BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 416 (January 2022) **C1**
Microprocessor and Embedded Systems Laboratory

Final Project Report

Gas Leak Detection and Explosion Prevention with Air Quality Monitoring System

Evaluation Form:

STEP	DESCRIPTION	MAX	SCORE
1	Report (Format, Reference)	10	
2	Design Method and Complete Design (Hardware Implementation)	15	
3	Video Demonstration	10	
4	Novelty of Design	15	
5	Project Management and Cost Analysis	10	
6	Considerations to Public Health and Safety, Environment and Cultural and Societal Needs	10	
7	Assessment of Societal, Health, Safety, Legal and Cultural issues relevant to the solution	10	
8	Evaluation of the sustainability and impact of designed solution in societal and environmental contexts	10	
9	Individual Contribution (Viva)	20	
10	Team work and Diversity	10	
	TOTAL	120	

Signature of Evaluator: _____

Academic Honesty Statement:

IMPORTANT! Please carefully read and sign the Academic Honesty Statement, below. Type the student ID and Write your name in your own handwriting. *You will not receive credit for this project experiment unless this statement is signed in the presence of your lab instructor.*

"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

Full Name: Sanath Kumar Das **Student ID: 17016149**	**Full Name: Fatin Fardaous** **Student ID: 1707160**	**Full Name: Raisa Mashtura** **Student ID: 1706163**
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Table of Contents

1 Abstract

Devised an ultimate engineering solution against gas explosion:

- **We detected gas leak, flame, smoke using appropriate sensors**
- **We took preventive measures using exhaust fan, water pump, and a buzzer whenever a hazard is detected**
- **On top of that, we send text messages and calls to the user whenever a threshold of methane gas concentration in ppm is surpassed or flame is detected**
- **Additional measures are taken such as air temperature and humidity**
- **To make use of sustainable energy, we used solar power**
- **Data collected is uploaded in ThingSpeak**

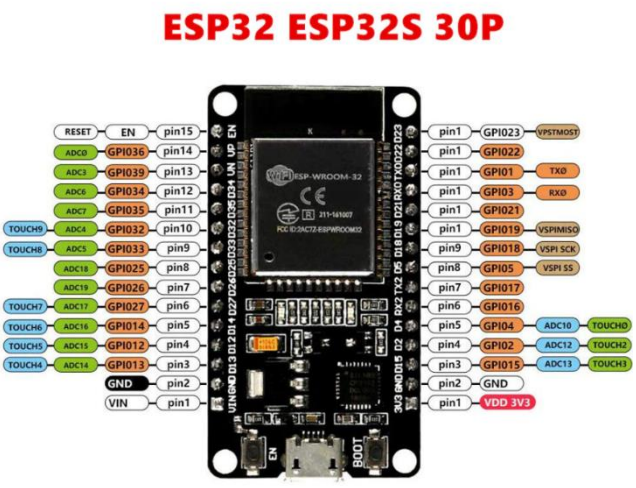
2 Introduction

Hundreds die every year due to gas leak resulting in explosion in Bangladesh. Almost all the time people are unaware. Deaths and damage could be prevented if a warning message could be sent before the danger gets out of scale. Furthermore, automated actions can be taken to help containment of fire or leakage upon early detection by activating water pumps to spray water, an exhaust fan to disperse gas and a buzzer to send alarms.

3 Design

3.1 Design Method

4 ESP32



ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

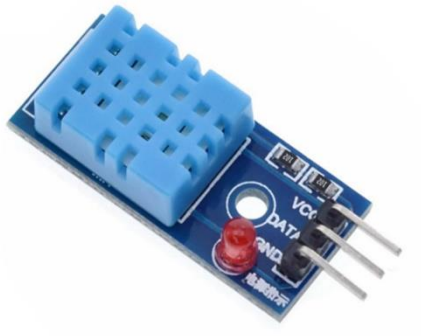
5 MQ2

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. The MQ-2 is a smoke and combustible gas sensor from Winsen. It can detect flammable gas in a range of 300 - 10000ppm. It's most common use is domestic gas leakage alarms and detectors with a high sensitivity to propane and smoke.

6 MQ135

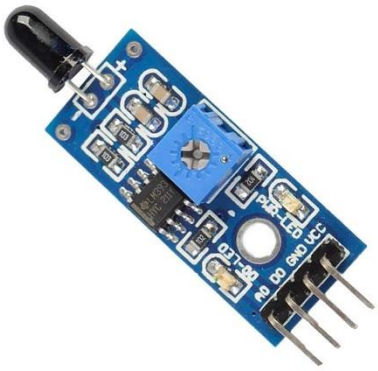
MQ135 Gas Sensor is an air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benzene steam, also sensitive to smoke and other harmful gases.

7 DHT11



The DHT-11 Digital Temperature And Humidity Sensor is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

8 FLAME SENSOR



A flame sensor module that consists of a flame sensor (IR receiver), resistor, capacitor, potentiometer, and comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700nm to 1000nm.

9 GSM MODULE SIM 900A

SIM900A is an ultra compact and reliable wireless module. This is a complete GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions. The module offers GPRS/GSM technology for communication with the uses of a mobile sim. It uses a 900 and 1800MHz frequency band and allows users to receive/send mobile calls and SMS.

10 WATER PUMP

Just connect tube pipe to the motor outlet, submerge it in water and power it to pump water when flame is sensed.

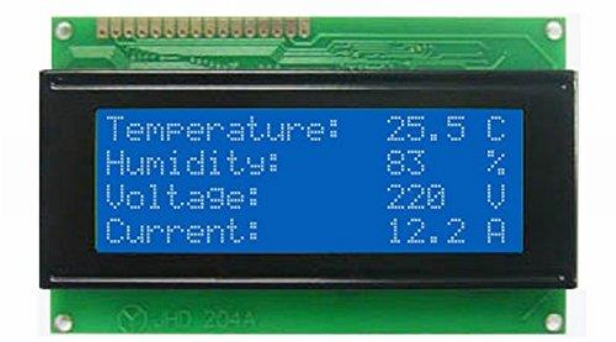
11 BUZZER

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

12 EXHAUST FAN

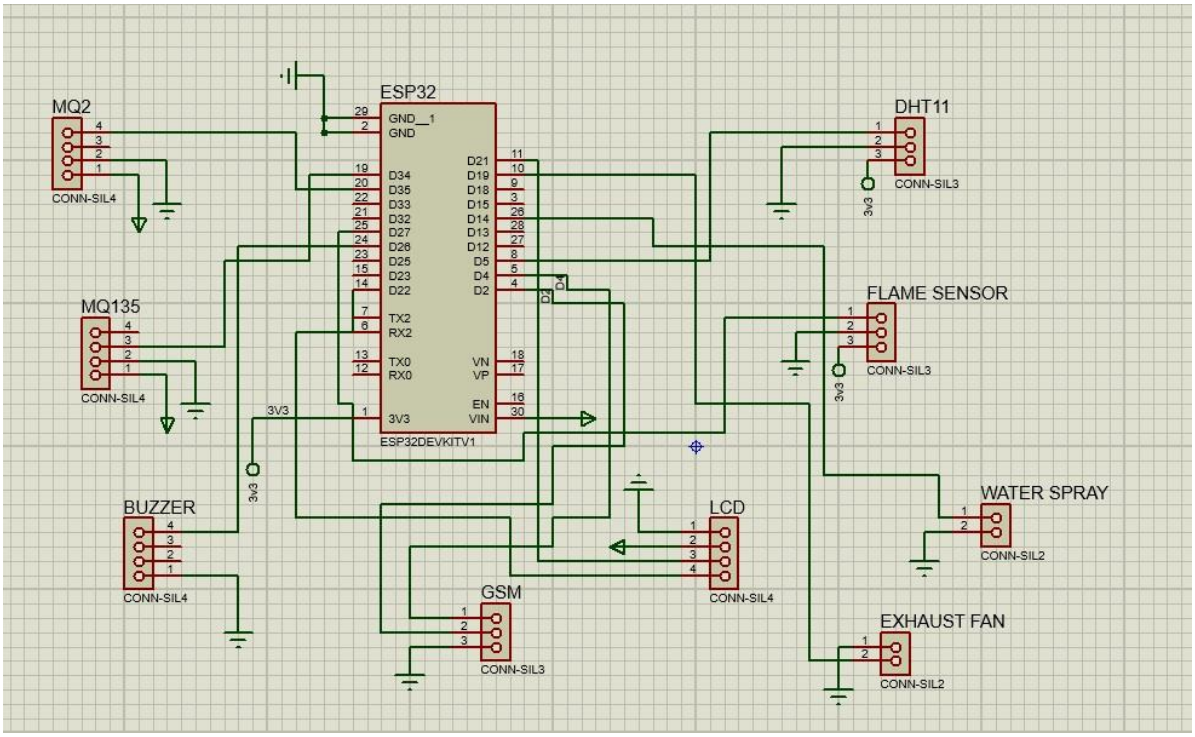
This fan is used to drive away the gas concentration above a threshold ppm gas when gas sensor detects.

13 LCD Display



14 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. It is used for displaying sensor data.

14.1 Circuit Diagram



14.2 Full Source Code of Firmware

Use small font size, Consolas Size 7, double column Test	

Table: Source Code for the main program

15 Implementation

15.1 Description

The proteus schematic file was created with respect to the implemented hardware design. Most modules and sensors did not have a PCB preview hence we used connection strips instead. The PCB design was implemented in a single (bottom) layer so avoid issues regarding vias. Sufficient gap was maintained by placing a few connections manually to avoid wires getting shorted. Power wires were assigned a thickness of T60 while the signal wires were kept T40.

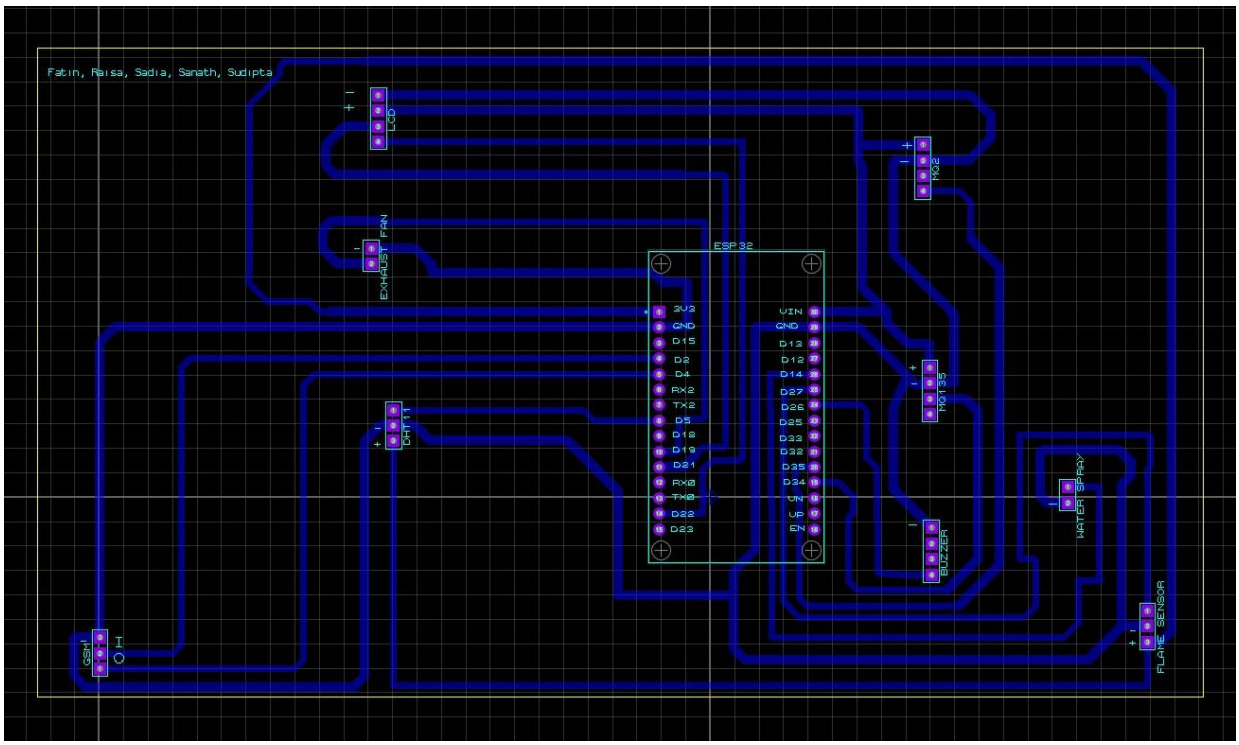
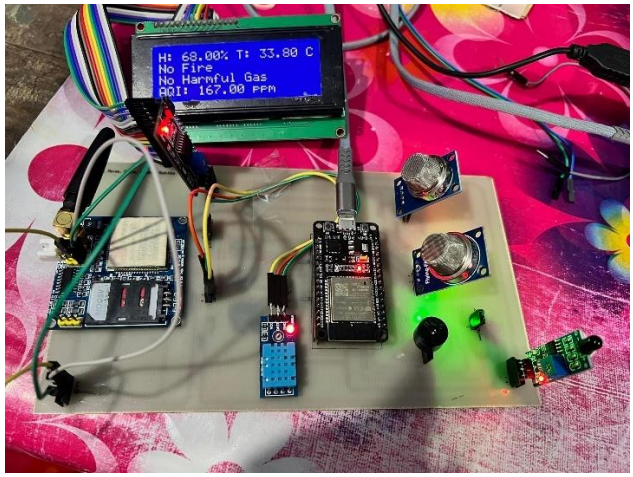


Figure 2a: PCB Layout



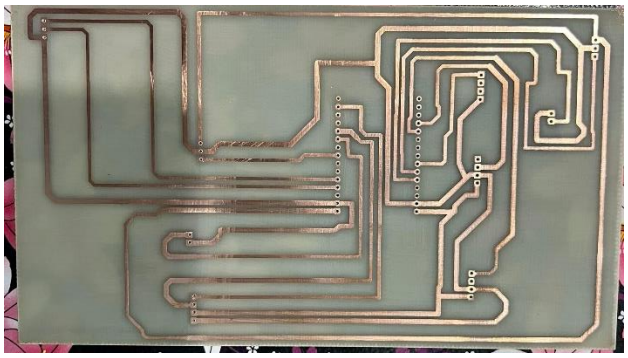


Figure 2b: Implementation of Design

15.2 Results

Our project could successfully accomplish all the assigned tasks and more. First of all, the gas and flame sensors connected to esp32 could successfully sense and send data which was later on read and compared inside a code. After that necessary actions were taken such as sending a text message or a call upon signs of danger or merely uploading sensor data on thingspeak at periodic intervals. Furthermore, the few automated responses as preventive measures worked successfully such as exhaust fan activation upon leakage or water sprayed upon flame detection. However, all these were done at a very small scale and for real life implementation, must be scaled up.

16 Design Analysis and Evaluation

16.1 Novelty

Solar powered: self powered system so that even if members of a household are away or there's no mains supply, the circuit would operate.

Water spray: our model accounts for preventing fire from spreading by taking spraying water on flame zone.

Exhaust Fan: In case of gas leak, our model drives an exhaust fan to drive away the gas and prevent it from accumulating.

16.2 Project Management and Cost Analysis

16.2.1 Bill of Materials

Parts name	Quantity	Cost per unit (Tk.)	Cost of part(Tk.)
ESP32	3	600	1800
GSM SIM900A	3	900	2700
GSM SIM800L	1	365	365
MQ135	2	130	260
MQ2	2	124	248
5V adapter	1	200	200
Flame sensor	1	51	51
PCB	4	347	1390
LCD 20x4	1	532	532
I2C LCD driver	1	126	126
Exhaust fan	1	140	140
Water pump	1	160	160
Frame	1	570	570
DHT11	1	180	180
DHT22	1	490	490
Buzzer	1	15	15
PV panel	2	227	454
Charger circuit	1	48	48
3.7 V Battery	2	90	180
Soldering			300
Transport cost			1000
Walton USB type B	1	350	350
Edison Type B	1	110	110
Cost per unit			**11669**

16.2.2 Calculation of Per Unit Cost of Prototype

Cost per unit of prototype = Tk. 11,669

16.2.3 Calculation of Per Unit Cost of Mass-Produced Unit

Cost per unit (mass production)
=(600+900+130+124+200+51+347+532+126+140+160+570+180+15+227+48+90)
=Tk. 4440

16.2.4 Timeline of Project Implementation

Date	Tasks accomplished
01/07	Project planning
03/07	Components bought
16/07	Sensor data taken, regulated and displayed
20/07	GSM module made to send call
21/07	Arduino code implemented in a wifi module
25/07	Discard and now coded for esp32
30/07	Online server connected, data uploaded
10/08	GSM went wrong, tried multiple times
15/08	PCB design
20/08	PCB printed
21/08	Ideas for novelty brainstormed
23/08	More components bought
27/08	PCB error so design again
28/08	PCB printed
29/08	Soldering done
29/08	Glass frame designed
30/08	Assembled
30/08	Data verification and testing of sensors
30/08	Final Demonstration

16.3 Practical Considerations of the Design to Address Public Health and Safety, Environment, Cultural, and Societal Needs

16.3.1 Considerations to public health and safety

Makes people aware beforehand so that they can take safety measures.
Moreover, it addresses a vital safety issue of the current status quo.

16.3.2 Considerations to environment

Uses sustainable form of energy as our model is solar powered.

16.3.3 Considerations to cultural and societal needs

Helps improve air quality by raising awareness by maintaining an excel file containing data.

16.4 Assessment of the Impact of the Project on Societal, Health, Safety, Legal and Cultural Issues

16.4.1 Assessment of Societal Issues

Has the potential to saves hundreds of lives every year if this safety device is implemented at every household on a proper scale

16.4.2 Assessment of Health and Safety Issues

Is a major safety protocol for the kitchen

16.4.3 Assessment of Legal Issues

No special legal permissions are required to implement this project as no privacy breach or anti-green action etc. took place

16.4.4 Assessment of Cultural Issues

This does not violate any cultural norm rather makes the design of a confined kitchen safer.

16.5 Evaluation of the Sustainability the and Impact of the Designed Solution in the Societal and Environmental Contexts

16.5.1 Evaluation of Sustainability

The project is supposed to have high sustainability given the sensors and module used are reliable

16.5.2 Evaluation of Impact of Design in Societal Context

Calls and sms are used to notify users- something that is very accessible to people all over the world.

16.5.3 Evaluation of Impact of Design in Environmental Context

From an environmental perspective, it implements solar powered panel to supply power to the system.

17 Reflection on Individual and Team work

17.1 Individual Contribution of Each Member

1706149	Sanath Kumar Das	
1706160	Fatin Fardaous	
1706161	Sadia Afrose	GSM design
1706162	Sudipta Saha	
1706163	Raisa Mashtura	Was in charge of PCB design

17.2 Mode of TeamWork

Mode: WILL DO- We decided and committed to a specific course of action, with clear ownership (e.g. decision and action meetings)

17.3 Diversity Statement of Team

Our team comprises of members of different genders, with different home districts and cultural backgrounds.

We tried to accommodate to each other's convenience and divided our work accordingly at the beginning. Later on, upon completion of individual tasks, we assembled the project together to resolve the final issues.

17.4 Log Book of Project Implementation

Date	Milestone achieved	Individual Role	Team Role	Comments
01/07	Project planned			
03/07	Components bought			
16/07	Sensor data taken, regulated and displayed			
20/07	GSM module made to send call			
21/07	Arduino code implemented in a wi-fi module			
25/07	Discard and now coded for esp32			
30/07	Online server connected, data uploaded			
10/07	GSM went wrong, tried multiple times			
10/08	PCB design			
15/08	PCB printed			
20/08	Ideas for novelty brainstormed			
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27/08	PCB printed			
28/08	Soldering done			
29/08	Glass frame designed			
30/08	Assembled			
	Data verification and testing of sensors			
	Final Demonstration			

18 References

https://www.engineersgarage.com/pcb-layout-design-with-proteus/#:~:text=Proteus%20has%20the%20integrated%20ARES,with%20list%20of%20component%20packages.

https://www.youtube.com/watch?v=3tXRNusJhgs

https://www.youtube.com/watch?v=nUcrrCJd1sY

https://www.snapeda.com/home/