Project Report

On

"LPG GAS LEAKAGE DETECTION SYSTEM USING ARDUINO UNO"

A Real Time Project Submitted to Jawaharlal Nehru Technological University Hyderabad in partial fulfillment of the Academic Requirement for the completion of

Bachelor of Technology

In

Electronics & Communication Engineering

By

B.KRUTHIKA	**235U5A0402**
CH.POOJITHA	**235U5A0404**
G.VAISHNAVI	**235U5A0406**
G.NIKITHA	**235U5A0407**

Under the guidance of

Mr. J. Venkatesh

Assistant Professor, Dept. Of. E.C.E

Department of Electronics and Communication Engineering

AVN INSTITUTE OF ENGINEERING & TECHNOLOGY

(Approved by A.I.C.T.E. & Govt. of Telangana & Affiliated to JNT University, Hyderabad)

Accredited by NAAC & NBA

PATEL GUDA, IBRAHIMPATANAM (M), R.R-Dist-501510-TS

2023-24

CERTIFICATE

This is to certify that the dissertation entitled "LPG GAS LEAKAGE DETECTION SYSTEM USING ARDUINO UNO" is a bonafide work done and submitted by

B.KRUTHIKA	**235U5A0402**
CH.POOJITHA	**235U5A0404**
G.VAISHNAVI	**235U5A0406**
G.NIKITHA	**235U5A0407**

In partial fulfillment of requirement for the completion of **BACHELOR OF TECHNOLOGY DEGREE in ELECTRONICS AND COMMUNICATIONS ENGINEERING** at AVN Institute of Engineering & Technology, Hyderabad. Certified further that to the best of my knowledge the work in this dissertation has not been submitted to any other university or institute for the completion of any degree.

Coordinator
Mr. J. Venkatesh
Assistant Professor
Dept of E.C.E

Head of the Department
Dr.N.Suresh
Professor & H.O.D
Dept of E.C.E.

Internal Guide
Mr. J. Venkatesh
Assistant Professor
Dept of E.C.E

AVN INSTITUTE OF ENGINEERING & TECHNOLOGY
Accredited by NAAC & NBA
An Autonomous Institute Affiliated to JNTU Hyderabad

ACKNOWLEDGEMENT

We are greatly thankful to the following people for their contribution, advice and assistance towards the development of this project and also in the completion of the report entitled **"LPG GAS LEAKAGE DETECTION SYSTEM USING ARDUINO UNO".**

We express our sincere thanks to our Internal Guide **Mr. J. Venkatesh,** Assistant Professor for the guidance, he showed us and for his sincere effort in building the Real Time Project in right direction.

We express our sincere thanks to My Coordinator **Mr. J. Venkatesh,** Assistant Professor for the guidance, He showed us and for his sincere effort in building the project in right direction.

We are indebted to **Dr. Suresh Narasimman**, Head of the Department of ECE for his valuable suggestion and for the motivation he provided. My sincere thanks to him for sparing his valuable time and constant encouragement.

We are highly indebted to Principal, **Dr. P Nageswara Reddy,** for their support who has not only shown utmost patience, but fertile in suggestions, vigilant in directions of error and who have been infinitely helpful.

B.KRUTHIKA	**235U5A0402**
CH.POOJITHA	**235U5A0404**
G.VAISHNAVI	**235U5A0406**
G.NIKITHA	**235U5A0407**

DECLARATION

We hereby declare that Real Time Project Report entitled **"LPG GAS LEAKAGE DETECTION SYSTEM USING ARDUINO UNO"** being submitted by us in II Year Semester-II of Bachelor of Technology Degree in Electronics and Communications Engineering at JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD is a bonafide record of AVN INSTITUTE OF ENGINEERING & TECHNOLOGY and has not been submitted to any other course or university for award of any degree.

B.KRUTHIKA	**235U5A0402**
CH.POOJITHA	**235U5A0404**
G.VAISHNAVI	**235U5A0406**
G.NIKITHA	**235U5A0407**

Table of Contents

List of Figures

ABSTRACT

As we know, security has been major issue in today's scenario. Accidents are on increasing day by day. Here, we are talking about those accidents that are being occurred due to combustible gases, i.e., LPG, CNG. Frequently we hear, explosion in cylinder of household and vehicles. Several people have been injured and some got dead. So we are making this project for security purpose that will detect combustible gases and alert candidates. Now a day's, LPG Gas leakage detector's comes in the market with the Gas sensor that only senses any gas leakage In this paper, we are reviewing on the use of LPG Gas leakage detector using other simple Gas leakage detector.

The presence of hazardous LPG gas leakage in a domestic, work place, also, stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is used to vibrate an alarm which is buzzer. Buzzer gives an audible sign of the presence of LPG volume. And LCD Display is used which display whether the gas is detected or not. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the LPG sensor senses gas leak from work place or home, sensor output goes to active low (logic-0) condition. Arduino UNO is used in the project; low signals are overlooked by the Arduino and gas leakage is been noticed by the Arduino. The Arduino UNO turns on the buzzer and displayed on LCD.

Chapter 1
INTRODUCTION

1.1 Introduction

With the development of world, the technology is enhanced day by day with the realistic projects and efficient work. In this project we are using MQ-6 semiconductor sensor to detect combustible gas. This sensor has lower conductivity in fresh air. When target combustible gases exist, the sensor conductivity is higher along with gas concentration rising. Basically, conductivity of this sensor depends upon concentration of the gas so it may detect not only combustible gas but also smoke, butane, isobutene, liquor.

The usage of the gas brings great problems in the domestic as well as working places. The inflammable gas such as liquidized petroleum gas(LPG), which is excessively used in the house and at the work places. The leakage of the gas causes destructible impact to the lives and as well as to the heritage of the people. So, by keeping it in the concept of the project we have determined to develop an examining system which finds the leak of LPG gas and protects the work places by taken correct precautions at correct time. This system provides the information such as when a gas leakage is noticed, sensor of in the project are used to notice the gas leakage and immediately turns ON the buzzer for the danger indication. Buzzer is a clear indication of gas leakage.

Chapter 2

LITERATURE SURVEY

1. LPG Gas Leakage Detection Using Arduino Uno:

Author : M.Meenakshi, G.Sudha, N.Meena,

Abstract:

Gas leaks are a serious safety hazard in many different commercial, residential, and industrial contexts. A Gas Leakage Detection System is designed, utilizing an Arduino Uno to solve this problem. In order to monitor and identify the presence of potentially dangerous gases like methane, propane, and carbon monoxide in the environment, this system combines the skills of an Arduino Uno with gas sensors. The system's brain, the Arduino Uno, processes data from the sensors and manages the alarm system.

2. LPG Gas leakage Detection and monitoring using IOT

Author : Somashekhara Reddy, Raja praveen K N

Abstract :

In today's society, proper safety procedures must be introduced in schools and workplaces. Installing gas leak detectors in risky areas is one way to avoid gas leak threat. Gas detectors detect the presence of gases as part of safety systems. Gas Detectors can alert operators to a leak so they can fix it or leave. This gadget is crucial since numerous gases can hurt humans and animals. Containment in areas where the gas shouldn't be avoided. A minor leak can build up an explosive gas concentration, making leaks exceedingly dangerous. The Gas Leakage Detector with Alert System was created to prevent fire or explosion in homes or businesses. This gas detector continually detects gas if it has power. Arduino UNO was utilised as the CPU to process sensor information and deliver an SMS alert to the user. The buzzer will ring until harmful gas levels are reached. These projects avoid fires from unattended cooking and gas explosions from gas leaks

3. Atmega 328- based gas leakage monitoring and alert IOT system with SMS

Author : P.Naveen, K.Ravi Teja, M. Dinesh Kumar, K.Sahithi Redddy

Abstract :

This project demonstrates how to construct a monitoring and alerting system with a safe wireless module. The project addresses gas-related issues by automatically rotating a servo motor 220 degrees to turn off the gas knob, activating a red LED and buzzer to signal an explosive atmosphere. The device is composed of several components, including an ATMEGA 328 microcontroller, a buzzer, an i2c-LCD display, an exhaust fan, a servo motor, a GSM module, and a gas sensor. The circuitry consists of an Arduino microcontroller, an MQ6 gas sensor, and a buzzer, which detects gas leaks and sends SMS notifications when necessary. Upon sensing the gas leakage, the microcontroller processes the data and transmits an alert message to the user's smartphone via SMS, empowering them to take suitable measures. The results of this study will be useful in preventing gas leakage issues both now and in the future.

4. IOT Based smart gas management system :

Author : R.Chaitanya, Sonyshrestha, V.P. Krishna Anne

The problem of gas leakage and fire is often encountered in our day-to-day life. LPG, Liquified Petroleum Gas, is highly flammable gas used as fuel in heating appliances. Leakage of this gas raises the risk of building fire, suffocation or an explosion. The mentioned problem can be solved with the development of reliable techniques to detect gas leakage. As soon as gas leakage will be detected, user will be notified via SMS and call so that he/she can turn off gas valve from anywhere in his work place. The issue of flame and fire at kitchen can be monitored with the help of fire sensor. The buzzer starts beeping whenever fire is detected. In addition to these, it is often found that a person forgets to book gas cylinder due to his/her busy schedule. The main aim of this paper is to design an IOT based Smart Gas Management System that will be able to detect gas leakage and fire. With the help of load sensor, automatic booking of a gas cylinder is also facilitated.

Notification is sent to the booking agency to book a gas cylinder whenever load cell detects that the weight of gas cylinder has reached below a threshold value. At the sametime, user will be notified about gas cylinder going empty.

CHAPTER 3

EXISTING METHODOLOGY

.

In primary focus intelligent gas leakage detector using Arduino is only possible for detecting the harmful gaseous and alert the people. Gas leakage is serious problem and nowadays it is observed in many places like residences, industries and vehicles like Compressed Natural Gas (CNG), buses, cars, etc. It is noticed that due to gas leakage, dangerous accidents occur. The Liquefied Petroleum Gas(LPG), or propane, is flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industrial, automobiles and vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and eager harm to the environment Liquid Petroleum Gas (LPG) is highly inflammable and 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 leakage gases may lead to an explosion. Gas leakage leads to various accidents resulting in both material loss and human injuries. The risk of explosion, fire, suffocation is based on their physical properties such toxicity, flammable, etc.

The user is alerted about the gas leakage through buzzer. The level of LPG in cylinder is also continuously monitored. proposed the system in which the leakage is detected by the gas sensor and produce the results. It provides a design approach on software as well as hardware.

Chapter 4

PROPOSED METHODOLOGY

The block diagram of the gas leakage detection and alerting system. Arduino UNO (Atmega-328) is the main unit of the system which performs the following tasks. A signal conditioning of the Arduino UNO is done by output signal of the sensor, provided input to Arduino. The detection results displayed on LCD. Indicates the people of danger in work place, factory, home. Buzzer activity with beep(siren) sound and Displayed on LCD.

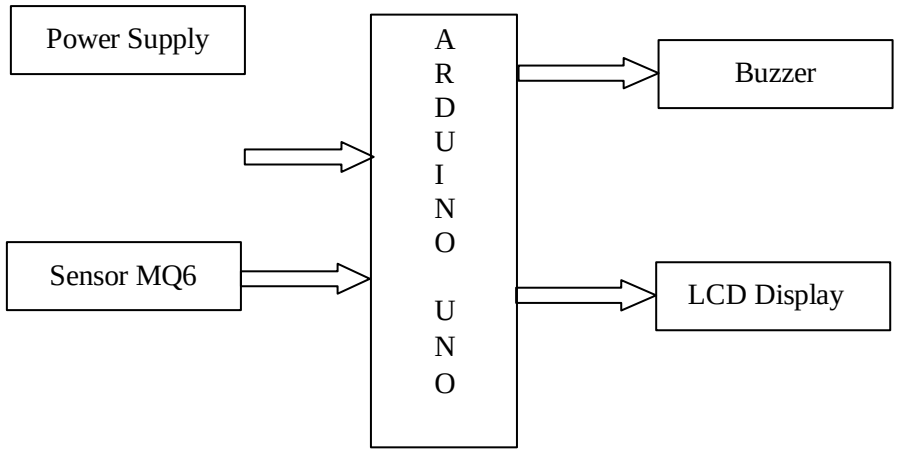

Fig 4.1 : Block Diagram of gas leakage detecting and alerting system.

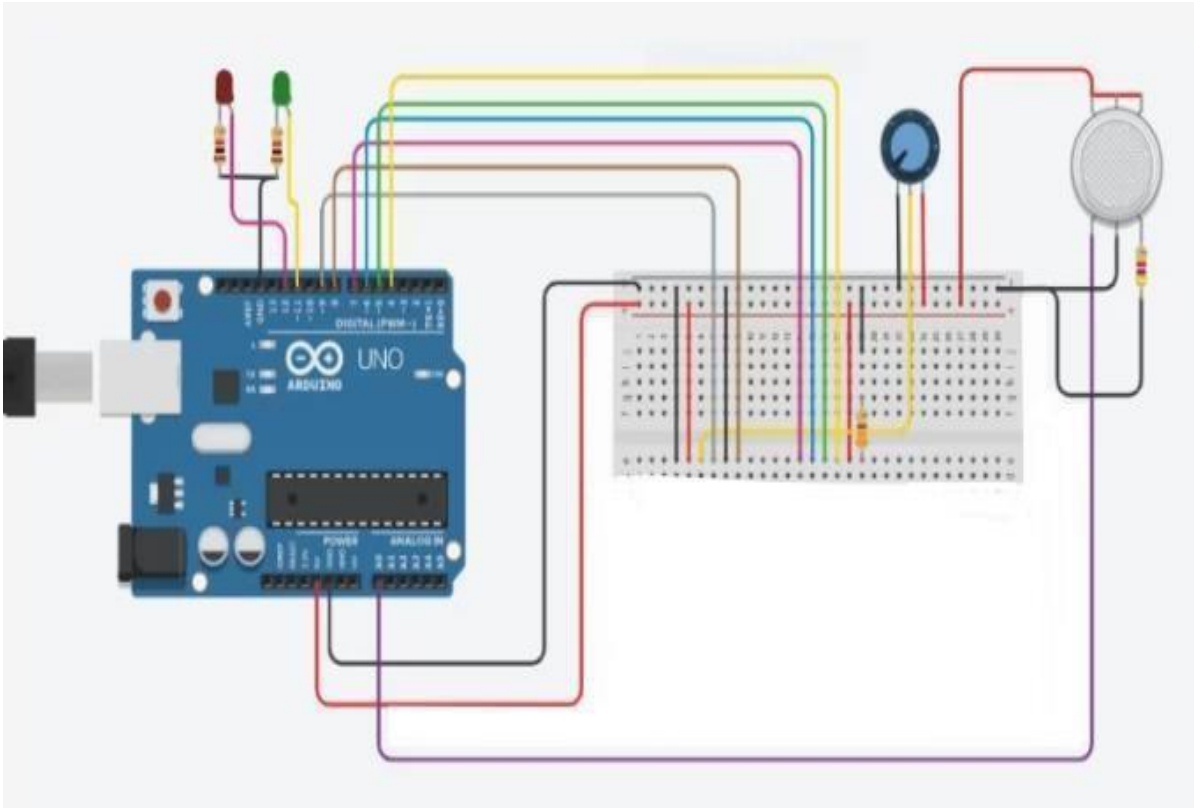

Fig 4.2: Proposed Connection Diagram

4.1 Hardware Description

Arduino UNO:

The central unit of the system is Arduino board, where all the components are interfaced externally on the board and programmed as per their functionality to work in synchronization. It's an electronic prototyping platform/ board supported Atmega-328 which is of 8-bit, 16 MHz. During this serial communication is enabled and has 14 digital input /output pins (out of which 6 are PWM) and 6 analog input pins. It operates at 5v every pin contains a specific function to control.

The storage is non-volatile storage and EEPROM. The key comparison of a non-volatile storage with the EEPROM is that the incontrovertible fact that non-volatile storage contents are erasable. In contrast to a EEPROM, the entire device is erased. where one can erase and judge on bases of Byte and section. The availability of the non-volatile memory during which the blocks of the contains are divided and therefore block by block the portion is erased, where no erased option is provided for the EEPROM byte thanks to the actual fact that the programming of the non-volatile storage performed while it's on the system board socket. BIOSROM of the PCB is the new upgrade which is immensely used.

Fig 4.3 Arduino UNO Board

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The Diecimila, Duemilanove, and current Uno provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board and Arduino UNO boards may provide male header pins on the underside of the board that can plug into solder less breadboards.

PIN DISCRIPTION:

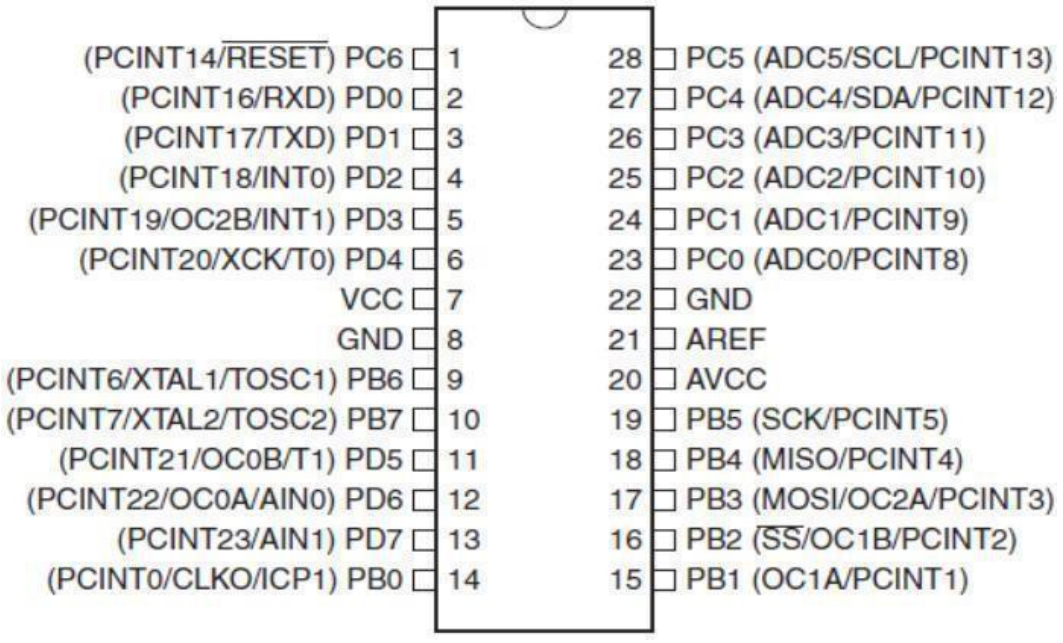

Fig 4.4: Pin Diagram

VCC: Digital supply voltage

GND: Ground

Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8 bit bi-directional I/O port with internal pull-up resistors. The port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port B pins that are externally pulled low with source current if the pull up resistors are activated. The port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB 6

can be used as an input to the inverting oscillator amplifier and input to the internal clock operating circuit.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB7.6 is used as TOSC2.1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set. The various special features of Port B are elaborated in "Alternate Functions of Port B" and "System Clock and Clock Options"

Port C

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors. The PC5.0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port D (PD7:0)

Port D is an 8 bit bi-directional I/O port with internal pull-up resistors. The port D Output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port D pins that are externally pulled low with source current if the pull up resistors are activated. The port D pins are tri-stated when a reset condition become active, even if the clock is not running. The various special feature of port D are elaborates in "Alternate Function of port D"features of port D are elaborated in "Alternate Function Of port D".

AVCC

AVCC is the supply voltage pin for the A/D converter, PC 3:0, and ADC 7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low pass filter. Note that PC 6.4 use digital supply voltage.

AREF

AREF is the analog reference pin for the A/D converter

ADC7:6 (TQFP and QFN/MLF Package Only)

In the TQFP and QFN/MLF Package, ADC7:6 servey as analog inputs to the AD converter.These pins are powered from the analog supply and servey as 10 bit ADC channels

MQ6Sensor:

It is a sensor detector used to detects the flammable gas and smoke concentration of the combustible gas in the air, and output is read in the analog voltage and digital value output. Supply input voltage is 5v. it is very sensitive to H2, LPG, CH4, CO, SMOKE, PROPANE. It has three pins for transmitter, receiver, ground and sensitivity can be adjust by the potentiometer. Detects LPG from 200ppm to 10000ppm.

Fig 4.5 : MQ-6 Gas Sensor

Buzzer:

Buzzer is used to alarm the beep sound to indicate and warn the danger to the people working around. The buzzer is the output of the system. The sound of the buzzer is beep-beep, which indicates the danger.

Fig 4.6 : Buzzer

Regulated Power Supply:

An electronic circuit that produces a stable DC voltage of fixed value across the load terminals irrespective of changes in the load is known as regulated power supply. Thus, the primary function of a regulated power supply is to convert an AC power into a steady DC power. The regulated power supply is sometimes also called as a linear power supply. The regulated power supply ensures that the output power at the load terminals should remain constant even if the input power varies. The regulated power supply receives an AC power as input and generates a constant DC power as output. A regulated power supply is basically an embedded circuit consisting of various blocks.

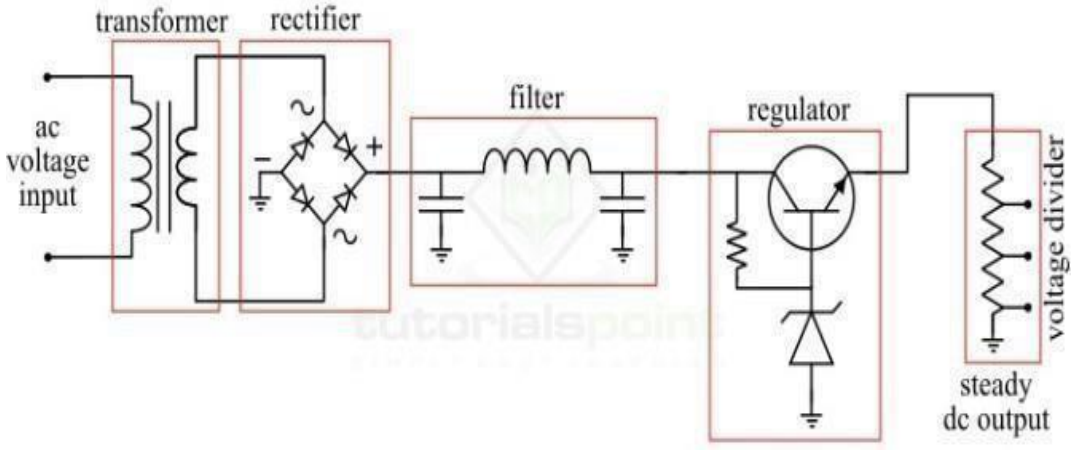

Fig 4.7 : Circuit Diagram Of Regulated Power Supply

Liquid-Crystal Display (LCD):

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. A character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight.

Fig 4.8 : LCD display

4.2 Software Description

This project is implemented using following software's:

□1. Express PCB – for designing circuit

□2. Arduino IDE Studio Compiler - for compilation part

Arduino IDE Compiler

This instructible adds to anyof the Arduino on a Breadboard instructables.

1. We need a microcontroller with a pre-loaded Bootloader, or must load your own

2. Not all ATmega328's are equal

(A bootloader, very simply, is a programme that sits on the chip and manages the upload of your sketches onto the chip)

Compilation and Simulation Steps:

Step 1: Parts

1 x Arduino on a Breadboard

1 x Arduino UNO Connecting wires

Arduino IDE installed on your PC

Step 2: The Approach

We use the Arduino UNO to bootload the ATmega328 that is sitting on the Arduino-on-a-Breadboard. This is fairly straightforward having an ATmega328P-PU,but needs an extra step for an ATmega328-PU.

Step 3: Program your Arduino UNO as an ISP

We need to program the Arduino UNO to act as an ISP (In-System Programmer), so that itcan burn the bootloader onto the Breadboard chip.

1. Open the Arduino IDE
2. Open the Arduino ISP sketch (under File, Examples)
3. If you're using version 1.0 of the IDE:

Search for void heartbeat and change the line that reads:

delay(40);

to

delay(20);

Connect your UNO to the PC, making sure it's not connected to the Arduino on a Breadboard.Ensure your UNO is selected under the Boards menu option, and upload the sketch.

Step 4: Connect your ATmega328

Now connect your ATmega to your UNO as follows:

- UNO 5v ---> ATmega pin 7 (VCC)
- UNO GND ---> ATmega pin 8 (GND)
- UNO pin 10 ---> ATmega pin 1 (RESET)
- UNO pin 11 ---> ATmega pin 17 (MOSI)
- UNO pin 12 ---> ATmega pin 18 (MISO)
- UNO pin 13 ---> ATmega pin 19 (SCK)

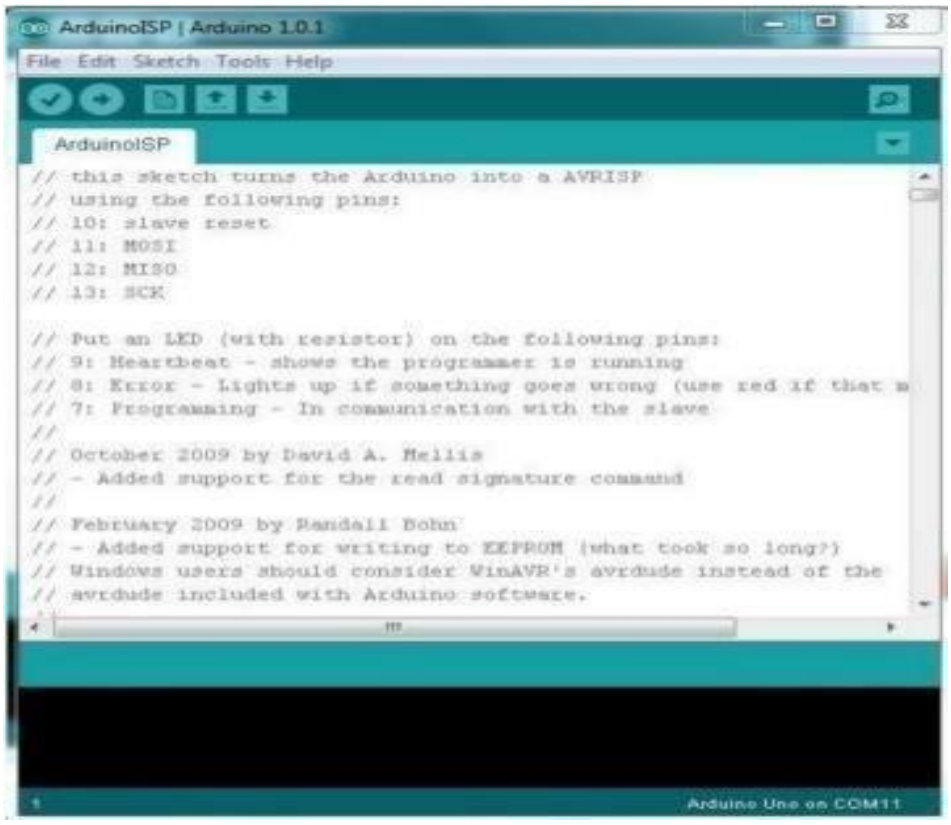

Fig 4.9 : Arduino IDE Software

Step 5: Which ATmega328 are you using?

I learnt the hard way that there is more than one type of ATmega328. The two variants that are of interest to us are the ATmega 328-PU and the ATmega 328P-PU. The 328P is a pico Power processor, designed for low power consumption, and is used on the Arduino boards. Given low power consumption this is first choice.

Unfortunately, the websites that sell these chips don't always differentiate between them and forums are filled with people struggling to use the ATmega328-PU.

Step 6: ATmega328-PU workaround.

Fig 4.10 : Errors while compiling

In your Arduino folder, find the sub folder.\hardware\tools\avr\etc

1. Make a backup copy of the file: avrdude.conf
2. Open the file avrdude.conf in a text editor
3. Search for: "0x1e 0x95 0x0F" (this is the ATmega328P signature)
4. Replace it with: "0x1e 0x95 0x14" (this is the ATmega328 signature)
5. Save the file
6. Restart the Arduino IDE
7. Make a backup copy of the file: avrdude.conf
8. Open the file avrdude.conf in a text editor
9. Search for: "0x1e 0x95 0x0F" (this is the ATmega328P signature)
10. Replace it with: "0x1e 0x95 0x14" (this is the ATmega328 signature)
11. Save the file
12. Restart the Arduino IDE
13. Continue with the rest of the steps in the instruct able, and once boot loading is completethe backup copy you made.

Step 7: Bootload the ATmega328

In the Arduino IDE, from the Tools menu

- under the Board option choose Arduino UNO
- under the Serial Port option ensure the correct port is selected under the Programmer option choose Arduino as ISP

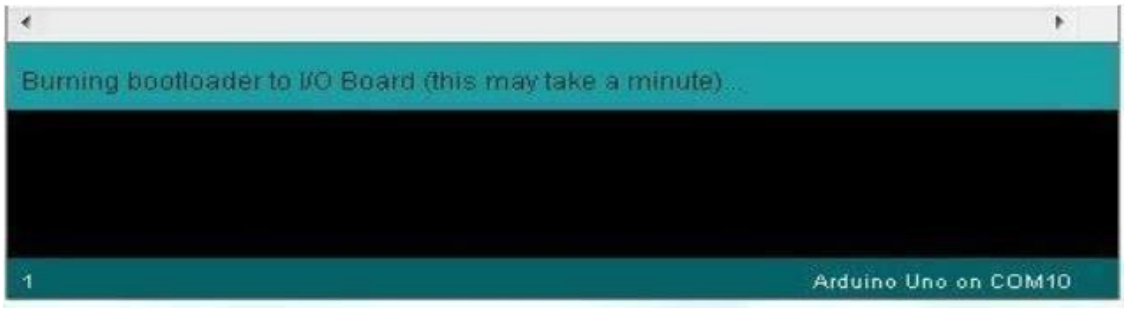

Fig 4.11: Boot loading the Atmega328

CHAPTER 5

RESULT AND DISCUSSION

The MQ-6 gas sensor successfully detected LPG concentration in the air. The sensor's response time was quick, typically within a few seconds of gas exposure. The system could reliably detect LPG at low concentrations, triggering alerts well before reaching dangerous levels. Upon detecting LPG, the system activated the buzzer and displayed a warning message on the LCD screen, providing both visual and auditory alerts. The alerts were clear and prompt, ensuring immediate awareness of potential gas leaks. The system operated consistently during extended testing periods, showing no false positives or missed detection.

The Arduino microcontroller managed sensor data processing and alert mechanisms efficiently, with stable performance throughout the testing phase. The LPG gas leakage detection system proved to be effective in detecting gas leaks and alerting users promptly. The system's components worked well together, demonstrating the feasibility of using Arduino-based solutions for safety applications. These results indicate that the LPG gas leakage detection system is a practical and reliable solution for preventing gas-related accidents in both residential and Industrial settings.

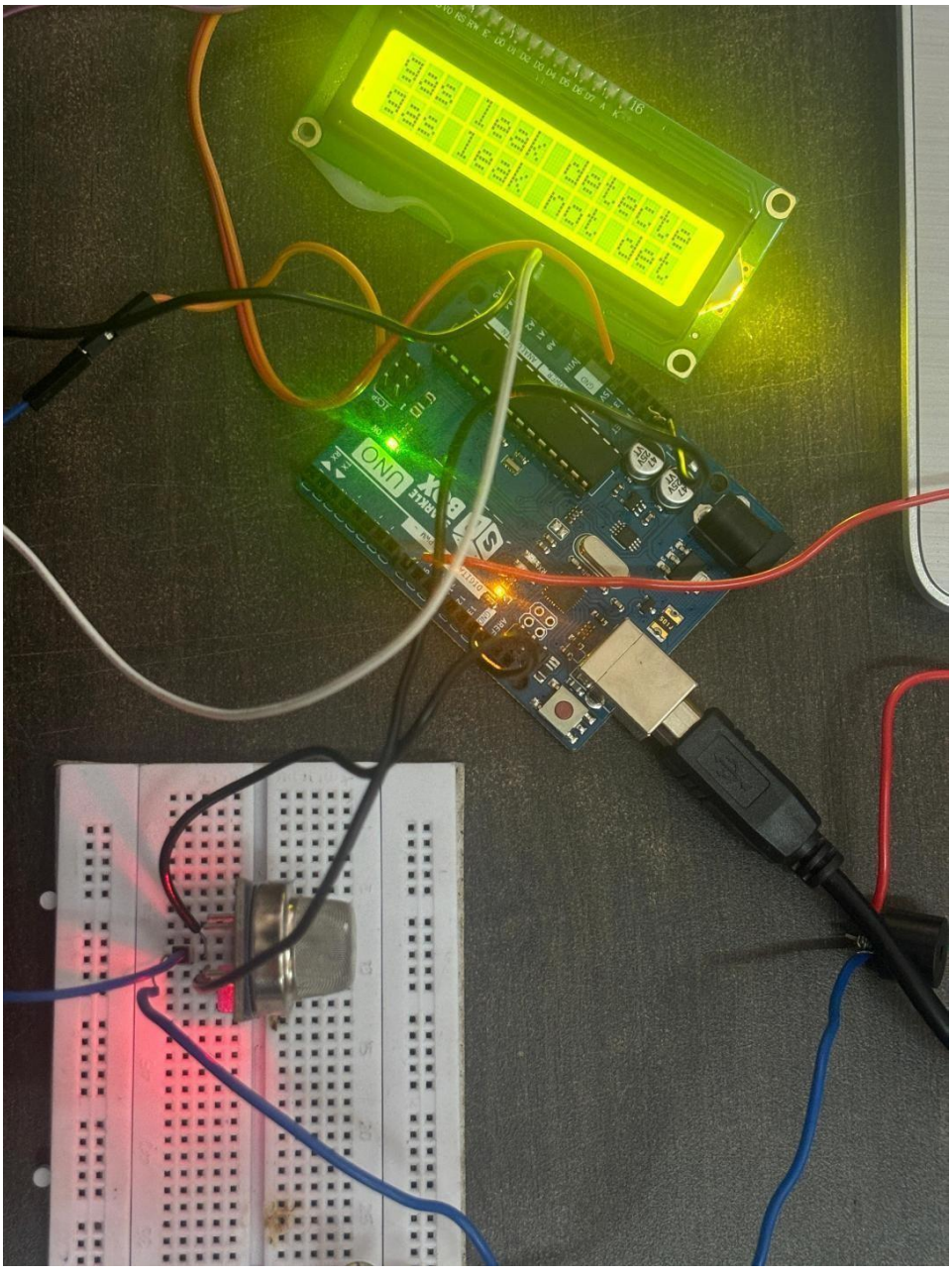

Fig 5.1: Result

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

Conclusion:

The LPG gas leakage detection system developed using Arduino has proven to be an effective and reliable solution for ensuring safety in environments where LPG is used. The system successfully detects gas leaks through the MQ6 sensor, which provides real-time monitoring and immediate alerts. Buzzer ensures the alert and displayed a warning message on the LCD screen providing both visible and audible notification to users. The use of Arduino enhances the system's flexibility, allowing for easy customization and potential integration with other smart home systems.

Future Scope:

Wireless Connectivity: Integrating Wi-Fi or Bluetooth modules to enable remote monitoring and control via smartphones or other devices. Sending real-time alerts through SMS or email notifications to users, even when they are not on the premises.

Power Backup Solutions: Adding battery backup options to ensure the system remains operational during power outages.Exploring energy-efficient components to extend battery life and enhance reliability.

Scalability: Developing modular designs that allow easy scaling for larger installations, such as in commercial buildings or industrial plants.Creating customizable solutions tailored to specific userneeds and environmental conditions.

Future improvements could include adding wireless communication modules for remote monitoring, integrating with IoT platforms for advanced data analytics, and incorporating battery backups to ensure functionality during power outages. Overall, the project demonstrates the feasibility and importance of implementing such safety systems in households and industrial settings to protect lives and property.

REFERENCES

[1] Shrivastava, A., Prabhakar, R., Kumar, R., & Verma, R. GSM based gas leakage detection system. International Journal of Emerging Trends in Electrical and Electronics (IJETEE-ISSN:2320-9569), 2013; 3(2):42-45.

[2] Hema, L. K., Murugan, D., & Chitra, M. WSN based Smart system for detection of LPG and Combustible gases. In National Conf. on Architecture, Software systems and green computing-2013.

[3] Ramya, V., & Palaniappan, B. Embedded system for Hazardous Gas detection and Alerting. International Journal of Distributed and Parallel Systems (IJDPS), 2012; 3(3):287-300.

[4] Priya, P. D., & Rao, C. T. Hazardous Gas Pipeline Leakage Detection Based on Wireless Technology. International Journal of Professional Engineering Studies, India, 2014; 2(1).

[5] Jero, S. E., & Ganesh, A. B. 2011, March. PIC18LF4620 based customizable wireless sensor node to detect hazardous gas pipeline leakage. In 2011 International Conference on EmergingTrends in Electrical and Computer Technology (pp. 563-566). IE

APENDEX

```
#include <Servo.h>
#include <LiquidCrystal_I2C.h>

// Define the pins
const int gasSensor = A0;
const int buzzer = 8;
LiquidCrystal_I2C lcd(0X27, 16, 2);

int gasThreshold = 130;

void setup() {
 lcd.init();
 lcd.backlight();
 Serial.begin(9600);

 pinMode(gasSensor, INPUT);
 pinMode(buzzer, OUTPUT);

 }

void loop() {
 delay(1000);
 lcd.setCursor(0,0);

 int gasLevel = analogRead(gasSensor);
```

```
Serial.print("Gas level: ");
Serial.println(gasLevel);

if (gasLevel>gasThreshold){

 digitalWrite(buzzer, HIGH);
lcd.println("gas leak detected");
delay(1000);

 Serial.println("Gas leak detected! Buzzer activated.");
 } else {
 lcd.setCursor(0,1);
 digitalWrite(buzzer, LOW);

 lcd.println("gas leak not detected");
 delay(1000);

 Serial.println("Gas level normal. System safe.");
 }
 delay(1000);

}
```