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Analysis of Air Quality Measuring Device Using Internet of Things-Based MQ-135 Sensor

Delima Sitanggang[1)*], Chris Samuel Sitompul[2)], Jao Han Suyanto[3)], Sharen Kumar[4)], Evta Indra[5)]
[12,3,4,5)]Universitas Prima Indonesia, Indonesia
[1)]delimasitanggang@unprimdn.ac.id, [2)]chrissitompul13@gmail.com, [3)]yauhansuyanto2000.ys@gmail.com,
[4)]sharenkumar2000@gmail.com, [5)]evtaindra@unprimdn.ac.id

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Abstract: Air is a gas that is indispensable for the survival of living beings. As the times progress, the air we breathe is increasingly not good for the health of living beings. In most situations, humans cannot tell the difference between good and bad air conditions. The purpose of this research is to design a tool that can monitor air quality in many places using an Internet of Things-based concept, the MQ-135 gas sensor and display it on a 16x2 LCD and Blynk application. The method used in this study is a direct test method to identify gases around the MQ-135 sensor with the NodeMCU ESP 8266 as a controller. Air quality is divided into 5 categories, which consists of good, average, unhealthy, very unhealthy, and dangerous. After the air quality value is displayed on the 16x2 LCD screen, the user can monitor the air quality remotely using the Blynk application on the smartphone. It can be concluded that the design of this tool can detect air quality in classrooms, vehicle exhaust fumes, gas lighters, house rooms, and burned paper. If the air quality is bad, the buzzer will release the sound to notify that the air quality is poor according to the index of air quality.

Keywords: 16x2 LCD, Blynk, Buzzer, IoT(Internet of Things), MQ-135, NodeMCU ESP8266

INTRODUCTION

One of the challenges facing humanity in the 21st century is preventing the continuous accumulation of the greenhouse effect in the atmosphere. At the United Nations Climate Change Control Conference (UNFCCC) held in Paris, the Paris Agreement was formed. The goals of the Paris Agreement are to contain increases in global average temperatures well below 2^{o}C above pre-industrial levels and to pursue efforts to limit temperature increases to 1.5^{o}C above pre-industrial levels (Warren, Price,VanDerWal, 2018).

Based on the Climate Transparency review (2020), Indonesia's carbon emissions increased by 140% between 1990 and 2017. The main driver of all carbon emissions in Indonesia is CO2 emissions from burning fuel. In Indonesia, there was a significant increase in carbon emissions in 1990 reaching 581 MtCO2 (metric tons of carbon dioxide equivalent) in 2019 (Pratama, 2021). Unhealthy air will cause various diseases in living things, especially in the respiratory system. The negative impacts of technological developments themselves are also accompanied by positive impacts, one of which is the existence of special tools that can detect air quality in a place (Demain, 2018).

After seeing the background description, the problem is how to detect and recognize air quality in a place that has good or bad air quality, namely by using the MQ-135 sensor which can detect gas concentrations. The air quality of a place is determined by the surrounding natural conditions and the amount of pollution in the surrounding environment. The sensitivity of the MQ-135 sensor is very strong to gas and smoke, so it is very appropriate to be used as a means of detecting air quality in a place. Previously there had been research conducted to detect air quality using the MQ-135 in places such as building halls (Nasution, 2019). In this study, the test was carried out in the campus parking lot, house room, classroom, gas lighters, and burned papers.

The purpose of this research is to identify and detect the existing air quality in a place, whether it is in good or bad conditions and to show that MQ-135 can be used to monitor air quality, especially CO_2. This research will benefit many people by reducing CO2 emissions where the air quality is measured, and will also contribute to maintaining public health.

*name of corresponding author

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LITERATURE REVIEW

Internet of Things (IoT) is a network of physical objects that contain embedded technologies to communicate and sense/interact with internal or external environments. In simple terms, IoT can be defined as a concept where an object has the ability to connect data over a network without requiring direct human intervention. IoT has the ability to share data with various technology devices. The goal of IoT is automation in various sectors, such as agriculture, health, transportation, environment, and so on by connecting, unifying and integrating physical objects with computer and internet-based systems (Hanes, Salgueiro, Grossetete, Barton & Henry).

The tools used for this research are MQ-135, NodeMCU ESP8266, 16x2 LCD, Buzzer, Blynk. MQ-135 is a gas/air sensor that is specifically used to measure air quality (Hadi, Alsaker, Eshoom, Elmnifi, Alhmode & Habeeb, 2021). The 16x2 LCD is a Wi-Fi Microchip with a standalone SOC (System-on-chip), as well as an integrated TCP/IP protocol, which with all of these components can give the microcontroller access to a Wi-Fi network. A 16x2 LCD is a device that uses liquid crystals that function to display data and messages as much as 32 characters with a coverage of 16 columns and 2 rows (Ibrahim, 2012). Buzzer is a device that provides a signal in the form of sound by converting an electrical signal to an object. Blynk is an Application for Android or IOS that is used to control hardware devices such as Arduino, Rasbery Pi, Wemos and the like remotely using Wi-Fi/Internet.

METHOD

This study uses an experimental method (trial). The experiment was carried out using the MQ-135 sensor as input, then the sensor will measure the air quality after receiving the data, next it will be processed by ESP8266 and a 16x2 LCD as the product will display the sensor reading results with a Buzzer signal. For blynk, after the sensor reads the data, the ESP8266 processes the connection and then checks the connection whether the ESP8266 is connected to Wi-Fi or not. If the conditions are fulfilled, the reading value will be displayed on the smartphone screen that we use. The schematic can be seen in Figure 2.1.

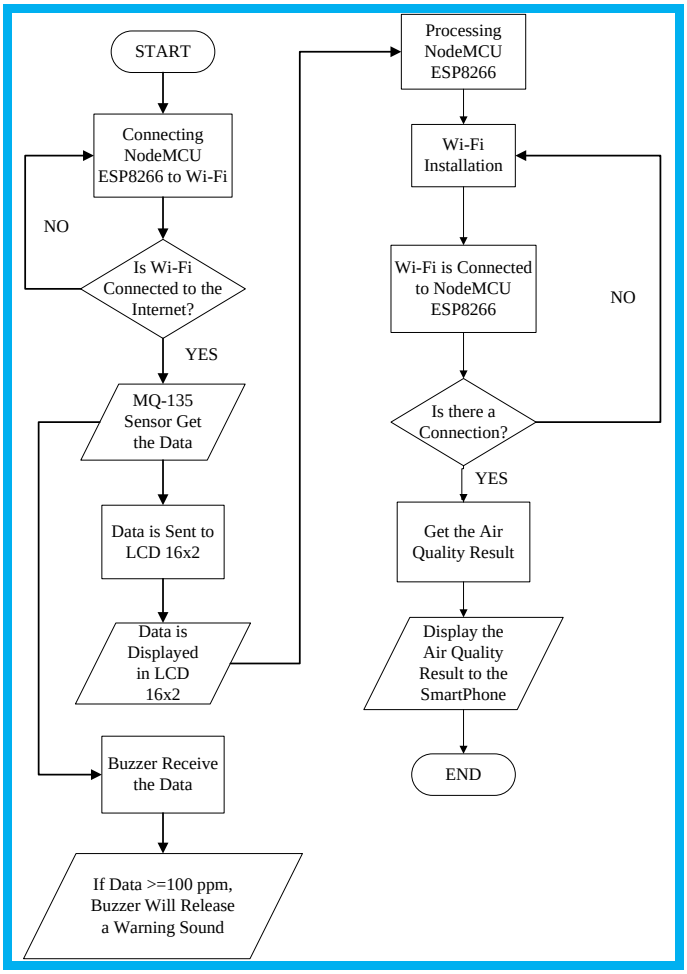

Fig. 1 Flowchart Experiment

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RESULT

The results of the research are shown in Figure 2, where the air quality detector has been designed.

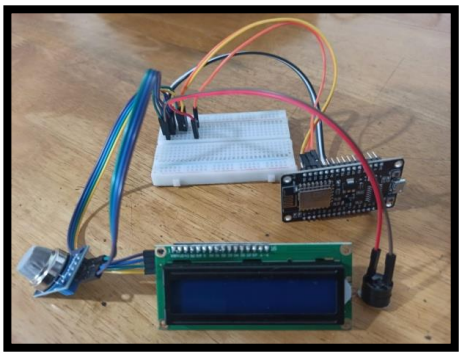

Fig. 2 Air Quality Detector

To measure the quality of air pollution, the air pollution index is used to determine whether the air is good or bad, as can be shown in Table 1

Table 1. Air Pollution Index

No	Value	Category	Description
1	1 – 50 ppm	Good	The level of air quality is very good, does not have a negative effect on humans, animals and plants
2	51 – 100 ppm	Average	The level of air quality is still acceptable for human, animal and plant health
3	101 – 200 ppm	Unhealthy	The level of air quality that is harmful to humans, animals and plants.
4	201 – 300 ppm	Very Unhealthy	Air quality levels that may increase health risks in some segments of the exposed population
5	301 + ppm	Dangerous	Air quality levels that may increase health risks in some segments of the exposed population

The pollutant components from this research are Nitrogen Dioxide, Sulfur Dioxide, ozone, carbon monoxide. Based on observations, MQ-135 gas sensor cannot be considered the best tool to measure the Carbon Dioxide. A better tool will be discussed in the Discussion session.

The following figures and tables are the results of air quality detection by using MQ-135. The places where the observations were conducted are classrooms, gas lighters, vehicle exhaust fumes, house rooms, and burned paper.

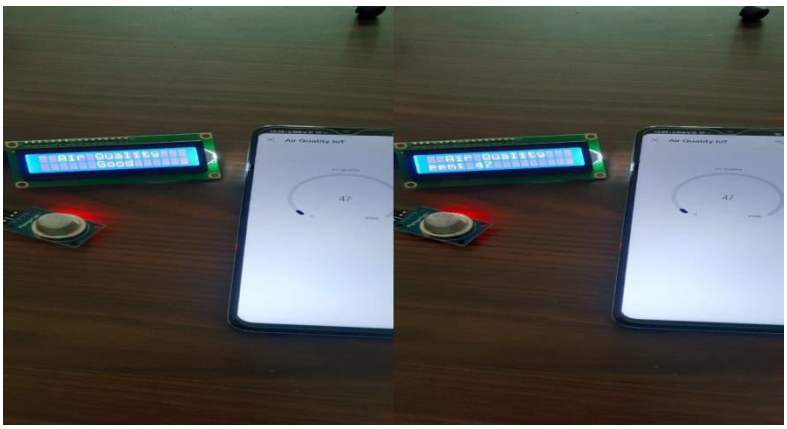

Fig. 3 Test Results in Classroom

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Table 2. MQ-135 Test Results in Classroom

Attempts No. (every 10 Seconds)	Buzzer	16x2 LCD Display
1	OFF	47 ppm
2	OFF	51 ppm
3	OFF	49 ppm
4	OFF	47 ppm
5	OFF	47 ppm
6	OFF	50 ppm
7	OFF	45 ppm
8	OFF	47 ppm
9	OFF	49 ppm
10	OFF	48 ppm

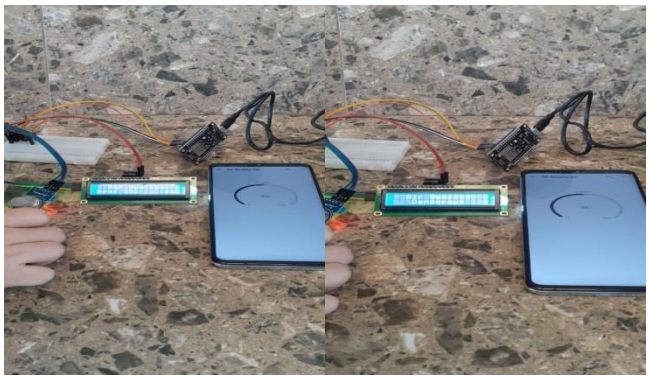

Fig. 4 Test Results on Gas lighters

Table 3. MQ-135 Test Results on Gas lighters

Attempts No.(every 10 Seconds)	Buzzer	16x2 LCD Display
1	ON	992 ppm
2	ON	895 ppm
3	ON	774 ppm
4	ON	847 ppm
5	ON	784 ppm
6	ON	756 ppm
7	ON	703 ppm
8	ON	721 ppm
9	ON	732 ppm
10	ON	697 ppm

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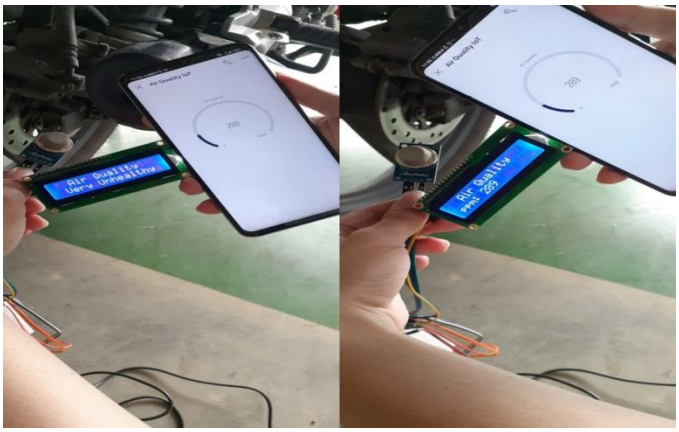

Fig. 5 Test Results on MQ-135 Test Results on Vehicle Exhaust Smoke in Parking Lot

Table 4. MQ-135 Test Results on MQ-135 Test Results on Vehicle Exhaust Smoke in Parking Lot

Attempts No.(every 10 Seconds)	Buzzer	16x2 LCD Display
1	ON	289 ppm
2	ON	220 ppm
3	ON	291 ppm
4	ON	277 ppm
5	ON	253 ppm
6	ON	256 ppm
7	ON	197 ppm
8	ON	283 ppm
9	ON	301 ppm
10	ON	276 ppm

Fig. 6 Test Results in house room

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Table 5. MQ-135 Test Results in house room

Attempts No.(every 10 Seconds)	Buzzer	16x2 LCD Display
1	ON	168 ppm
2	ON	173 ppm
3	ON	188 ppm
4	ON	169 ppm
5	ON	140 ppm
6	ON	155 ppm
7	ON	125 ppm
8	ON	103 ppm
9	OFF	97 ppm
10	ON	104 ppm

Fig. 7 Test Results on burned paper

Table 6. MQ-135 Test Results on burned paper

Attempts No. (every 10 Seconds)	Buzzer	16x2 LCD Display
1	ON	172 ppm
2	ON	186 ppm
3	ON	188 ppm
4	ON	202 ppm
5	ON	198 ppm
6	ON	194 ppm
7	ON	199 ppm
8	ON	208 ppm
9	ON	227 ppm

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10	ON	240 ppm

DISCUSSIONS

From the results above it shows that the tool can function normally at a voltage of 5 volts. It is known that in the class rooms the average content that comes out is around <= 60 ppm, which means the room can be considered safe to be occupied, while in vehicle exhaust fumes the results of these measurements are around 200-300 ppm, which means vehicle exhaust fumes are not good to be inhaled, the results of gas lighters are around 700-900 ppm, which means match gas is very dangerous when inhaled directly or in close proximity, in a room of the house in the range of 90-200 ppm, which means the air condition depend on each room condition, paper burning smoke ranges from around 150 – 300 ppm, which means paper burning smoke is not good to inhale.

Based on research on air quality measuring devices with the MQ-135 sensor, several things can be suggested as follows:

1. Use a larger LCD, such as a 20x4 LCD.
2. It is recommended to add LEDs to multiply the indicators.
3. It is recommended to use a more accurate sensor tool for Carbon Dioxide, such as MG-811.

CONCLUSION

Based on research on air quality measuring devices containing carbon dioxide with the MQ-135 sensor, it can be concluded that this sensor can be used to detect air quality. It also takes time to stabilize the air quality levels before the sensor can accurately detect the gases. The device will sound if the air quality is > 100 ppm. If the air quality is getting worse, the device will sound faster.

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