IoT Noise And Air Quality Observation System

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Abstract

An IoT noise and air quality observation system are a device that is used to detect a noisy sound. Besides that, it also will detect any leak gas. This is a project that used a combination of electronic components and software. It will send the information on the Blink application if there is any leak gas or a noisy sound on that area. It is essential to use it in dangerous places like hospitals. In this project, Arduino UNO R3, NodeMCU, gas sensor, sound sensor, and resistor are the components that had been used. From this project, it can help a company or a place from facing dangerous problems such as fire, explosion and disturbances that can disturb the order of a place.

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1. Introduction

Nowadays, air pollution is a rapidly growing problem faced by the entire population of the earth. Various ways have been

done to avoid this problem but there is no solution that can solve this problem. In addition, noise pollution is also a problem that people often face. However, this noise pollution also comes from human actions. Through this pollution, it can have a bad effect on the body and human health. The best way that can be done is to prevent it from continuing to happen by always making people aware to pay attention to the surrounding conditions. Therefore, the project I am doing is focused on observing the level of noise and air quality in an area. Because of this, this project is more focused on areas such as hospitals. It is because areas such as hospitals are areas with a high potential to be exposed to pollution such as air and noise pollution. Through this project, if it detects gas, it will tell through the Blynk application that there is a gas leak, and the buzzer sounds as a sign of emergency. In addition, when it detects a noisy sound in the area, it will also notify through the Blynk application, and the buzzer will also sound.

1.1. Project Overview

This project is to detect if there is a gas leak that can have adverse effects on human health. In addition, this project is also to detect the level of noise in an area if the noise can disturb the peace of others. Through this project it can examine the situation in that area in a good and safe condition. To solve this problem this project has used sound sensor, gas sensor, buzzer and smartphone.

This IoT Noise and Air Quality Observation System works when the sound sensor detects a loud noise sound, and the gas sensor detects any gas leak. The sound sensor will pick up the sound and determine whether to go beyond its limit rate or not. The NodeMCU ESP8266 notified a signal from the sound sensor when it detects sound from any sources that exceed the maximum rate. NodeMCU ESP8266 will send the information to the smartphone. Moreover, this IoT Noise and Air Quality Observation System can detect any leakage of gas by using the gas sensor. The gas sensor is able to detect any gas leaks in that region. When the gas sensor detects more gas than it can handle, a buzzer will instantly turn on. Other than that, the smartphone will display all conditions. The buzzer and smartphone help the security on that hospital to be more alert with any condition that happens in the hospital.

1.2. Problem Statement

Air pollution and sound pollution are becoming bigger issues. Controlling pollution in certain areas is important, such as hospitals. Air pollution problems that can occur in hospitals are gas leaks. It is because in the hospital there are different types of gas that are used. Therefore, if there is a gas leak, a big problem occurs, for example, explosion and fire. In addition, leaks can also cause health problems for patients in the hospital. Besides that, another problem that often occurs in hospitals is the problem of noise pollution. A noise problem that often occurs is noise from visitors who visit patients in the hospital. Thus, it will disturb other patients in the hospital. To solve this problem, I have developed a system that can detect gas and sound. The system is able to detect if there is any gas leaking. Other than that, this system is also able to detect noise at a certain level.

1.3. Objective

The objectives of IoT Noise & Air Quality Observation are to analyze the level of noise in dangerous areas and large corporations. Besides that, to detect gas leaks that could cause danger.

1.4. Scope of Work

To accomplish the project objectives, there are several components that need to be used, such as the Arduino UNO R3, NodeMCU ESP8266, a sound sensor, a gas sensor, a buzzer, and others. To construct this project, precise and accurate coding is necessary so that the expected result can be produced. Simulation have been made to get a result about this project either success or fail.

2. Theoretical Background

The development of IoT noise and air quality observation system project can be divided into two parts, which are software and hardware. Thinkercad was used for this project to design a complete circuit of noise and air quality observation system. Then, in this project, there are several components that are not available in Tinkercad. So, it has been replaced with other components that can react the same as the original component. The hardware involved is discussed as follows:

2.1. Tinkercad

Figure 2.1 shows an Autodesk Tinkercad software. Tinkercad was used in making the simulation of this project. Tinkercad is a robust and user-friendly web-based application that enables people, particularly students and hobbyists, to easily design and create 3D models and digital prototypes. Tinkercad, created by Autodesk, provides a straightforward yet reliable platform for bringing concepts to life in the fascinating fields of 3D design and electronics. But in the Tinkercad there is several components that I need are not inside the Tinkercad such as NodeMCU and sound sensor.

Figure 2.1. Tinkercad

2.2. NodeMCU ESP8266

NodeMCU ESP8266 Wi-Fi module as shown in figure 2.2 is combined with an intuitive programming environment on the NodeMCU development board, which is open-source firmware. With integrated Wi-Fi and GPIO pins for interacting with

external devices, it enables users to create IoT projects. This ESP8266 Wi-Fi module will send the information to the smartphone through Bylnk application.

Figure 2.2. *NodeMCU ESP8266*

2.3. Arduino UNO R3

Arduino UNO R3 is an open-source microcontroller board developed by Arduino. cc that is based on the Microchip ATmega328P microprocessor.

Figure 2.3. *Arduino UNO R3*

Referring Figure 2.3, an Arduino UNO R3 is used to handle the project's development, understand the coding, and produce the expected output. A buzzer that will sound when any gas is detected and shows that information on Blynk.

2.4. Gas sensors

Gas sensors are electronic devices that detect and identify different types of gases. Gas sensors are used in manufacturing facilities and factories to find gas leaks and to detect smoke and carbon monoxide in residential buildings. It can detect flammable gas in a range of 300 - 10000ppm.

Figure 2.4. *Gas sensor*

From Figure 2.4, it shows a gas sensor. A gas sensor is used to detect any leak gas. The gas sensor has been set if the gas sensor detects any leak gas more than 500ppm it will send the data to the Arduino. So, it will generate the buzzer to make a sound and display the information on Blynk.

2.5. Blynk

As shown in figure 2.5, Blynk is a user-friendly platform that allows you to easily build mobile applications for controlling and monitoring IoT (Internet of Things) devices. By using Blynk we managed to monitor the situation of that area. When there is any leaks gas or noise sound it will send information to security guard to be more alert.

Figure 2.5. *Blynk*

2.6. LCD 16x2

LCD 16x2 is a 16-pin device with 2 rows of 16 characters each. The LCD 16x2 can be used in either 4-bit or 8-bit mode. It

is also possible to create your own characters. It contains eight data lines and three control lines for controlling things.

Figure 2.6. *LCD 16x2*

Referring figure 2.6 LCD is implemented in this project, to display the condition in that area without any gas and noise. For the simulation of this project, a LCD 16x2 will replace the Blynk application. The LCD will display "NOISE" when the sound sensor detects sound that exceeds the maximum sound rate, and "QUITE" if the sound sensor does not detect any sound that exceeds the maximum sound rate. Other than that, when the gas sensor detects the leak gas the LCD will display "GAS DETECTED".

2.7. Sound Sensor

A sound sensor, also known as an acoustic sensor, is a module that detects and transforms sound waves based on their depth. A capacitive microphone, a height detector, and an incredibly sensitive sound amplifier are all part of the sound sensor.

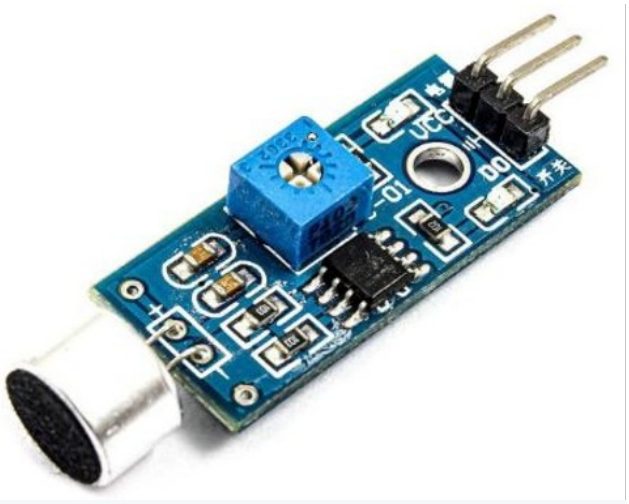

Figure 2.7. *Sound sensor*

Referring to figure 2.7, the sound sensor is used to detect any noise. For the simulation of this project, an ultrasonic distance sensor was used to replace the sound sensor. The ultrasonic distance sensor has been set to 60 cm as the

maximum distance. When the area detected by the ultrasonic distance sensor is less than 60 cm, it will show the area is noisy. Then, the sound sensor will send a signal to the Arduino UNO R3 to display “NOISE” on display. When the distance is more than 60 cm, it’s shown that the area in quite sound. The sound sensor will then transmit a signal to the Arduino UNO R3 to display “QUITE” on LCD.

2.8. *Piezo Buzzer*

The buzzer is a device that produces sound by converting audio signals into sound signals. As a sound device, it is commonly utilized in alarm clocks, computers, printers, andother electronic items.

Figure 2.8. *Piezo buzzer*

Using the piezoelectric activity of piezoelectric ceramics and driving the vibration of a metal plate with a pulse current, the piezoelectric buzzer from figure 2.8 is used in this project to produce sound. When a leak is discovered, the piezoelectric buzzer's purpose is to alert nearby residents by producing sound. In this project the buzzer will active when the gas sensor detects any leaks gas.

3. Project Description

The system diagram, block diagram and system operation discussed as follows:

3.1. System Diagram

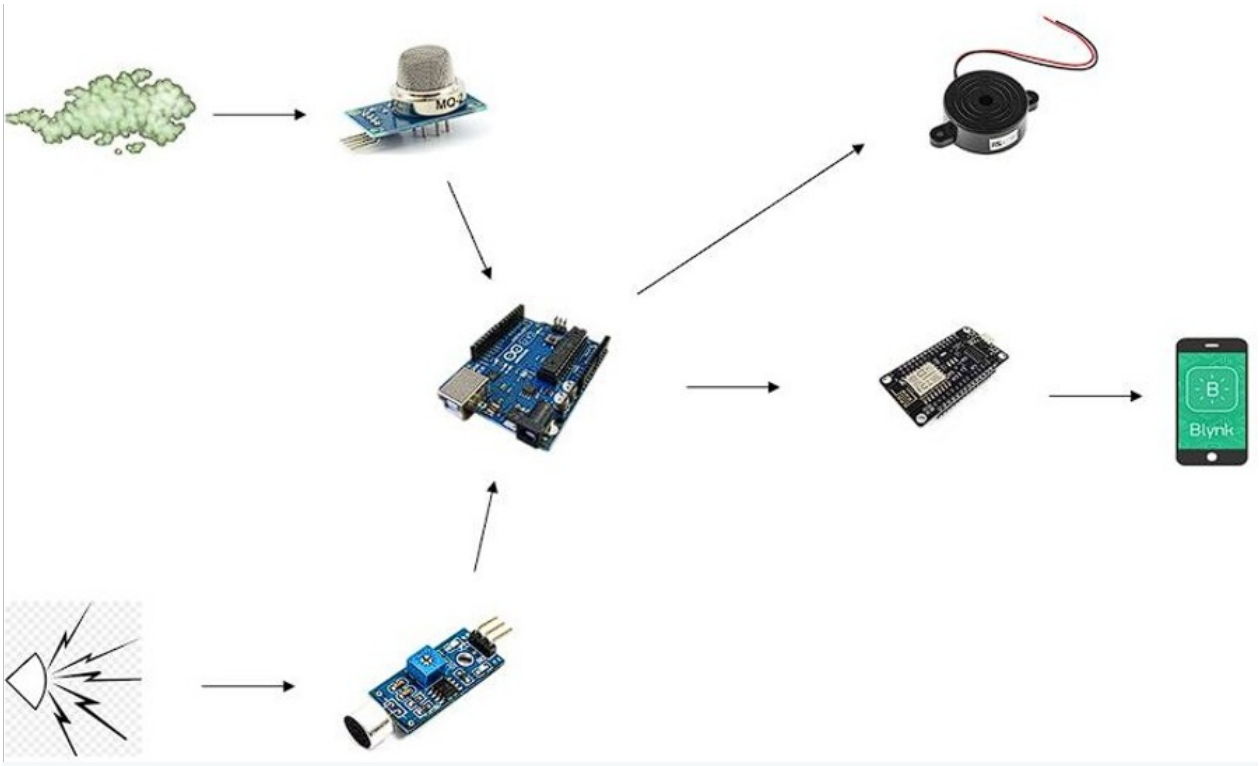

Figure 3.1. *System diagram*

Figure 3.1 shows an IoT noise and air quality observation system activates when any gas leakage detected by gas sensor. As a result, the buzzer will automatically turn on until the gas sensor doesn't detect any gas. Furthermore, this IoT noise and air quality observation system can detect the sound sensor in order to keep the area in a good situation without any interruption. When the sound sensor detects noise sound on that area, the LCD will display "NOISE" and send information to the Blynk. This is to ensure that to ensure that areas such as hospitals are not disturbed by noise disturbances by visitors present. Furthermore, the smartphone will display the conditions in that area. It can help a security guard in monitoring the condition of an area such as a hospital in avoiding problems such as fire and noise that disturb other people.

3.2 Block Diagram

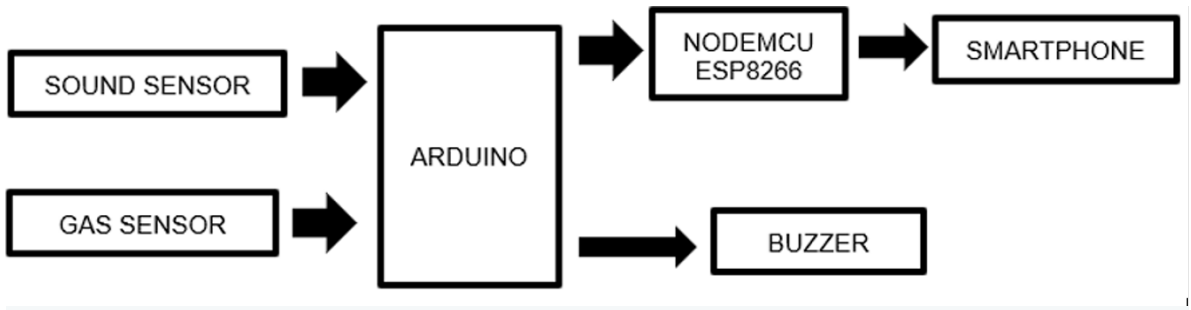

Figure 3.2. *Block diagram*

Figure 3.2 shows an IoT noise and air quality observation system contains two inputs and two outputs. The power supply, sound sensor, and gas sensor arethe inputs, while the smartphone and buzzer are the outputs of this noise and air quality observation system. All of the inputs and outputs will be linked to the Arduino UNO R3. This is because the Arduino UNO R3 is used to process all project development, which requires analyzing every programming to ensure the intended output is produced. This IoT noise and air quality observation system produces a buzzer sound and displays the condition of a room on smartphone that can help the security guard to act quickly if there is any problem in that room. In this project, a sound sensor is used to pick up noise, and a gas sensor is utilized to pick up any gas leaks. The smartphone in this project also aids in displaying all of the local weather conditions. For instance, if the sound sensor detects any noise sound, the smartphone or in the simulation LCD will display “GAS DETECT” when the gas sensor detects any leak gas. Otherwise, it also will display “NOISE” when detects any noisy sound. Other than that, the buzzer in this project to warn people in the area when detect any leaks gas so that they can act early.

3.3. System Operation

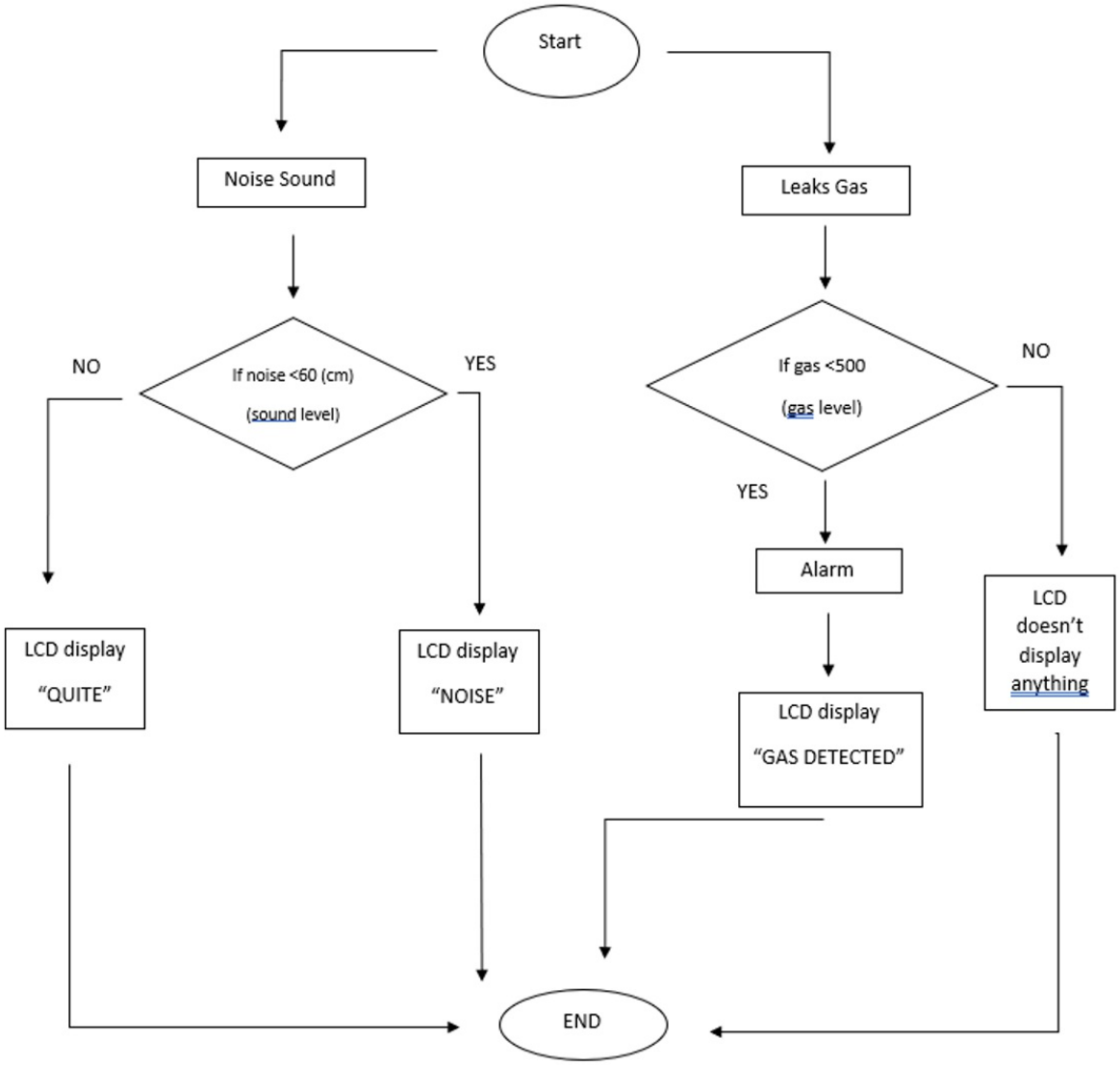

Figure 3.3. *System operation*

Figure 3.3 shows the system operation of the IoT noise and air quality observation system. Firstly, when there is noise, the sound sensor will detect the noise sound either exceeding the maximum rate of the sound sensor or not. For the simulation of this project, an ultrasonic distance sensor was used to replace the

sound sensor. The ultrasonic distance sensor has been set to 60 cm as the maximum distance. When the area detected by the ultrasonic distance sensor is less than 60 cm, it will show the area is noisy. The LCD will then show "NOISE" after the sound sensor has sent a signal to the Arduino UNO R3. When the distance is more than 60cm (slow sound), it'sshown that the area is not in noise sound. The LCD will display "QUIET". Moreover, this IoT noise and air quality observation system an able to detect leaks gas by using the gas sensor. When the gas sensor detects any leaked gas that has exceeded the maximum rate of gas which is 500 ppm, a buzzer will automatically turn on. After that, the LCD will display "GAS DETECTED". When the gas sensor is not able to detect any gas, a buzzer will turn off, while the LCD will not display anything, but it will display the original word which is "QUIET". The function of the buzzeris to inform them, for example security guards, that the area is not in a safety situation. Otherwise, it also will inform the security guard that the area is in noisy.

3.4. Problem Encountered and Solutions

While carrying out this project, the difficulty that is often encountered is connecting the circuit and making the circuit work. This problem can be solved by doing research to get information through google and watching a little demo on YouTube video. Other than that, the problem I face is finding software that has all the components I need. But this problem can be dealt with by replacing the component with another component that has the same concept and function. In addition, the problem I faced in this project was making the buzzer sound after detecting gas and noise at the maximum sound and maximum gas. But this problem can be solved by using the correct coding. Finally, the buzzer can work properly.

4. Result and Discussion

The schematic diagram, circuit diagram and simulation test results discussed as follows:

4.1. Schematic Diagram

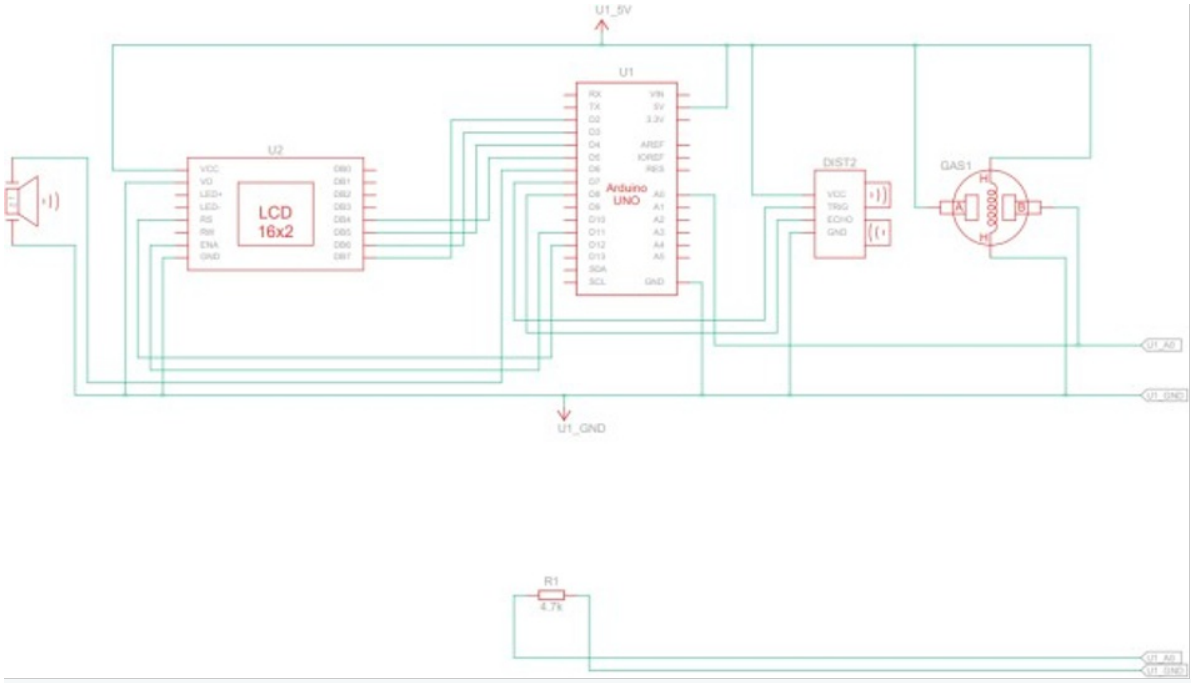

Figure 4.1. *Schematic diagram*

Referring to figure 4.1, the schematic diagram of the IoT noise and air quality observation system. The Arduino UNO R3 connects to a sound sensor and a gas sensor, which together make up the project's two inputs. In the simulation of this project, an ultrasonic distance sensor was used in place of the sound sensor while Blynk application was replaced by LCD 16x2.

4.2. Circuit Diagram

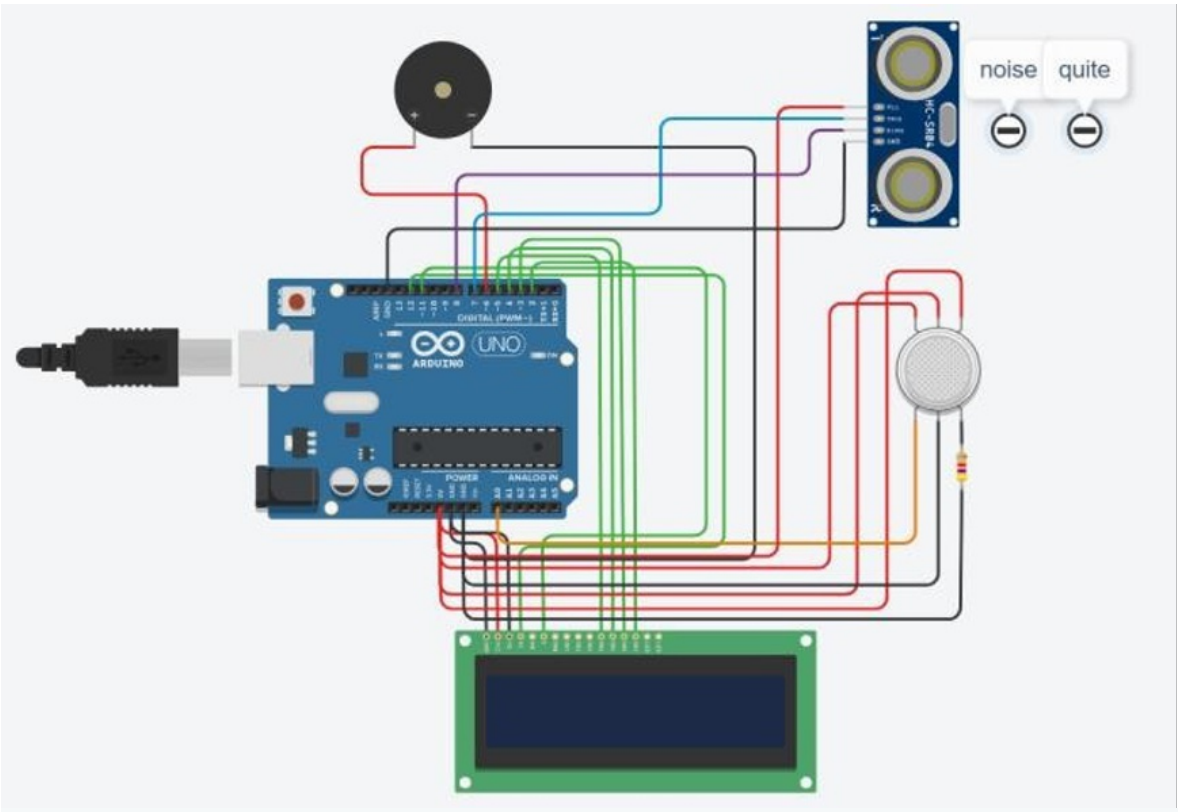

Figure 4.2. *Circuit diagram*

From the figure above, 4.1 and 4.2, a complete circuit of IoT Noise and Air Quality Observation System.

4.3. Simulation Test Result

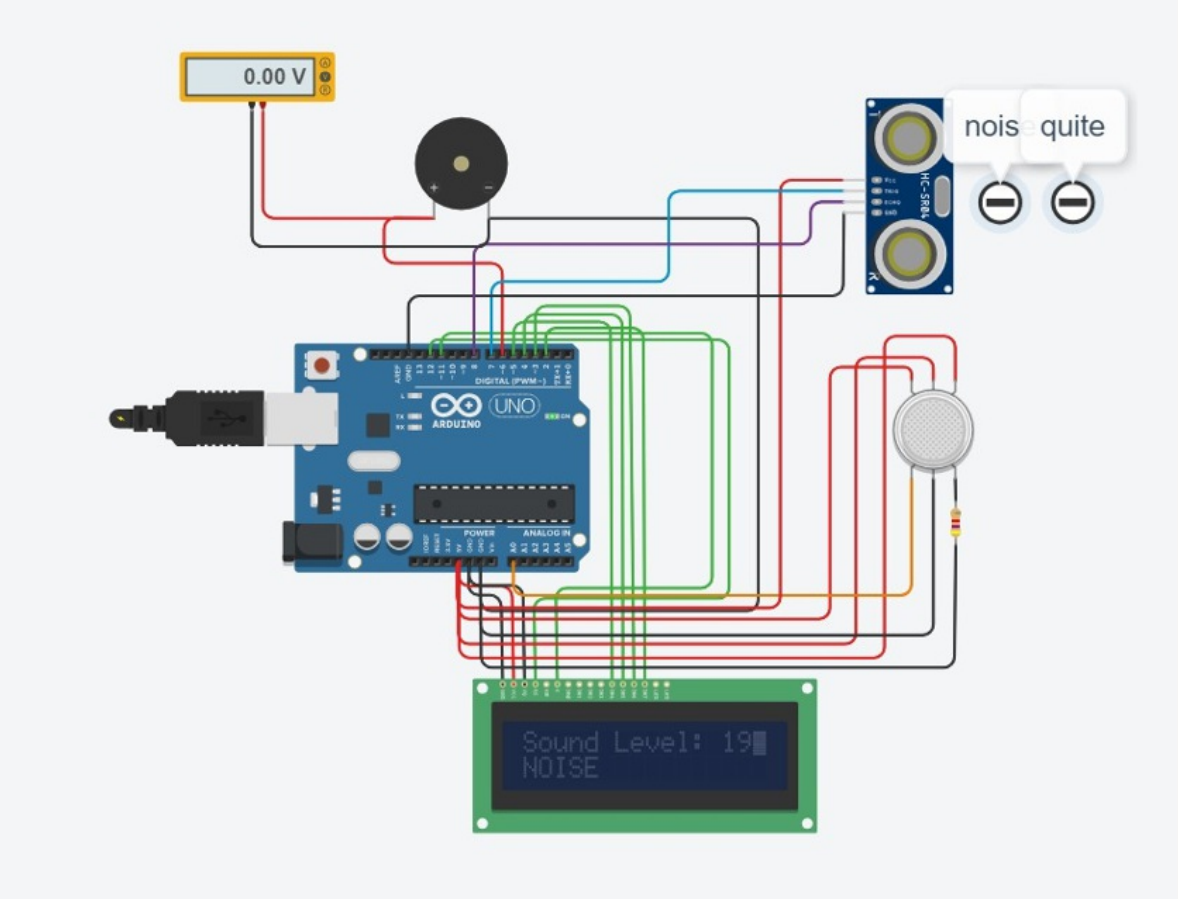

Figure 4.3. *Simulation test result*

Figure 4.3 shows the complete circuit of the IoT Noise and Air Quality Observation System. Tinkercad was the software used for the simulation test results because it makes the circuit easier to comprehend and modify by putting coding inside the project. Otherwise, it is free and enables you to design a circuit online without having to download any software. As shown in figure 4.3, the LCD will display "NOISE" if the sound distance is less than 60 cm. The LCD will show "QUITE" if the sound distance is greater than 60 cm. as shown in figure 4.4. Additionally, as shown in figure 4.5, the LCD displays "GAS DETECTED" along with the buzzer activates when the gas sensor detects any leaks of gas in the region that are greater than 500ppm.

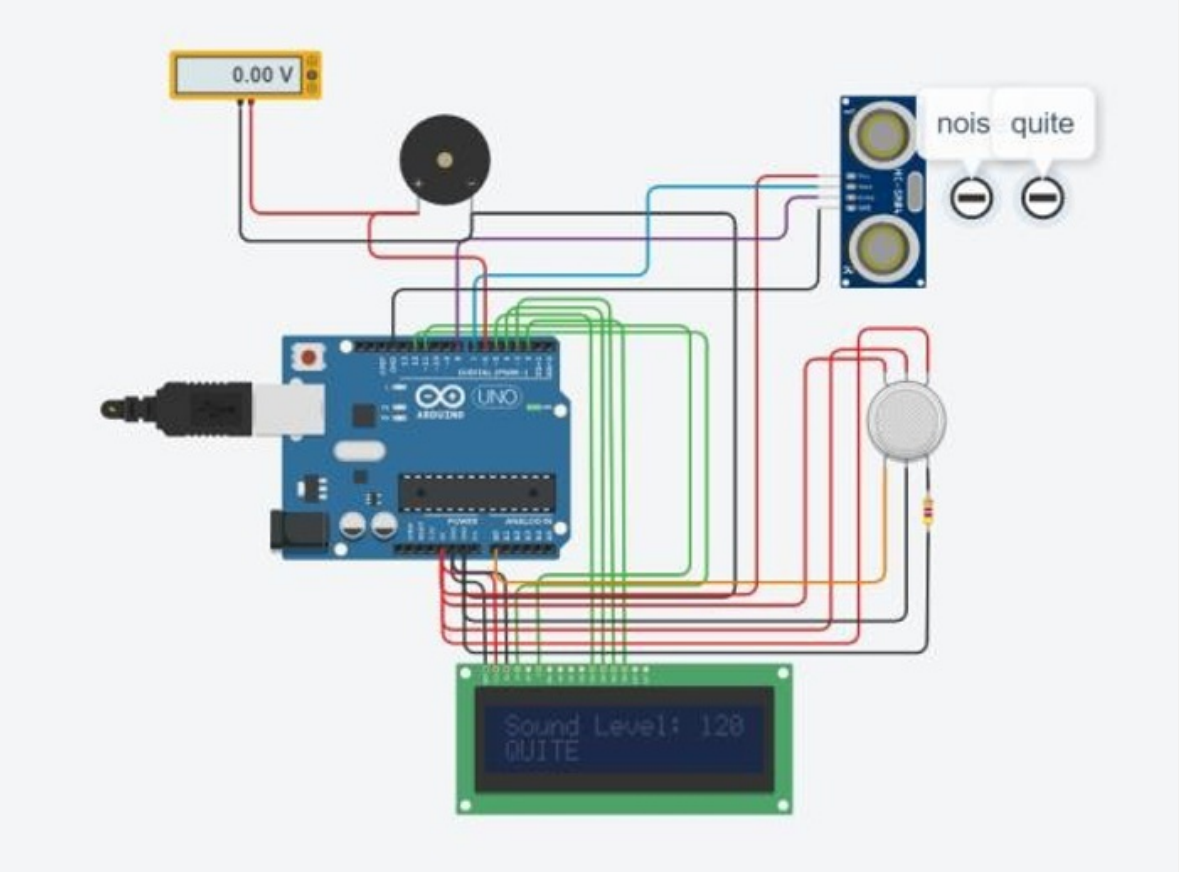

Figure 4.4. *Simulation test result*

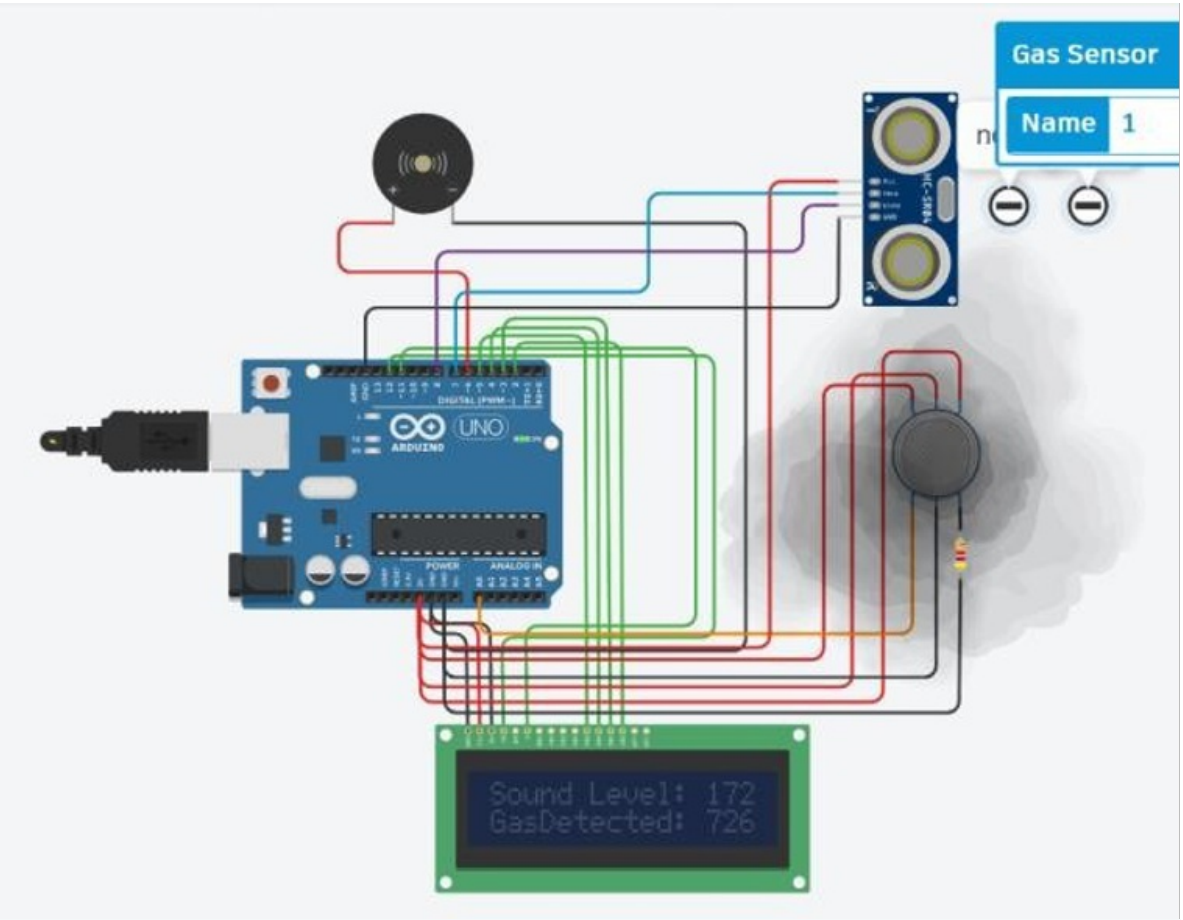

Figure 4.5. *Simulation test result*

Tables 4.1 and 4.2 demonstrate the simulation results for this IoT Noise and Air Quality Observation System. Table 4.1 shows the result for detect noisy sound, and Table 4.2 shows the result for detect any leaks gas.

Table 4.1. *Result for detecting noisy sound.*

INPUT SOUND SENSOR (cm)	LCD DISPLAY
<60	NOISE
>60	QUITE

According to table 4.1, when the ultrasonic distance sensor detects sound in distance is less than 60 cm the LCD will then display "NOISE". While, when the sensor detects distance over 60 cm, the LCD will display "QUIET".

Table 4.2. *Result for detect leaks gas*

INPUT GAS SENSOR (ppm)	BUZZER (V)	BUZZER	LCD DISPLAY
<500	0	OFF	QUITE
>500	2.3	ON	GAS DETECTED

According to table 4.2, the buzzer activates and starts to ring if the gas sensor detects any leaks of gas greater than 500 ppm. When gas leakage is detected, the LCD will show "GAS DETECTED." The buzzer is turned off when the gas sensor detects any leaks and the gas concentration is less than 500 ppm, as shown by a value of 0V in the buzzer.

5. Conclusions

In conclusion, this project, IoT Noise and Air Quality Observation System, can help agencies such as hospitals in dealing with dangerous problems such as gas leaks. When the sound sensor detects a noisy sound, it will send information to the security guard. Thus, it can help the security guard to monitor an area for noise that disturbs other patients. In addition, what if the gas sensor detects any gas leakage, it will also send information to the security guard to take steps to avoid problems such as explosions that can injure people. Besides that, buzzer will act as alarm to alert the people on that area.

5.1. Future Plan

For the next step I will run this project in hardware. For the hardware, I will use the original components for this project such as sound sensor, NodeMCU ESP8266 and Blynk application. For example, I'm goanna replace LCD with Blynk. So, I can monitor the condition of noise and air quality through smartphone.

References

- "IOT BASED NOISE AND AIR QUALITY MONITORING SYSTEM," n.d.,https://www.irjet.net/archives/V7/i8/IRJET-V7I8697.pdf
- (PDF) "IoT Based Air and Noise Pollution Monitoring System." (n.d.). ResearchGate. https://www.researchgate.net/publication/353287494_IoT_Based_Air_and_Noise_Pollution_Monitoring_System
- "IoT based Noise & Air quality Monitoring using Blynk IoT |" New Automation Tab update in Blynk #iot. (n.d.). www.youtube.com. https://youtu.be/p3-0mWkOFBk
- "IOT Based Air Pollution Monitoring System using Arduino & MQ135 Sensor," Circuitdigest.com, 2016. https://circuitdigest.com/microcontroller-projects/iot-air-pollution-monitoring-using-arduino
- Sai, P. Y. "An IoT Based Automated Noise and Air Pollution Monitoring System." IJARCCE, 6(3), 2017, pp. 419–423. https://doi.org/10.17148/ijarcce.2017.6397