BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

BUET

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Course No. : EEE-404. **Section :** G_1

Course Title: Robotics & Automation Laboratory.

Level/Term: 4/2

Project Title: Gas Burner Monitoring

Submitted to: (i) Dr. Celia Shahnaz

(ii) Md. Jawad Ul Islam

PROJECT REPORT: 01

Group No. : 04.

Group Members:

(i) Shaswata Mahernob Sarkar **(1806037)**

(ii) Md. Ashikur Rahman Any **(1806050)**

(iii) Emaz Elmi **(1806083)**

(iv) Rudra Roy **(1806085)**

(v) Tasnimul Hoque Rafi **(1806096)**

(vi) Md. Abtahi Majeed Chowdhury **(1806106)**

Proposed Features

1. If the Gas Burner is kept on in absence of human:

(i) A Red Bulb will start flashing.

(ii) A Buzzer will start buzzing synchronous to the Red Bulb.

(iii) An Email will be sent to the respective person.

(iv) A Phone Call & an SMS will be sent to the respective person.

(v) The alert will be updated in the Website & Android Application.

2. If Gas leaks from the Burner in absence of human:

(i) A Yellow Bulb will start flashing.

(ii) A Buzzer will start buzzing synchronous to the Yellow Bulb.

(iii) An Email will be sent to the respective person.

(iv) A Phone Call & an SMS will be sent to the respective person.

(v) The alert will be updated in the Website & Android Application.

Additional: Burner will automatically turn off in case 1 & 2.

3. If the Gas Burner is kept on in presence of human:

(i) A Red Bulb will turn ON.

4. If Gas leaks from the Burner in presence of human:

(i) A Yellow Bulb will turn ON.

Additional: The temperature & the humidity will be monitored as well.

Monitoring & Alerting Hierarchy:

LCD Display → AC Colour Bulbs → Buzzer → Call → SMS → Email → Website → Android Application

Components List & Budget

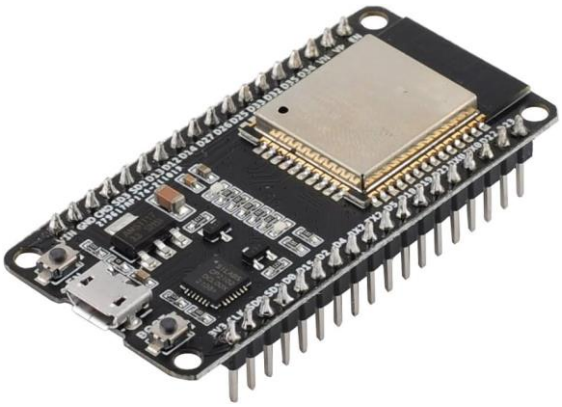
Component	Quantity-Price	Total
1. ESP32	2 x 420	840
2. MQ-5/2 Gas Sensor	2 x 100	200
3. Flame Sensor	3 x 50	150
4. DHT-11	1 x 100	100
5. SONAR	1 x 75	75
6. 20 x 4 LCD+I2C Driver	1 x 450	450
7. SIM900A GSM Module	1 x 700	700
8. 4 Channel Touch Sensor	1 x 110	110
9. 1 Channel Touch Sensor	2 x 60	120
10. Breadboard Large	2 x 90	180
11. Breadboard Small	1 x 50	50
12. Jumpers M+M, M+F, F+F	3 x 60	180
13. Buzzer	2 x 10	20
14. AC Colour Bulbs	3 x 30	90
15. 2 Channel 5V Relay Module	2 x 80	160
16. Soldering Iron + Wire + Flux	1 x 600	600
17. Sockets & AC Wires	1 x 100	100
18. IR Sensor	3 x 40	120
19. Double Slot Battery Holder	2 x 30	60
20. Single Slot Battery Holder	2 x 25	50
21. Batteries 3.7V (Sanford)	2 x 110	220
22. Battery Charger 3.7V	1 x 110	110
23. DC-DC Buck LM2595	2 x 60	120
24. SONAR Bracket	1 x 35	35
25. 3.3V to 5V	1 x 150	150
26. Servo SG90	1 x 100	100
	Grand Total(Tk)	

Note: Expenses for PCB design & 3D Model design+ Print have been excluded.

Testing: All of the purchased components have been tested & are working fine.

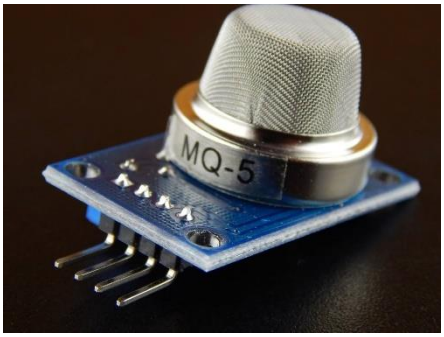
Components descriptions:

1) Esp32:



The ESP32 is a versatile microcontroller developed by Espressif Systems. Here's a brief overview:
Microcontroller: Dual-core Tensilica Xtensa LX6 processor.
Wireless Connectivity: Built-in Wi-Fi and Bluetooth for IoT applications.
Clock Speed: Operates at speeds up to 240 MHz.
Memory: Flash for program storage, RAM for data storage (amount can vary).
GPIO Pins: Abundant General-Purpose Input/Output pins for connecting peripherals.
Peripherals: Supports SPI, I2C, UART, ADC, PWM, and more.
Development Environment: Programmed using Arduino IDE, PlatformIO, or ESP-IDF.
Low Power Consumption: Designed for efficiency, suitable for battery-powered applications.
Open-Source: Both hardware and software are open-source.
Applications: Used in IoT devices, home automation, robotics, wearables, etc.
Overall, the ESP32 is popular for its wireless capabilities, dual-core processing, and wide range of applications.

2) MQ-5(Gas Sensor):

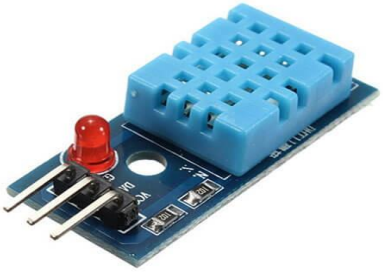


The MQ-5 is a semiconductor gas sensor that detects combustible gases like LPG and methane. It operates based on changes in conductivity when exposed to target gases, with a built-in heating element. Commonly used for gas leak detection in applications such as gas alarms and industrial safety systems.

3) Flame Sensor:

A flame sensor is a device that detects the presence of flames using infrared or ultraviolet detection methods. It is commonly used in fire safety systems to trigger alarms or shutdown mechanisms in response to the presence of a flame.

4) DHT-11:



The DHT-11 is a basic and cost-effective temperature and humidity sensor module. It utilizes a capacitive humidity sensor and a thermistor to measure environmental conditions. The sensor provides digital output and is commonly used in various DIY electronics and IoT projects for monitoring and controlling temperature and humidity levels.

Necessity of Proposed Features

Leaving a gas burner on in the absence of a human can lead to various risks and dangers. Here are some potential consequences:

Gas Leak:
The most immediate and serious risk is the potential for a gas leak. If the burner is left on, gas can escape into the air, creating a dangerous situation.
Fire Hazard:
An unattended gas burner can pose a significant fire hazard. If the gas comes into contact with an open flame, spark, or any other ignition source, it can lead to a fire.
Carbon Monoxide Poisoning:
Incomplete combustion of natural gas can produce carbon monoxide (CO), a colorless and odorless gas that is highly toxic. Prolonged exposure to carbon monoxide can lead to serious health issues, including death.
Oxygen Depletion:
A burning gas flame consumes oxygen. In a closed or poorly ventilated space, leaving the burner on for an extended period can deplete the oxygen levels, leading to an unsafe environment.
Appliance Damage:
Continuously running a gas burner can cause wear and tear on the appliance itself. This may result in malfunctions, increased risk of leaks, or damage to the burner.
Energy Waste:
Leaving a gas burner on when not in use wastes energy and increases utility bills

A gas leak can pose serious risks and dangers. If gas continues to leak in the absence of humans, various consequences may occur:
Fire and Explosion Hazard:
One of the most immediate and severe risks of a gas leak is the potential for a fire or explosion. If the leaked gas comes into contact with an open flame, spark, or ignition source, it can ignite and cause a fire or explosion.
Asphyxiation:
Certain gases, such as natural gas, displace oxygen in the air. Prolonged exposure to a high concentration of gas in a confined space can lead to oxygen depletion, resulting in asphyxiation. Lack of oxygen can be life-threatening.
Health Issues:
Depending on the type of gas leaking, exposure can cause various health problems. For example, natural gas leaks may release methane and other potentially harmful compounds that can affect respiratory and central nervous systems.
Carbon Monoxide Poisoning:

If the leaking gas contains carbon monoxide (CO), it poses a risk of poisoning. CO is colorless and odorless, making it particularly dangerous. Symptoms of carbon monoxide poisoning include headaches, dizziness, nausea, and, in severe cases, death.

Environmental Impact:

Gas leaks contribute to environmental pollution. Methane, a component of natural gas, is a potent greenhouse gas, and its release into the atmosphere can contribute to climate change.

Property Damage:

Gas leaks can damage property. If gas accumulates in an enclosed space and ignites, it can lead to fires and explosions, causing significant damage to buildings and belongings.

Evacuation and Displacement:

To ensure safety, a gas leak may necessitate the evacuation of the affected area. This can result in temporary displacement of residents and disruption of normal activities.

Expensive Repairs:

Detecting and repairing a gas leak often requires the assistance of professionals. Ignoring the issue can lead to more extensive damage and costly repairs.

If there is suspicion of a gas leak, it's important to take immediate action:

Evacuate the Area:

Leave the building or affected area immediately.

Do Not Use Ignition Sources:

Avoid using anything that can create a spark or open flame, including electrical appliances, light switches, and matches.

Call Emergency Services:

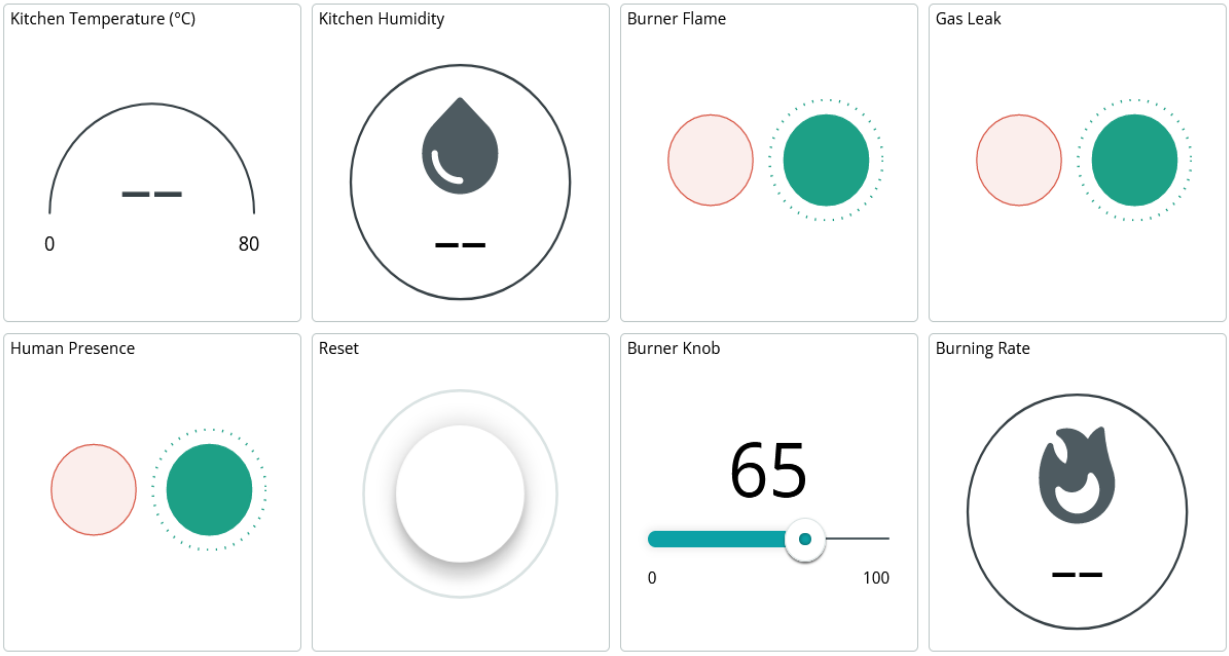
Contact the gas company or emergency services to report the leak. They will be able to assess the situation and take appropriate action.

Ventilate the Area:

If it's safe to do so, open windows and doors to ventilate the space.

Gas leaks are emergencies that require prompt attention to ensure the safety of individuals and property.

Web Dashboard:



1) **Kitchen Temperature:**

Maintaining the right kitchen temperature is crucial for safe and effective cooking, preventing undercooking or overcooking of food, and ensuring proper hygiene and food storage.

2) **Kitchen humadity:**

Understanding kitchen humidity is crucial for chefs and bakers to create an ideal environment for proofing dough, chocolate tempering, and preserving the delicate balance needed for certain culinary techniques, ensuring the best possible outcomes in food preparation.

3) **Burner Flame:**

This indicates if the burner in the kitchen is on or off. As it might be important to someone in remote to know and take action accordingly.

4) **Gas Leak:**

One of the most crucial features of our project, has can save someone from a fatal accident and also in the absence of the human, it is really important to save property from damage.

5) **Human Presence:**

The system we have designed works according to the presence and absence of human being in the kitchen. In the presence just alerting and giving warning might be enough to handle any inconvenience. But in absence of human, we have to deal with them remotely.

6) **Reset:**

Reset button is just for resetting all the pointers to default so doesn't become confusing for a user.

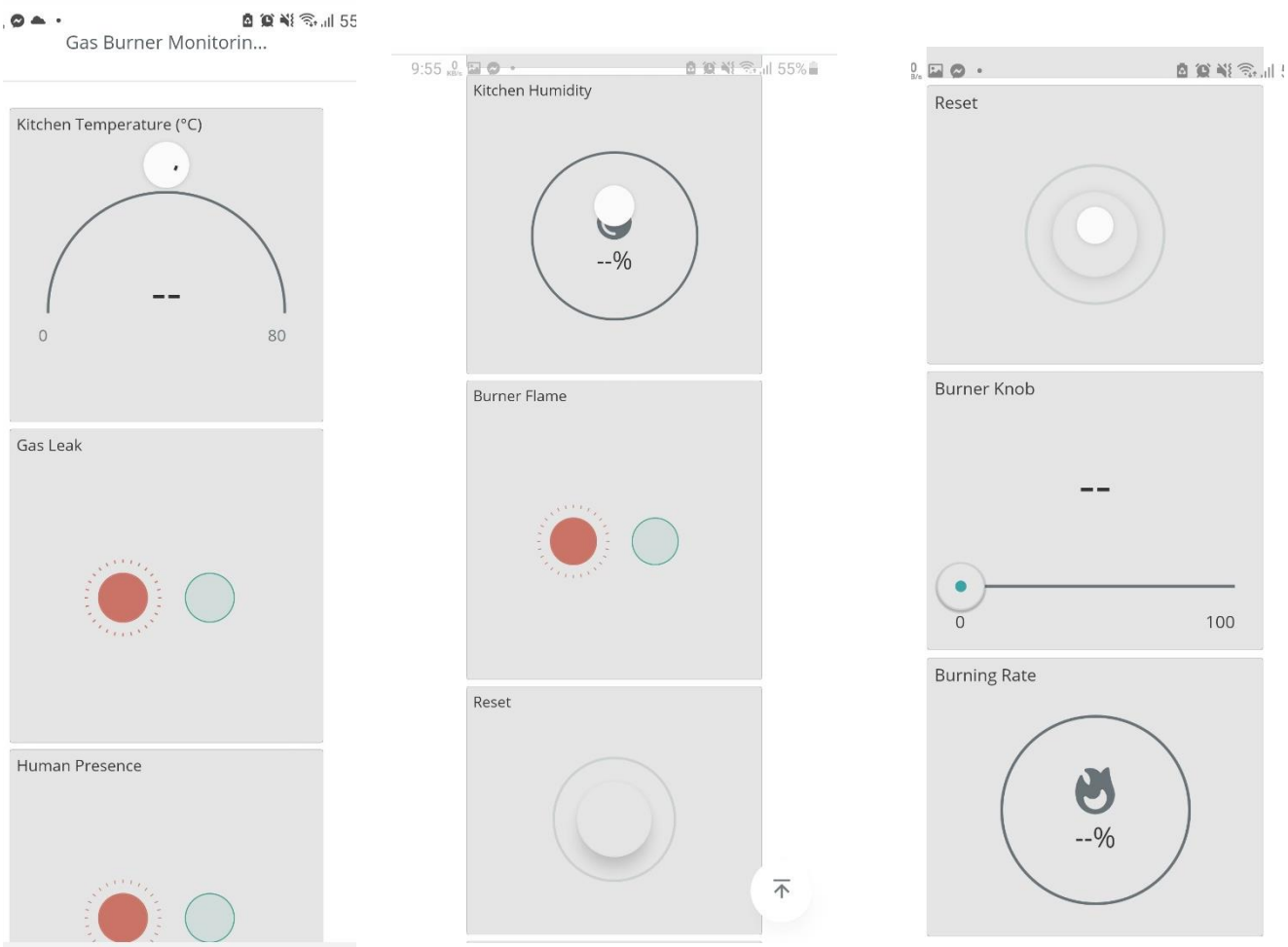
7) **Burner Knob:**

With this burner knob we can control the gas flow remotely. In some cases, when you kept the gas burner on unknowingly and may be not near the kitchen, then it would be a great feature to have full control on the current gas flow volume to be controlled remotely. Also, it can prevent form a lot of unwanted casualties.

8) **Burning Rate:**

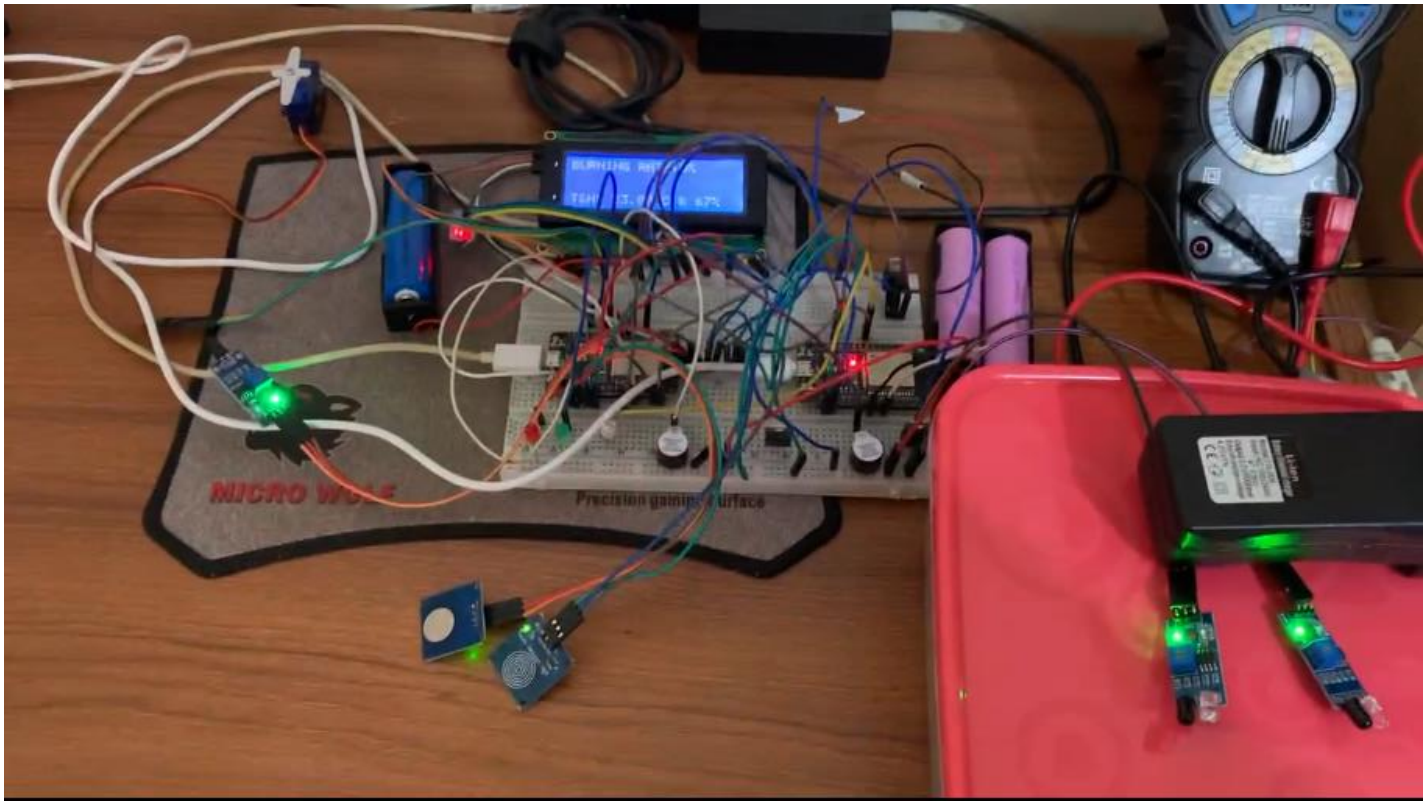
It is the indicator to show whether gas is burning or not. Moreover, we can observe the rate of the burning flame.

Android Dashboard:

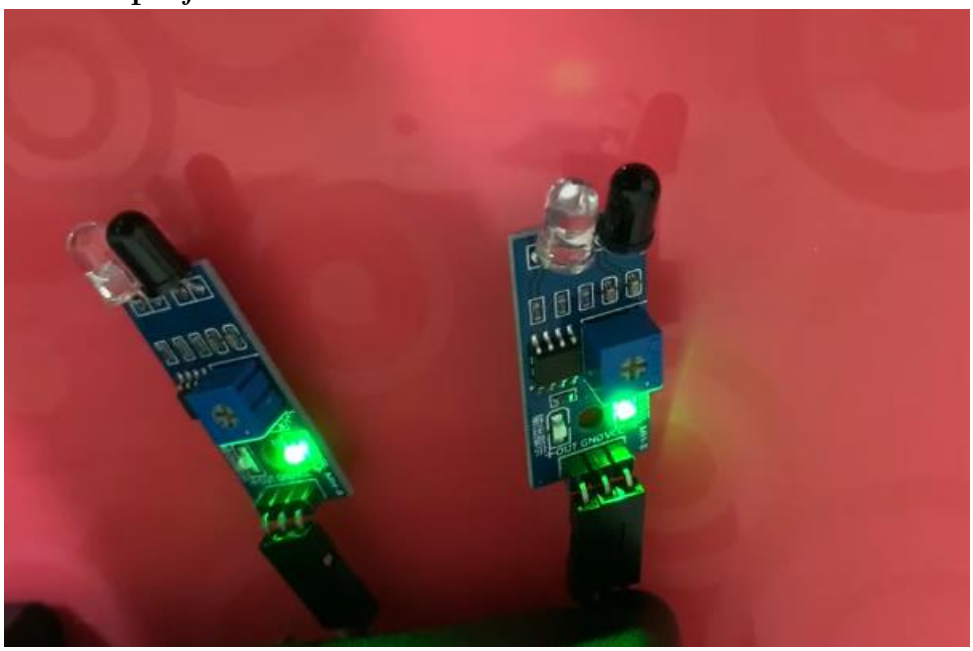


We have designed the both android web dashboard as well as android dashboard as a interactive user interface for the sake of convenience.

Description of the project:

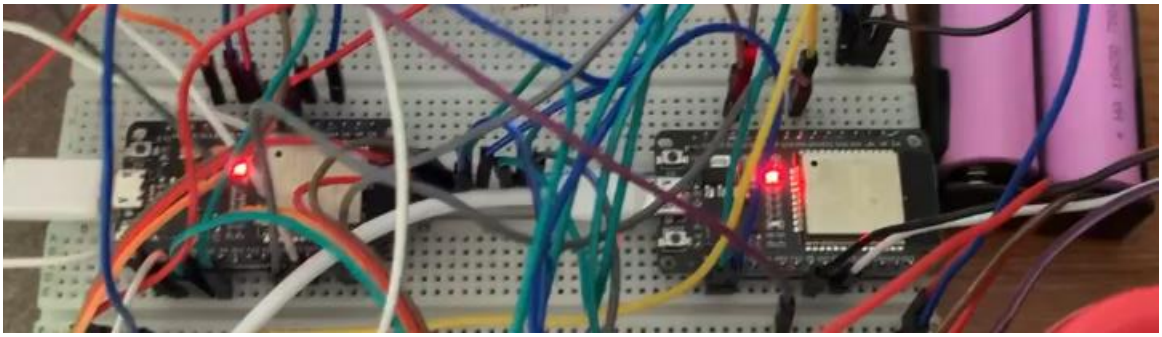


So, our project is entitled Gas Burner Monitoring System. Initially, we'll describe the components that we've used here along with their functionalities, and then we'll demonstrate how the project works.

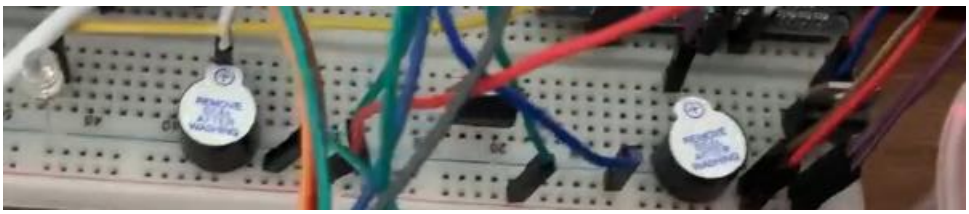


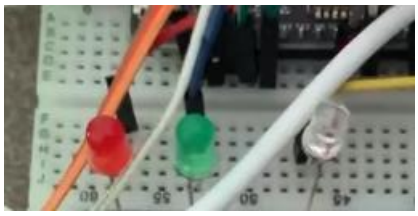
First of all, as you can see, we have here a pair of infrared sensors. We will be using these sensors to detect the presence of persons inside the kitchen. As a person enters the kitchen, they will first cross the initial IR sensor and then the second one. Similarly, as they exit the kitchen, they will cross the initial sensor and then the second one. Utilizing this concept, we have developed a logic to count the number of persons inside the kitchen. Based on the presence or absence of persons in the kitchen, we have introduced different levels of alerts, which we will demonstrate shortly. So right now, there is no

person in the kitchen. And as a person crosses this IR sensor and the second one, then it will detect a person inside the kitchen. Then, as you can see, this is my main circuit, and you can also see the control units onto the breadboards.



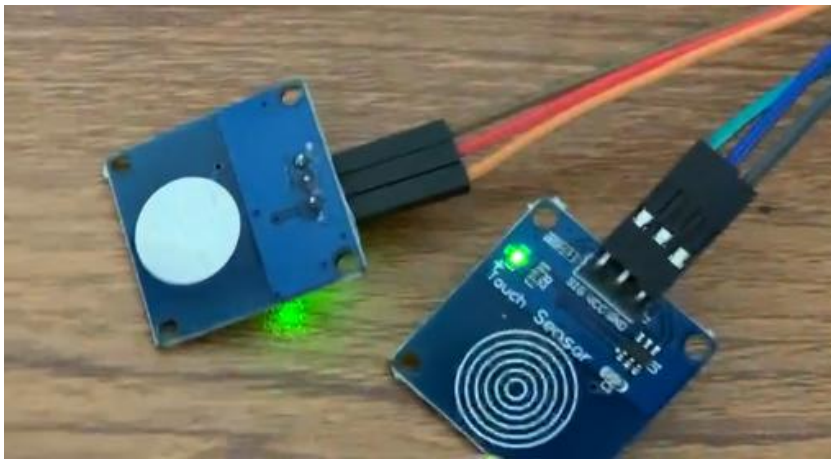
Two ESP three, two boards. So this is my parent ESP three two board. And this is my child ESP three two board. I have already explained the reason for using two microcontrollers in my previous update. Mainly the main work is done by the parent ESP 32 board. And the later one, the child one, only does the work of detecting the presence of persons inside the kitchen. I have already explained the reason before for using two ESP three two boards.





You can see two buzzers that are used in order to introduce different alerts. And you can also see a number of leds that will be alerting us about the events. Like the red one will be alerting us about the burner's flame. The green one will alert us about any kind of gas leakage from the burner. And this one will tell us about the presence or absence of human. If it is up, if it is on, then it means that someone is inside the kitchen. If the green led is on, that means gas is leaked from the burner. If the red one is on, then it means that fire is leaking from the burner. And as you can see, I have here the LM seven eight five linear voltage regulator.

I have used this pair of batteries in order to supply a number of components over here. And as most of my components are either five volt or 3.3 volts tolerant. I had to step down the voltage generated by this pair of batteries.



So this pair of batteries generate around 8 volts. And I had to step it down using this linear voltage regulator, LM 7805 to 5 volts. And then you can see that I have two touchpets over here. The touch capacitive, single channel touch capacitive sensors that are used in order to control the knob of the burner digitally. So the burner is kind of digitized in case of our project. Over here, I have the flame sensor, which is in fact an ir receiver. And it will be detecting any kind of flame which is burning unnecessarily from the burner and the sensors. I mean, the gas sensor or the flame sensor will be on top of the burner. So I have not plugged in the gas sensor for the time being. I will show it later on. But what happens for the flame sensor? The same will happen for the gas sensor. I have programmed everything, but for the time being, I've not plugged it in for some reasons. And over here, as you can see, I have the DST eleven temperature plus humidity sensor module that will be showing me the temperature and the humidity of the kitchen. And you can see that I have a mini servo over here. For the sake of testing purpose, I have used this servo motor, this small servo motor. But later on, in case of coupling this servo motor with the burner snob, we will be using a larger one that will be capable of generating sufficient amount of torque in order to control the these barners. So the burner snob will be tuned using this servo motor. So the shaft of the servo motor will be coupled with the burner snob by a mechanical system. Maybe we will introduce a gear system so that the servo can control the burner stop. And of course, I'm telling you once again that this is a prototype. And I've used this micro servo for testing purpose. But later on, I'll be replacing it with a bigger one that will be capable of generating enough amount of torque in order to switch or tune the burner snap. Over here you can see that I have kept the 20 x four lcd display, including the ITC driver. The use of the ITC driver eventually allows me to work with the least possible number of wires. Otherwise, I would require at least 16 to 20 wires to connect with my microcontroller. That would leave me with the least possible number of ports available to my microcontroller. So I had to use the I two c driver, which is below the display as you can see. And then I guess I have described most of my components. I guess nothing is left. I haven't connected 900 a GSM module, but for now I will connect it later. I have already programmed the hardware and I have not connected the gas sensor. So these are the two things that have not connected. Otherwise the entire stuffs, the entire components, all the components have been

connected and the entire configuration may look a bit messy as I'm doing it for testing purpose. It looks a bit messy, but in our final assembly the things will be indeed compact. Maybe we'll go for PCB design or 3d. We will print 3d model in order to make our entire design compact, as compact as possible. So I believe I have been able to describe all the components. Right now I'd like to directly dive into the demonstration. So first of all, well, another thing that I would like to tell you, the alerts will be introduced in a number of stages. First of all, we'll be alerted with these leds. Maybe later I will replace this with the AC color bulbs and these buzzers and we will be alerted into the LCD display. The alert will be sent to us by means of an email and we can monitor everything from the IoT dashboard. As you can see, we can also monitor everything from our cell phone using the Android application. I will be showing you very shortly. So I'd like to dive into the demonstration right now. So as a person, right now there is no person inside the kitchen. As you can see, this led is not on. And in the Iot dashboard you can see that human presence is red marked. That means there is no person inside the kitchen. If it is green, that means there is someone inside the kitchen. And you can see that the temperature and humidity is 24.1 degrees celsius and 66% for now. And yes, in the IoT dashboard, in our cloud service, the reading is the same and the burner flame and the gas leak, these two gage, they are green for now. Green means everything is fine. But if it is red, it means that there is something wrong, like the burner is running for no reason or gas has been leaked. And then you can see that I've kept a reset button. This button will reset the number of persons inside the kitchen in case of any ambiguous readings and the burner stop. Also, I was told to replace these continuous steps with a single turn off state only. But for the sake of generalization, for now, I have not removed this gage burner knob. Even if a person won, then he can control the burners knob remotely if he wants to. And it also includes the zero state. That means the off state. So for the sake of generalization, I have not replaced it with the single turn off state yet. And you can see the burning rate gage. And finally you can see that we have a curve that can show us the live burning rate and in intervals of an hour a day, seven days, or at most 15 days. So this gage, I have introduced this chart gage for the sake of visualizing the amount of burning rate or the amount of gas which is being burned. In order to assume, in order to predict the usage, maybe I have to do some computations, do some maths, and establish an equation that will be able to predict the amount of usage. And I was asked to add this as a passive feature by my course teacher when I showed him the proposal for the first time, maybe around a month back. So let's dive into the demonstration right now. For now, you can see that this gage is red. That means there is no person. And as I cross it, you can see as someone crosses this IR sensor, I've just now passed these IR sensors with my finger. So you can see, it means that someone is inside the kitchen. And as you can see that this blue led is up. And in our iot dashboard, the human presence gage is also green. For now, it means that someone is inside the kitchen. And if there is no one inside the kitchen, that means if the person exits the kitchen, then he will cross these IR sensor first.