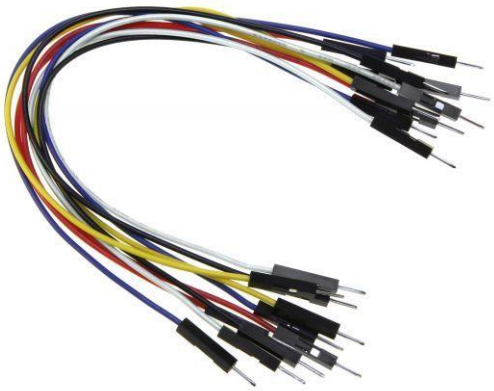
A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob

is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

So the main task of servomechanism is to maintain the output of a system at the desired value at presence of noises

- **Jumper Wires:**

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.



Though jumper wires come in a variety of colors, the colors don't actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power.

- **Types:**

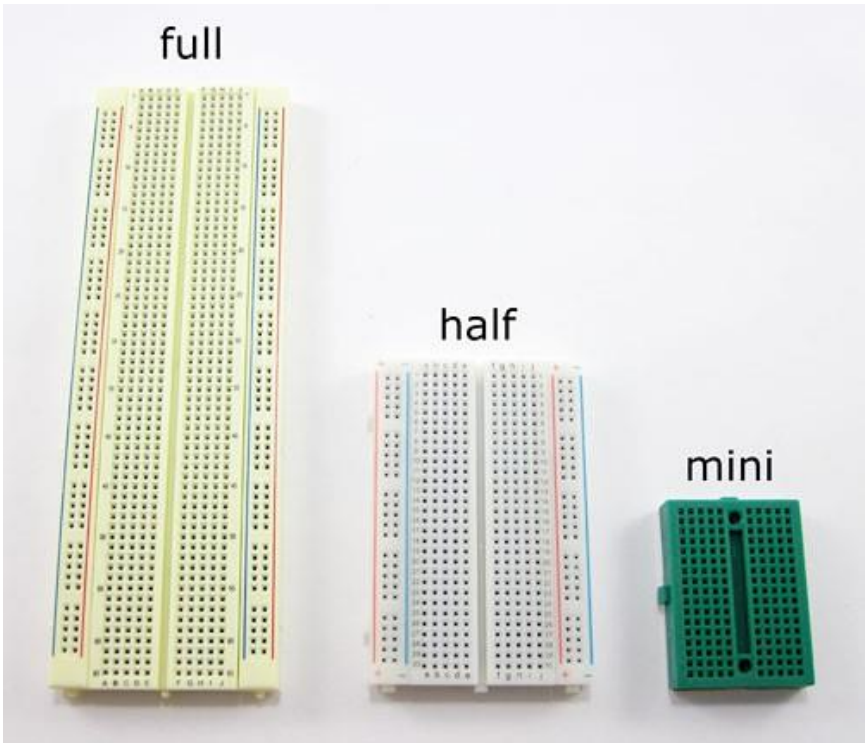
Jumper wires typically come in three versions: **male-to-male**, **male-to-female** and **female-to-female**. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.

- **Bread Board:**

A 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). To learn more about individual electronic components.

The connections are not permanent, so it is easy to remove a component if you make a mistake, or just start over and do a new project. This makes breadboards great for beginners who are new to electronics. You can use breadboards to make all sorts of fun electronics projects.

Modern breadboards are made from plastic, and come in all shapes, sizes, and even different colors. While larger and smaller sizes are available, the most common sizes you will probably see are "**full-size**", "**half-size**", and "**mini**" breadboards.



- **LEDs:**

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime, improved physical robustness, smaller size, and faster switching.

Here we use two LEDs one is Green and Another is Red that indicates Normal and Faulty condition respectively.

- **Gas Regualtor:**

A natural gas regulator brings the gas pressure to a normal level by detecting the gas pressure downstream of the regulator and modifying the spring valve as necessary to provide a continual flow of gas.

Here we use Gas Regulator for the demonstration of gas stopping mechanism.

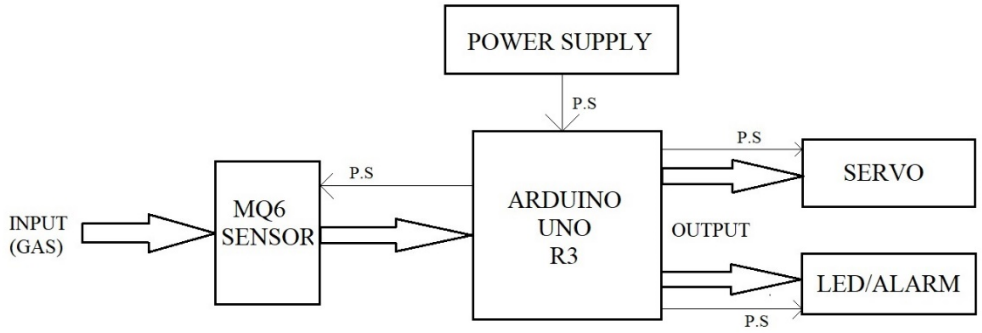
- **Cardboard Box:**

Cardboard boxes are industrially prefabricated boxes, primarily used for packaging goods and materials and can also be recycled.

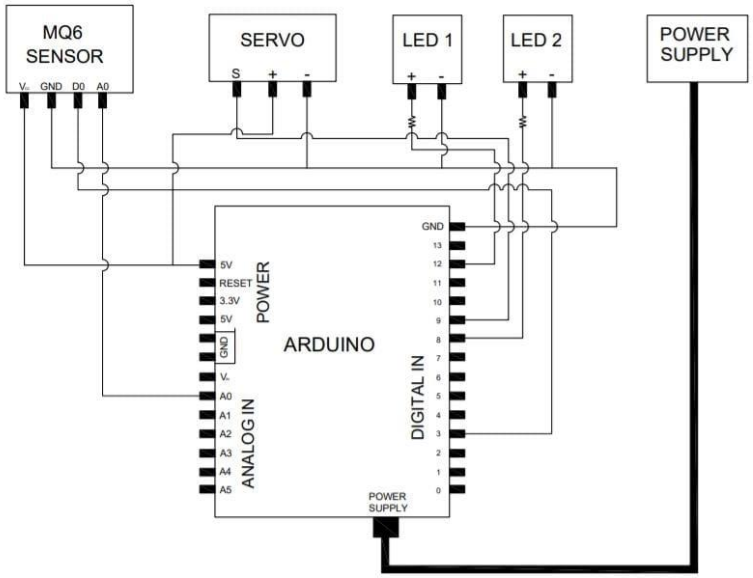
Here we use the cardboard to form structure box for the prototype model.

Chapter 3: Design

- **Block Diagram:**



- **Circuit Diagram:**

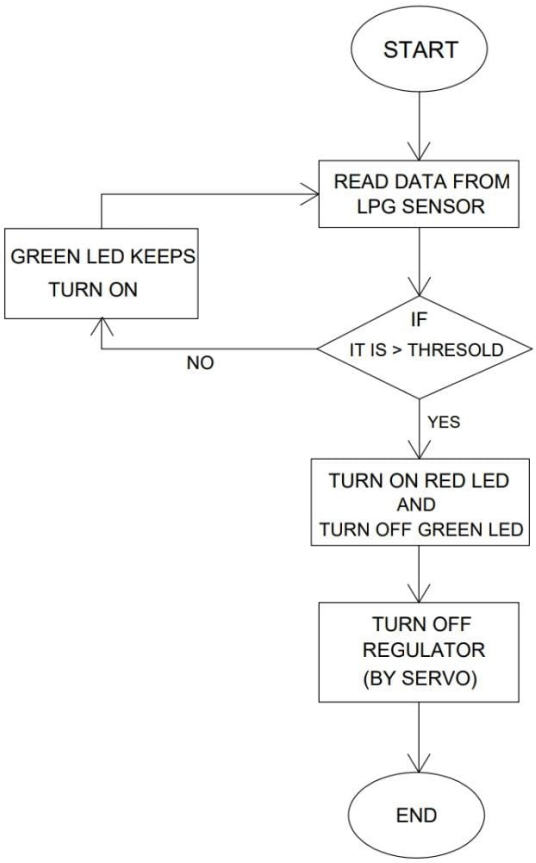


Chapter 4: Working and Algorithm

- **Working Principle:**

We need to install gas sensors inside the oven and near the gas regulator. A lighted Green LED indicates that the system is in normal condition. Whenever there is a leakage of gas, the sensors detect the amount of leaked gas and according to the data from the programme it operates the servo and turns off the knob of the cylinder. Simultaneously it also turn on the Red LED to alart the person.

- **Algorithm:**



- **Programming Code:**

```
#include <Servo.h>

int MQ6 = 3;// MQ-6 SENSOR
int LPG_det;
int Led = 12;
int Led2 = 8;
long gas_lvl;
Servo myservo;
int pos = 0;

void setup()  {
        Serial.begin(9600);
        myservo.attach(9);
        pinMode(MQ6, INPUT);
        pinMode(Led, OUTPUT);
        pinMode(Led2, OUTPUT);
}

void loop()  {
        LPG_det = digitalRead(MQ6);
        gas_lvl= analogRead(A0);
        delay(1000);
        Serial.println("LPG Flag=");
        Serial.println(LPG_det);
        Serial.println("Analog Value");
        Serial.println(gas_lvl);

if (gas_lvl >200)  {
        Serial.println("LPG detected...");
        digitalWrite(Led, HIGH);
        digitalWrite(Led2, LOW);
                for (pos=0; pos<=180; pos+=1);
                myservo.write(pos);
                delay(15);
        }

else  {
        Serial.println("No LPG detected ");
        digitalWrite(Led, LOW);
        digitalWrite(Led2, HIGH);
                for (pos=180; pos>=0; pos-=1);
                myservo.write(pos);
        }
}
```

Chapter 5: Costing

Product Name	Price	Quantity
1. Arduino UNO R3	925	1
2. MQ6 Sensor	355	1
3. Servo Motor	216	1
4. Jumper Wires	130	10x3 = 30
5. Bread Board	218	1
6. LEDs	10	2
7. Gas Regulator	50	1
8. Others	85	
TOTAL	**1989**	

Chapter 6: Conclusion

- **Future Scope:**

Overall, software and hardware parts of the systems have been developed and tested by introducing a small amount of LPG near gas sensor module. The authors of this paper are currently working to include multi functions with this device. One of the notable future functions of this system is to add a sub system where wastage of gas and the uses of gas can be monitored using this system. The system is flexible as a greater number of sensors and relays can be added to it according to the whole LPG supply setup in those premises. The author is adding more software based intelligent functions with this system. This is an automatic gas detection, control and alert system. In future this system will have a feature where it can notify the emergency services if any accidents happen by adding NodeMCU to it. A mobile app and web-based app for real time monitoring also will be added. In the user app for this system many smart features like turn on Exhaust, will be added. The overall features will make the system more safe for the users. The system will be optimized for use in many places like the car, the home, industries and many other places.

After designing the final prototype with smart multifunctional features, the system will be implemented in real life scenarios as a pilot project.

- ## Conclusion:

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this paper. This is a low-cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere but also wastage of gases will hurt our economy. The proposed system will cost only near about rs.**1500-2000** which is affordable. In the open literatures it is noticed that much work has not been done for a smart gas detection system. In future, more advanced features will be integrated with this system which will provide users with more safety and relaxation. The proliferation of handheld devices has led to developments in the field of smart gas sensors, which has considerably widened their scope of application. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

Reference(on 19th June,2022):

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