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Implementation of the MQ135 Sensor for Carbon Monoxide Measurement in Air

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ABSTRACT

The increase in air pollution caused by industrial activities, transportation, and urbanization has led to a decline in air quality, particularly in urban areas. Carbon monoxide (CO) is one of the hazardous gases that can harm human health. This article discusses the use of the MQ135 sensor to measure CO concentration in the air, which is then monitored in real time through the Blynk application. The MQ135 sensor was calibrated using CO gas samples to ensure accurate readings. The test results showed that the sensor could quickly detect changes in CO concentration, and the Blynk application displayed the data directly in an easy-to-understand graphical form. These tests demonstrated that the developed system works effectively. A stable Wi-Fi connection on the ESP8266 module also ensured uninterrupted data transmission to the application. This implementation highlights the potential for real-time air quality monitoring, which is highly beneficial for managing air pollution and protecting public health.

Keywords:
MQ135; Carbon monoxide; Blynk; pollution; ESP8266

Introduction

The MQ135 sensor is one of the most widely used gas sensors for detecting air quality (Rasha AbdulWahhab et al., 2021). This sensor has the capability to detect several types of hazardous gases in the air, such as ammonia (NH3), nitrogen oxides (NOx), alcohol, benzene, smoke, and especially carbon monoxide (CO). The MQ135 operates based on the principle of resistance changes that occur when the target gas is detected, which are then converted into electrical signals for further analysis (Zidni et al., 2022).

This project aims to design and implement an air quality monitoring system using the MQ135 sensor to detect the presence of carbon monoxide. By utilizing this sensor technology, the developed system is expected to provide real-time air quality data that can be accessed by both the public and authorities for better decision-making in environmental management and public health.

A previous study conducted by Budianto (2024) The method use in this research is the research and development method, which included system design, device construction and integration, web-based application development, and system testing. The device consisted of a sensor circuit, NodeMCU ESP8266, Arduino Uno, and an LCD display. The results showed that the monitoring system successfully detected several gas parameters (CO_2 and CO), dust particles, temperature, and humidity. The air quality data obtained from the sensors were displayed in real time and stored in a database. Testing with different numbers of people showed that the system performed effectively when gas concentrations were within the sensor's detection range.

Another study by Rochmania and Yantidewi (Rochmania et al., 2021) was an experimental study aimed at developing and examining the operation of an IoT-based CO_2 monitoring device. The research began in November in two different locations, Panekan (Magetan Regency) and Ketintang (Surabaya City). The method used was a quantitative experimental approach, employing the developed monitoring device and comparing its performance with a reference tool, the "Air Quality Detector," which can detect CO_2 levels.

The difference between these previous studies and the present research lies in the use of the MQ135 sensor combined with the ESP8266 microcontroller to detect carbon monoxide in an IoT-based system utilizing the Blynk platform.

Methods

Materials
The equipment used in this experiment includes the MQ135 sensor, ESP8266, connecting cables, hot glue, and a power bank. Figure 1 shows the flow diagram of this study.

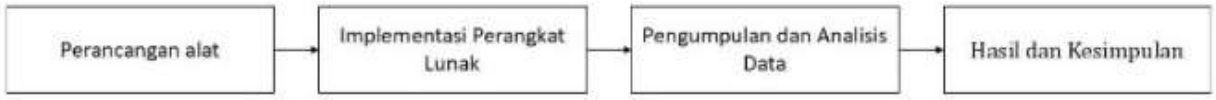

Figure 1. Research flow diagram

Device design
The first step of implementation is connecting the MQ135 sensor to the ESP8266 module using the following configuration GND (MQ135) to GND (ESP8266), VCC (MQ135) to 3.3V (ESP8266), and AOUT (MQ135) to A0 (ESP8266). A voltage regulator is used to provide a stable 5V supply for the MQ135 and 3.3V for the ESP8266. Once the connections are secure and stable, the circuit is checked to ensure there are no wiring errors. The system is then configured to transmit air quality data via Wi-Fi. Figure 2 shows the hardware design.

Figure 2. Hardware design

Programming
Firmware development was conducted using the Arduino IDE, with the program written in C/C++ for the ESP8266 microcontroller. The code initializes the MQ135 sensor, acquires analog input data from pin A0, and processes the values to monitor air quality levels. After being uploaded via USB, the ESP8266 functions autonomously, transmitting data to the server via Wi-Fi. The Arduino IDE provides a wide range of libraries and development tools, which significantly streamline the process of coding, debugging, and deployment.

Calibration
The MQ135 sensor was calibrated to detect carbon monoxide (CO) by adjusting the code parameters to achieve more accurate readings. The program was uploaded to the ESP8266 via the Arduino IDE to read the analog values and convert them into CO concentration data. Calibration testing demonstrated the sensor's sensitivity to fluctuations in CO levels, ensuring its accuracy and reliability in monitoring air quality. These results support its potential application in air pollution control.

In addition, calibration was also performed using an external application to verify CO levels, namely an Android-based app called CO CHECKER. Figure 3(a) shows the initial display of the CO CHECKER application.

Connecting to Blink
The ESP8266 was connected to the Blynk application using the Blynk library. This library simplifies integration and communication, enabling sensor data to be transmitted in real time to the Blynk dashboard for monitoring via m obile devices (Dwi Prasetyo et al., 2021).

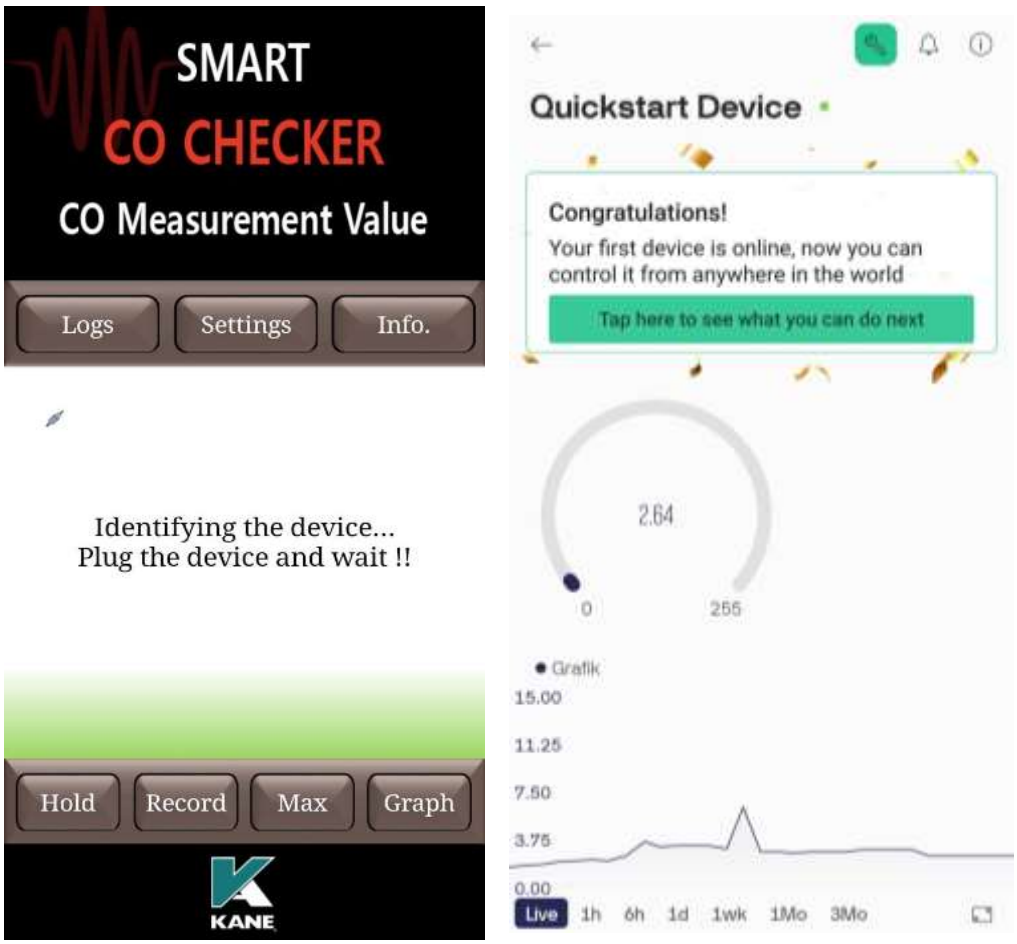

Figure 3. (a) Home screen of the CO CHECKER application (b) Display on the Blynk Platform

The code in the Arduino IDE was used to initialize Wi-Fi on the ESP8266 and configure communication with the Blynk server. Data from the MQ135 sensor was periodically sent to the Blynk application, allowing direct air quality monitoring through a user-friendly interface. Features such as notifications and data graphs help users interpret environmental conditions and respond quickly to changes. This integration ensures efficient and accessible sensor data monitoring (Pranatha, 2021). Figure 3(b) shows the Blynk interface after being connected to the MQ135 sensor.

Results and Discussions

Table 1 presents the results obtained from CO concentration readings by the MQ135 sensor indoors. Implementation of the MQ135 sensor for measuring carbon monoxide (CO) in air using the Blynk platform has shown positive results in this experiment. The MQ135 sensor, after being carefully calibrated with CO gas samples of known concentrations, was able to provide fairly accurate and consistent CO concentration readings. The test results indicated that the sensor was responsive to changes in CO concentration within a relatively short time, enabling the Blynk application to display real-time data with high accuracy.

Table 1. Results of Indoor CO Detection

Time	Sensor Value	Voltage	Resistance	CO (ppm)
01:41:47.828	37	0.12	266.49	2.26
01:41:48.911	37	0.12	266.49	2.26
01:41:49.901	40	0.13	245.75	2.49
01:41:50.890	33	0.11	300.00	1.97

Time	Sensor Value	Voltage	Resistance	CO (ppm)
01:41:51.925	33	0.11	300.00	1.97
01:41:52.915	31	0.10	320.00	1.82
01:41:53.902	24	0.08	416.25	1.34
01:41:54.940	30	0.10	331.00	1.75
01:41:55.928	29	0.09	342.76	1.68
01:41:56.916	30	0.10	331.00	1.75
01:41:57.905	30	0.10	331.00	1.75
01:41:58.941	32	0.10	309.69	1.89
01:41:59.930	33	0.11	300.00	1.97
01:42:00.918	36	0.12	274.17	2.19
01:42:01.955	37	0.12	266.49	2.26
01:42:02.942	38	0.12	259.21	2.34
01:42:03.932	37	0.12	266.49	2.26
01:42:04.969	42	0.14	233.57	2.64
01:42:05.957	56	0.18	172.68	3.77
01:42:06.950	51	0.16	190.59	3.36
01:42:07.943	52	0.17	186.73	3.44
01:42:08.934	52	0.17	186.73	3.44
01:42:09.974	52	0.17	186.73	3.44
01:42:10.963	49	0.16	198.78	3.20
01:42:11.952	85	0.28	108.95	6.49
01:42:12.943	46	0.15	212.39	2.96
01:42:13.979	46	0.15	212.39	2.96
01:42:14.968	45	0.15	217.33	2.88
01:42:15.957	46	0.15	212.39	2.96
01:42:16.992	46	0.15	212.39	2.96
01:42:17.983	46	0.15	212.39	3.11
01:42:18.970	48	0.15	203.13	3.11
01:42:19.961	48	0.15	203.13	3.11
01:42:20.273	42	0.14	233.57	2.64
01:42:24.067	42	0.14	233.57	2.64
01:42:24.956	42	0.14	233.57	2.64
01:42:25.985	42	0.14	233.57	2.64
01:42:27.019	42	0.14	233.57	2.64

Time	Sensor Value	Voltage	Resistance	CO (ppm)
01:42:28.012	42	0.14	233.57	2.64
01:42:29.007	42	0.14	233.57	2.64
01:42:29.999	42	0.14	233.57	2.64

The data displayed on the Arduino IDE serial monitor corresponds to the data shown on the Blynk platform and has been successfully converted into a graphical form through Blynk. Figure 4 shows the graph displayed by the Blynk application.

Figure 4. Graph displayed on Blynk application

This monitoring system is capable of providing real-time data that is relevant for comparing air quality in two different environments. By utilizing an IoT platform such as Blynk, users can continuously monitor changes in air quality and receive notifications when CO concentrations exceed hazardous thresholds for health. The MQ135 sensor is also sensitive to other gases such as ammonia and carbon dioxide, which may affect the accuracy of CO detection. Therefore, improvements in data processing algorithms and filtering are required to enhance accuracy.

The Wi-Fi connection on the ESP8266 proved to be stable during testing, with no significant data loss, demonstrating the reliability of this device for continuous air quality monitoring. The Blynk application makes it easier for users to monitor real-time data from anywhere. To improve reliability and accuracy, better data management and evaluation of environmental factors are needed. This implementation provides a strong foundation for the development of air quality monitoring technology based on the MQ135 sensor and Blynk.

Conclusion

This study demonstrates that the IoT-based air quality monitoring system, employing the MQ135 sensor and ESP8266 microcontroller, is effective in detecting carbon monoxide (CO) concentrations and monitoring air quality in real time. The system provides timely notifications when pollution levels exceed safe thresholds, making it a valuable tool for environmental health management. Despite its promising results, the sensor's cross-sensitivity to other gases remains a limitation, highlighting the need for improved data filtering and calibration methods. Future work may focus on enhancing system accuracy, expanding gas detection capabilities, and integrating cloud-based data analytics for broader environmental applications.

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