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LPG CYLINDER WEIGHT AND GAS LEAKAGE MONITORING SYSTEM

A PROJECT REPORT

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ABSTRACT

This system was proposed to create an awareness among people about gas leakage. Many people are affected due to this gas leakage. In this system, we have used two analog sensors which works only in closed environment. In present situation there are many cases related to gas leakage which cause innocent people lives and property damage. Implementing this application can be useful for companies, houses, which can save lives of people. For identifying the leakage, we are using MQ6 LPG gas sensor. When the gas is detected, the knob will automatically close using servo motor. For measuring the weight, we are using Load cell. To intimate the leakage, we are using buzzer which will alarm when the limit is reached. If the cylinder is going to empty, the LED will glow. We can also view the measurements using LCD. Hence, this paper presents a gas leakage alert system to detect the gas leakage and it also monitor the weight which will alarm the people onboard.

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LIST OF ABBREVIATION

ACRONYM	ABBREVIATIONS
LPG	Liquefied Petroleum Gas
LED	Light-Emitting Diodes
LCD	Liquid Crystal Display
MCU	Multipoint Control Unit
VDC	Volts of Direct Current
TTL	Transistor Transistor Logic
IDE	Integrated Development Environment

CHAPTER 1

INTRODUCTION

In India approximately 33crore people of the population are using LPG. Now-a-days there is nothing to replace LPG. A small leakage of this gas can cause a high after effect. But if any disaster happens due to gas leakage there is no proper measure to control it. These explosions may cause lossof lives, wealth etc. The Bhopal gas tragedy was an incident in which neither the leakage was detected earlier nor was the leakage controlled in time.

Gas is the most used fuel in Nigerian homes and industry in which some required measures must be strategized in other to protect against incidents and accidents such as suffocation and explosion associated with its usage. LPG is a highly inflammable gas made up of a mixture of butane (C4H10) and propane (C3H8) through butylene and propylene and another hydrocarbon present in small quantity, due to the odourless of these chemical ethyl mercaptans is added as an odorant to give a powerful scent so that when leakage occurs it can be perceived, however in a situation of the minimum quantity of gas leakage, some people have a poor sensing ability to perceive and so, more reliable, and effective device use in detecting gas (gas leakage detector) must be installed in homes, industries, and vehicles of LPG usage to avoid explosion. LPG leakage refers to several factors such as leakage in the pipe, hose not properly fixed, and hearing of whistling or hissing sound around the cylinder, valve not fitted properly.

The aim of the proposed project is to detect and control the leakage of LPG at home. MQ-6 sensor is used to detect the leakage of the gas. When the system senses the LPG content in the air the buzzer alarms the user simultaneously until the knob gets locked. The system also measures the weight of the gas cylinder continuously using load cell. When the weight of the cylinder reaches a minimum threshold, it will alert the user by LED light. Wi-Fi module is used, which will store the measured data in cloud. So that we can access it from anywhere. It will help in booking the cylinder in correct time. Arduino Uno microcontroller is used for the ease of programming and ability to prototype quickly.

PROBLEM STATEMENT

LPG is one of the clean fuels. It is most widely being used in India. It is being used for household purposes as well as for industrial purposes also. In case of household use it is mostly used in kitchen for cooking, whereas in case of industrial purpose it is being used in various industrial processes such as gas cutting, gas welding, metallurgical industries, steel plants, glass cutting, pharmaceutical industries and many more. Apart from this the gas cylinders are also used in schools, colleges, hospitals, hotels and restaurants and many other places. In the past years the demand for use of LPG have increased sustainably and will continue to rise. But with the increase in demand of use of LPG the rate of accidents caused due to it have also increased in the past few years. Most of the accidents are due to the explosion of LPG cylinder. But sometimes very small quantity of gas leakage is unnoticed and is responsible for the further major accident. This paper discusses the solution to it. The other problem which is faced by the users of LPG cylinder is the untimely emptying of the cylinder. We have used IoT in this project. It is the cloud service which will gather and store the data.

The gas cylinders mostly contain LPG. The main constituents of LPG are propane and butane gas. The sensor available to detect these gases is MQ-6 and MQ-5. MQ-6 sensor detects only LPG and butane gas. So, we selected it. As it detects the gases which are the main constituent of cylinders, it will give precise and accurate reading. Moreover, this sensor has very rapid response to LPG gas. It has very small sensitivity for alcohol, smoke. It detects propane, iso-butane, LPG with very high sensitivity and accuracy.

Here, we are using Load cell to measure the weight of gas cylinder. So that we can calculate when the cylinder is going to empty. In this project we have used active buzzer. The main purpose for using buzzer in this project is to alarm the people for any leakage if there is any. The led (Light Emitting Diode) is a semiconductor device which is used as light source. They are used as indicator lamps in many devices and nowadays they are being used for lighting. LCD uses liquid crystal to produce visual image. It is a super thin display that is used in laptop and computer screens, tv's, mobile phones and portable video games. In this project we are using LCD display to display the weight measure by the load cell. Overall, the problem of gas leakage will be overcome by using sensors and indicators.

CHAPTER 2

LITERATURE REVIEW

The system is highly reliable, tamper-proof, and secure. In the long run the maintenance cost is efficient. It is highly accurate. (A.sood, B.Sonkar, A.Ranjan, Mr. A.Faisal, June-2015)Liquefied Petroleum Gas commonly known as LPG consists of a mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons. It is an odorless gas due to which Ethyl Herceptin is added as powerful odorant so that leakage can easily be detected. LPG is commonly used in homes for heating and cooking. This energy source is primarily composed of propane and butane which are highly flammable chemical compounds. LPG was first produced in 1910 by Walter Snelling (Didpaye1, 2015) and is classified as a hazardous material because of its flammable properties and explosive potential when stored under pressure. Before the development of electronic household gas detectors in the 1980s and 90s, gas presence was detected with a chemically infused paper that changed its color when exposed to the gas (Didpaye1, 2015). Since then, many technologies and devices have been developed to detect, monitor, and alert the leakage of a wide array of gases. Hence the requirement of an efficient system to detect leakage of LPG is inevitable, which may be used for domestic and commercial purposes.

A system, that provides information when there is a gas leakage. In those cases, this system alerts the people around them. In the proposed system we have designed "LPG gas Leakage and weight monitoring system". This report focuses on detection of economic fuels like petroleum, liquid petroleum gas. LPG and gas sensors are used in the field of safety.

CHAPTER 3

PROJECT METHODOLOGY

The gas leakage detection system consists of ESP8266 module, MQ-6 gas sensor, a led and a buzzer. The cloud service used is Thingspeak.com. This system will be placed at such a location such that there will be no disturbance for the detection of gas leakage. The preferred location will be near the knob of the cylinder. If the MQ-6 sensor finds that there is any concentration of gas in the surrounding environment, then it will sense it and will send a signal to ESP8266 module. The module will process the signal and will activate the led or buzzer depending on the strength of the signal received. The maximum voltage to the sensor is 5V. When it detects the gas in the surrounding, the resistance of the sensor changes (increases or decreases) the voltage of the sensor. The signal generated by the sensor will depend on the voltage output of the sensor. Lower the voltage, stronger the signal generated.

This system consists of load cell, an Arduino module, and an LCD screen. This system will be placed at the base of the cylinder, or we design our own base for cylinder and place this system on it accordingly. The load cell is used to measure the weight of the object placed over it. In this case it will measure the weight of the gas cylinder. Before it measures the weight and begins the monitoring it requires calibration. After the calibration is done it will measure the weight placed over it continuously. It gives the output in analog form. The load cell is calibrated and will display thereadings on the LCD screen. For real environment, if the weight of the cylinder will be less than 19kg the message displayed on the LCD stating the low weight of the cylinder and to refuel it or to order a new one. Ifthe weight of the cylinder is below 14kg then the message displayed on the LCD stating that the cylinder is empty. For demo purpose, if the weight is less than 500g, the LED will glow up for indication. When a new cylinder will be placed on the load cell, it will calibrate the new weight and then measure the weight. The above process will be repeated for every cylinder placed on the load cell.

PROPOSED BLOCK DIAGRAM

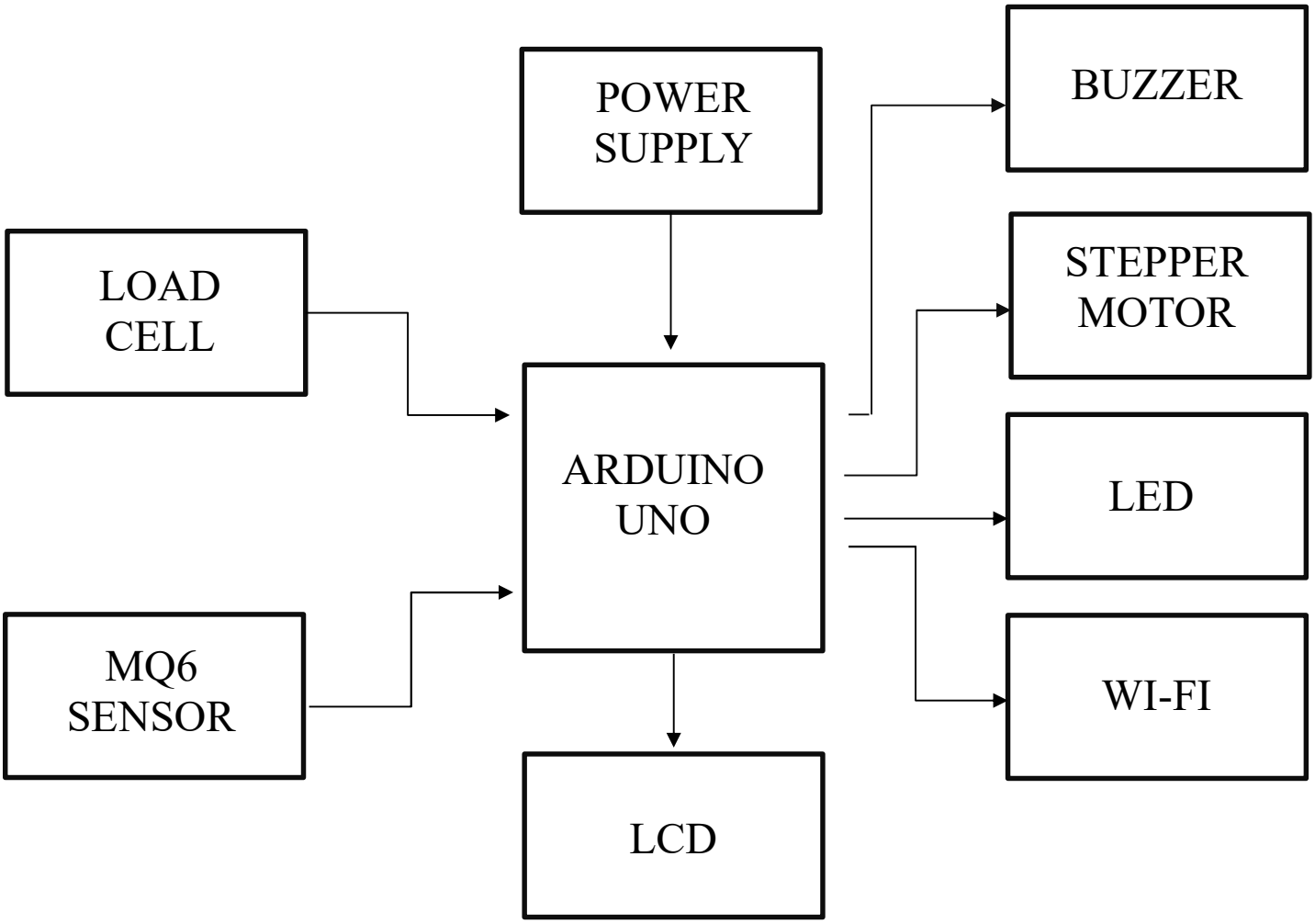

Fig. Proposed Block Diagram

COMPONENTS

MICROCONTROLLER MODULE

The microcontroller is a compact microcomputer, designed to control the operation of embedded electronic systems in various applications. Here, it is used to read the environment temperature from the sensor module, display the characters on the display module and switch on or off the necessary pins as perthe program uploaded on the microcontroller.

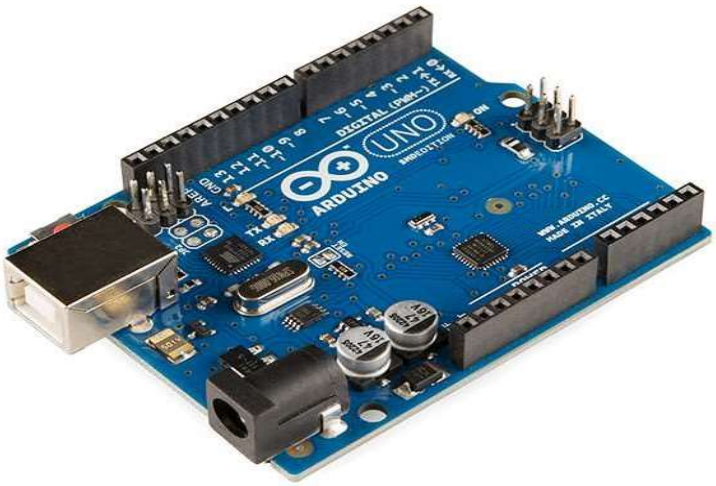

Fig. Arduino UNO

MQ6 GAS SENSOR

A Gas Sensor is a sensor that detects smoke as a primary indication of fire. It an easy tool to detect any type of gases or smoke occurred in the forest. The type of sensor used is MQ6. Its coverage is of 112m² per device, which is usually approximated to 100m². With heat detectors it has an area of coverage of 56m² per device which is rounded down to 50m². It has highly sensitive and has a high responding time so that the measurement can be done quicker.

Specifications of MQ-6 Gas Sensor

- Power requirements: 5 VDC @ ~165 mA (heater on) / ~60 mA (heater off)
- Current Consumption: 150mA
- DO output: TTL digital 0 and 1 (0.1 and 5V)
- AO output: 0.1- 0.3 V (relative to pollution), the maximum concentration of a voltage of about 4V
- Detecting Concentration: 0.05-10mg/L Alcohol
- Interface: 1 TTL compatible input (HSW), 1 TTL compatible output (ALR)
- Heater consumption: less than 750mW
- Operating temperature: 14 to 122 °F (-10 to 50°C)
- Load resistance: 200kΩ
- Sensitivity S: Rs (in air)/Rs (0.4mg/L Alcohol) ≥5
- Sensing Resistance Rs: 2KΩ-20KΩ (in 0.4mg/l alcohol)
- Dimensions: 32 x 22 x 16 mm

Fig. MQ6 Gas Sensor

LOAD CELL

There are four wires in loadcell: red, black, green, and white. To get a measurable data froma load cell, an HX711 load cell amplifier is used. It is having an accuracy of +/-5% because of the factors like drift, temperature, vibration etc.

Fig. Load Cell

SOUND MODULE

The buzzer in this circuit is used when microcontroller provides high signal, i.e., when a temperature is greater than or equals to 35 degrees Celsius, the circuit will be completed, and the buzzer will start alarming.

Fig. Sound Module

DISPLAY MODULE

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.

No	Symbol	Function
1	VSS	Ground
2	VDD	5V +
3	V0	Contrast
4	RS	Register
5	RW	Read/Write
6	E	Enable
7	D0	Data bus
8	D1	Data bus
9	D2	Data bus
10	D3	Data bus
11	D4	Data bus
12	D5	Data bus
13	D6	Data bus
14	D7	Data bus
15	A	Anode (5V+)
16	K	Cathode (GND)

Fig. Display module

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; the data register stores the data to be displayed on the LCD.

LED BULB

A light-emitting diode (LED) is a semiconductor device 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.

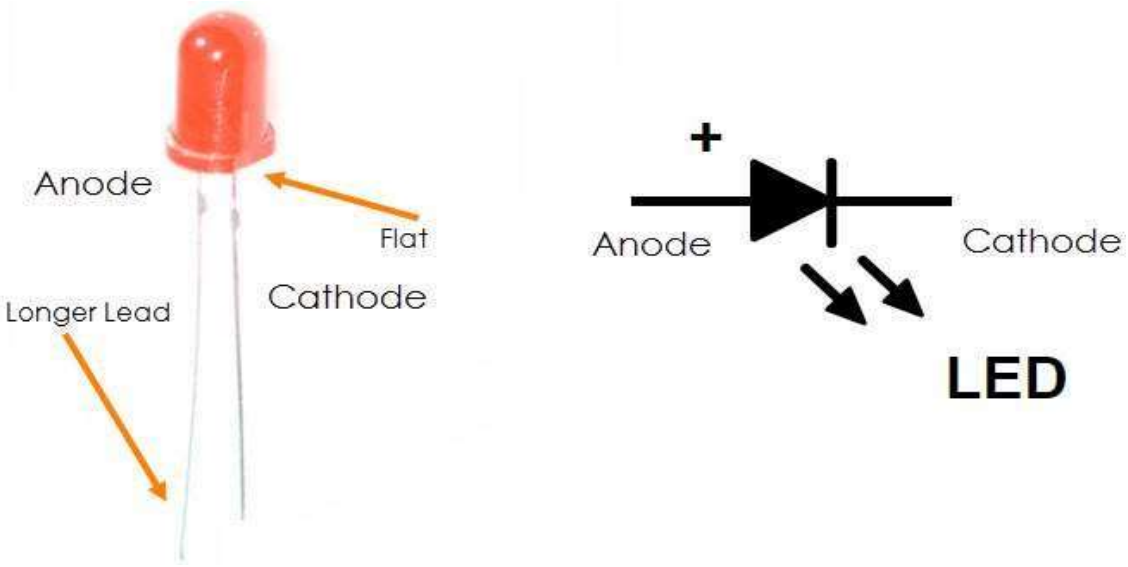

Fig. LED BULB

SERVO MOTOR

Servo motors are typically made up of a small DC motor, a gearbox, and a feedback control system. The feedback control system is what sets servo motors apart from other types of motors. It consists of a position sensor (such as a potentiometer or an encoder) that provides feedback to the motor controller, allowing it to accurately control the motor's position.

Fig. Servo motor

WI-FI MODULE

Wi-Fi modules or Wi-Fi microcontrollers are used to send and receive data over Wi-Fi. They can also accept commands over the Wi-Fi. Wi-Fi modules are used for communications between devices. They are most used in the field of Internet of Things.

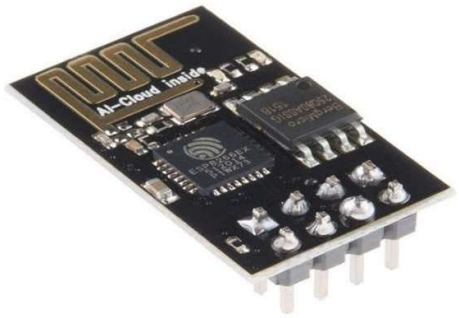

Fig. Wi-Fi module ESP8266

POWER SUPPLY

The Arduino UNO board is a popular microcontroller board used for various electronic projects. It utilizes a USB (Universal Serial Bus) cable to connect to a computer or other devices like Power Bank for programming and communication purposes.

The USB cable provided with the Arduino UNO is a standard Type-A to Type-B USB cable. It has a Type-A connector on one end, which is a flat, rectangular connector commonly found on computers and USB power adapters. The other end features a Type-B connector, which is a square-shaped connector specifically designed for devices like printers, scanners, and Arduino boards.

The USB cable serves two primary functions when connecting the Arduino UNO to a computer:

1. Power Supply: The USB cable provides power to the Arduino UNO board from the computer's USB port. This eliminates the need for a separate power supply as the board can draw power directly from the USB connection.
2. Serial Communication: The USB cable facilitates serial communication between the Arduino UNO and the computer. It allows you to upload your code to the Arduino board, monitor the serial output, and establish communication between the board and external devices.

Fig. USB cable

When you connect an Arduino UNO to a power bank using a USB cable, the power bank acts as a portable power source for the board. Here's what you need to know about using a USB cable and a power bank with an Arduino UNO:

1. USB Cable: The USB cable provided with the Arduino UNO is a standard Type-A to Type-B USB cable. It typically has a Type-A connector on one end (for connecting to the power bank or a USB power source) and a Type-B connector on the other end (for connecting to the Arduino UNO board).
2. Power Bank: A power bank is a portable battery pack that can supply power to electronic devices like smartphones, tablets, and Arduino boards. Power banks usually have one or more USB ports to connect devices via USB cables.

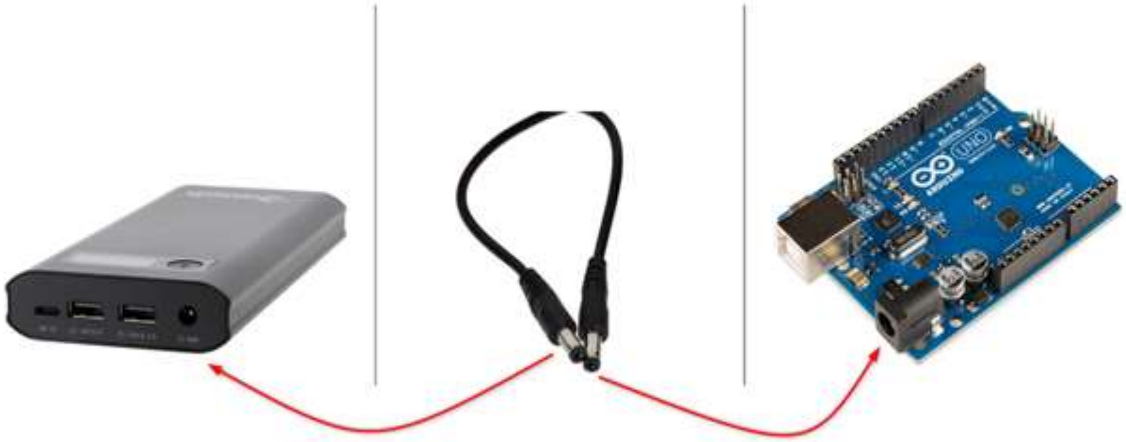

Fig. Power Supply given by Power Bank

To power an Arduino UNO with a power bank, follow these steps:

1. Ensure that your power bank is charged and has sufficient power.
2. Connect one end of the USB cable to a USB port on the power bank. Some power banks may have multiple USB ports, so you can choose any available port.
3. Connect the other end of the USB cable to the USB port on the Arduino UNO board. The USB port is typically located on the board's side or near the power jack.
4. Once the USB cable is connected, the power bank will supply power to the Arduino UNO board, and the board will turn on. You can now use the Arduino UNO as usual.

ARDUINO SOFTWARE (IDE)

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

WRITING SKETCHES

Programs written using Arduino Software (IDE) are called sketches. These sketches are written inthe text editor and are saved with the file extension ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and displays errors.

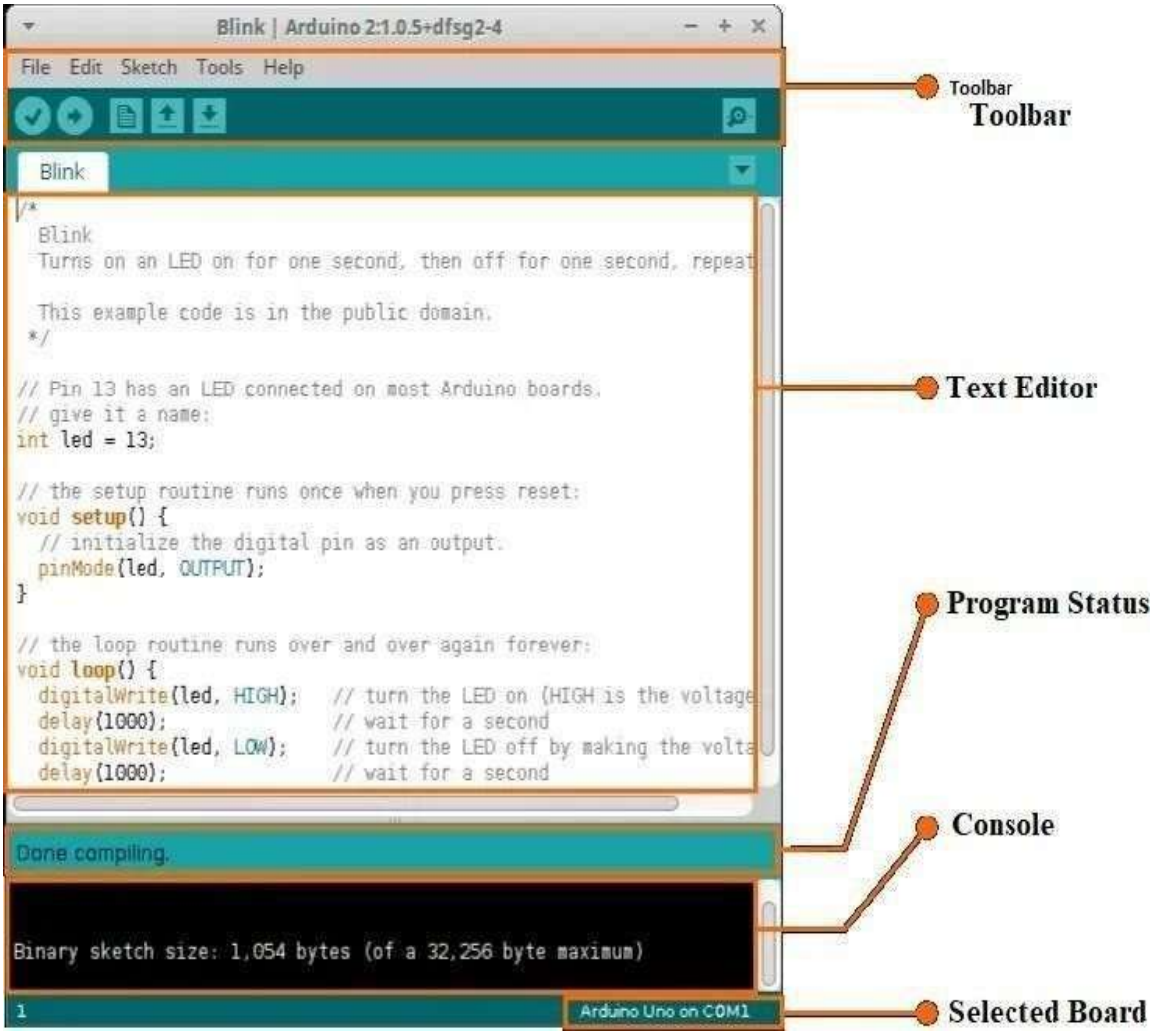

Fig. Arduino IDE

The console displays text output by the –Arduino Software (IDE), including complete error messages and other information. The bottom right- hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches,and open the serial monitor.

CHAPTER 4

WORKING METHOD

The safety of the consumer is mandatory. An efficient and fast working controller is needed to continuously sense the LPG gas and its level (weight) sensor's output. Also, a fast reply is desired when leakage is found. Along with this a system must possess capacity to store some information which can be used for further processing. Gas sensor detects the presence of gas, weight sensor gives the gas level in cylinder, and microcontroller will take corrective or necessary actions. The status of all these happening must be conveyed to the owner of system or housemates. The gas leakage will be detected using MQ6 sensor and the weight of the cylinder is measured using Load cell. These are connected to analog and digital pins of Arduino UNO. These are the input devices we have used in this project. These devices collect the data/information from the environment. The collected information is passed to the controller which will display the information in the display module. The display module used is LCD, which had 16X2 characters operating on +5Volt supply and operated in 4-bit mode is implemented for the task of displaying required messages. The indicators used are buzzer and LED. When the gas gets leaked, the sensor will automatically detect it. If it exceeds certain amount (causing Hazards), the buzzer will alarm and the knob will automatically close using servo motor. Likewise, the weight of the cylinder is also measured continuously. If the cylinder is going to get empty, the LED will indicate. These data can be viewed in cloud using Wi-Fi module.

WORKING MODEL

Fig. Prototype of the monitoring system

CODE USED

```
#include "HX711.h"
#include <LiquidCrystal_I2C.h>
#include <SoftwareSerial.h>
#include <Servo.h>
#define RX 2
#define TX 3
HX711 scale;

float calibration_factor = 52; // this calibration factor is adjusted according to my load cell
float units;
float ounces;
String WIFI_SSID = "Furious";
String WIFI_PASS = "Lathi@123";
String API = "IM7KD5UVFY897OCB";
String HOST = "api.thingspeak.com";
String PORT = "80";
int countTrueCommand;
int countTimeCommand;
int servoPin = 6;
int buzzerPin = 7;
int ledPin=8;
//int angle = 360;
Servo Servo1;
boolean found = false;
SoftwareSerial esp8266(RX,TX);
LiquidCrystal_I2C lcd(0x27,16,2);
 void setup() {
 lcd.init();
 lcd.clear();
 lcd.backlight();
 Serial.begin(9600);
 scale.begin(4,5);
 esp8266.begin(115200);
 Servo1.attach(servoPin);
 pinMode(buzzerPin, OUTPUT);
 pinMode(ledPin, OUTPUT);
 sendCommand("AT",5,"OK");
 sendCommand("AT+CWMODE=1",5,"OK");
  sendCommand("AT+CWJAP=\""+ WIFI_SSID +"\",\""+ WIFI_PASS +"\"",20,"OK");
  scale.set_scale();
  scale.tare();  //Reset the scale to 0
  long zero_factor = scale.read_average(); //Get a baseline reading
  Serial.print("Zero factor: ");
  Serial.println(zero_factor);
}
```

```
void loop() {
 int gas=analogRead(A0);
 scale.set_scale(calibration_factor); //Adjust to this calibration factor
 Serial.print("Weight: ");
 units = scale.get_units(), 1000;
 if (units <= 0)
 {
  units = 0.00;
 }
 ounces = units * 0.035274;
 Serial.print(units);
 Serial.print(" grams");
 lcd.setCursor(0,0);
 lcd.print("WEIGHT: ");
 lcd.setCursor(9,0);
 lcd.print(units,0);
 lcd.setCursor(14,0);
 lcd.print("g");
 lcd.setCursor(0,1);
 lcd.print("MQ6: ");
 lcd.setCursor(5,1);
 lcd.print(gas);
 lcd.setCursor(9,1);
 lcd.print("PPM");
 Serial.print("MQ6: ");
 Serial.print(gas);
 Serial.println("PPM");
 delay(1000);
 lcd.clear();
 if(units<500)
 {
 digitalWrite(ledPin, HIGH);
 }
else
 {
digitalWrite(ledPin, LOW);
 }
 if(gas>100)
 {
 Servo1.write(180);
 digitalWrite(buzzerPin, HIGH);
 }
 else
 {
 Servo1.write(0);
 digitalWrite(buzzerPin, LOW);
 }
```

```
 String getData="GET /update?api_key="+ API+"&field1="+gas+ "&field2="+units;
 sendCommand("AT+CIPMUX=1",5,"OK");
 sendCommand("AT+CIPSTART=0,\"TCP\",\""+ HOST +"\","+ PORT,15,"OK");
 sendCommand("AT+CIPSEND=0," +String(getData.length()+4),4,">");
 esp8266.println(getData);
 countTrueCommand++;
 sendCommand("AT+CIPCLOSE=0",5,"OK");
if(Serial.available())
  {
    char temp = Serial.read();
    if(temp == '+' || temp == 'a')
      calibration_factor += 1;
    else if(temp == '-' || temp == 'z')
      calibration_factor -= 1;
  }
}
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("OK");
    countTrueCommand++;
    countTimeCommand = 0;
  }
  if(found == false)
  {
    Serial.println("Fail");
    countTrueCommand = 0;
    countTimeCommand = 0;
  }
  found = false;
 }
```

WORKING OPERATION

The Gas sensor present in the system is used to detect the gas leakage and the load cell measuresthe gas level in the cylinder. These produces analog signal to the controller. The high signal produced by the input devices are processed by the controller and take necessary actions.

If the limit is exceeded, the controller provides order to the indicators to intimate the consumer. This can also be viewed in THINK SPEAK.COM through Wi-Fi module. The output measurements can also be viewed in display module.

CHAPTER 5

RESULTS AND DISCUSSION

The purpose of the system is to provide safe, reliable, simple and cost-effective LPG leakage detection and control system is simple. The aim of the system is to provide simple, secure, decisive, and cost-effective LPG leakage detection and control system. It helps us to modify the existing safety models in the house. The components used here are of less cost and are cheaply available. The major advantage over the conventional human- based system is that it provides quick response and precise detection and control and thus helps in appropriate handling of a critical situation.

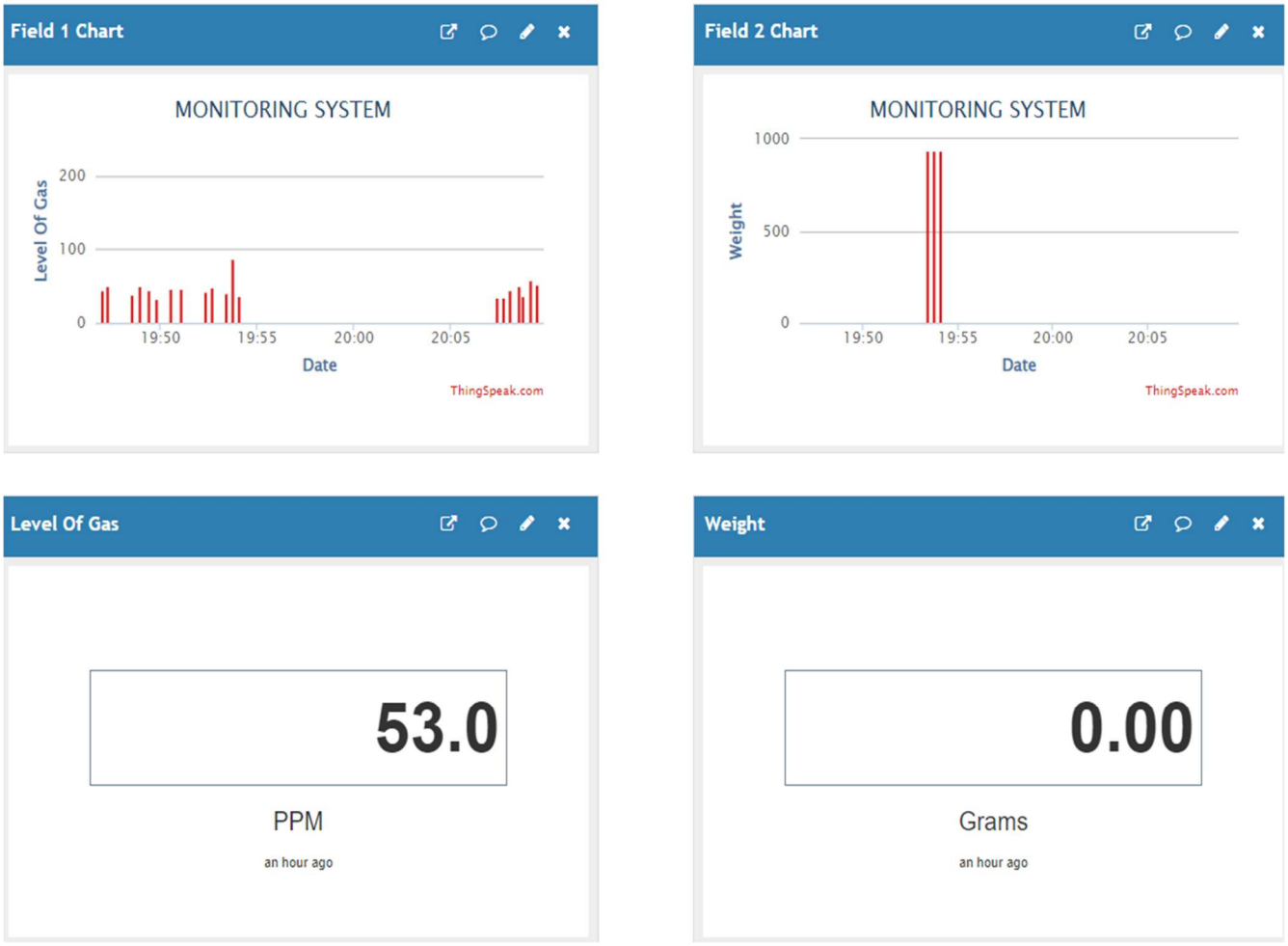

Fig. Output chart

CHAPTER 6

CONCLUSION

The scope of this project was to increase the safety of the people while cooking. Many people are affected due to gas leakage. In this system, we have used two analog sensors which works only in closed environment. The sensors present in this will measure the appropriate values and provides some safety measures. The indication system present in this will intimate us via buzzer and LED. The measures are also can be viewed in display module. Using Wi-Fi module, we can also view the information from anywhere using THINK SPEAK.COM.

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