Monitoring of Gas Levels and Air Cleaner Based on IoT

Abdhul Nur Hidayat[1], Marti Widya Sari[1,*], R. Hafid Hardyanto[1], Banu Santoso[2]

[1]*Faculty of Science and Technology, Universitas PGRI Yogyakarta*
Jl. PGRI I No. 117, Sonosewu, Yogyakarta, 55182, Indonesia
[2]*Faculty of Computer Science, Universitas AMIKOM Yogyakarta*
Jl. Ring Road Utara, Condongcatur, Sleman, Yogyakarta, Indonesia
[*]*Corresponding author: marti@upy.ac.id*

ABSTRACT
A The level of air quality in a place makes a measure of cleanliness against air pollution. Likewise with closed areas such as indoors. The percentage of gas trapped in the room is much higher than in the open. This is because in the area there is activity in and out of the air that can cause air pollution so that the potential for trapping carbon monoxide gas (CO) is very high. Based on these conditions, it is necessary to create a monitoring system for CO gas levels in the room. In this study, a co gas level Monitoring System was Created and Indoor Air Purifiers with Real-Time Methods Based on the Internet of Things (IoT). The gas sensor used is the MQ-135 and MQ-7 which is coupled with the Arduino Uno microcontroller. For real-time data delivery lines are used WiFi module ESP8266. Data that has been retrieved by the sensor will be stored on the Website through ESP8266. After going through a series of tests on Monitoring Gas Levels and Air Purifiers in IoT-Based Rooms obtained satisfactory results. From the results of the trial, the system can perform all the processes that are in the design. Detecting gas levels in the form of alcohol, cigarette smoke, LPG gas, the device can also send warning alarm notifications and turn on fans when there are gas levels that exceed the safe limit. Based on the monitoring results, the value of CO and CO2gas levels in the room is quite high, with an average value of 1100.5 ppm and the highest value is at 1400.9 ppm.

***Keywords**: Monitoring, PHP, Carbon monoxide, Carbon dioxide, MySQL, IoT*

1. INTRODUCTION

Air is one of the sources of human life that can be obtained freely. Good air quality can affect human health and activities [1], [2]. The increasing number of transportation equipment in the form of motor vehicles resulted in an increase in air pollution [3]. Air molecules that have been filtered or have been decomposed that were previously polluted air make clean. By changing the quality of polluted air makes clean air called air dispersion [4], [5]. The World Health Organization (WHO) states that there are substances hazards derived from buildings, construction materials, equipment, combustion processes or Heating can trigger health problems. [6]. This research is a development of the research that has been done. Previously produced a prototype air quality detector using sensors and microcontrollers [6], [7]. In major cities, the contribution of vehicle exhaust gases Motorized as a source of air pollution reaches 60-70%. While the contribution of exhaust gases from the chimney The industry only ranges from 10-15%, the rest comes from other sources of combustion, such as from households, burning garbage, forest fires, etc. [8]. Documented periodically and objectively based on existing rules on operating facilities and practices related to the phasing of environmental needs [9]. The air quality index value becomes the main concern for major cities. It's because the value becomes a benchmark for the level of health and comfort of a area [10]. Carbon dioxide (CO2) and H2O. Carbon monoxide and carbon dioxide are dangerous gases if inhaled beyond the limits.

A. Kusuma Wardana (ed.), *Proceedings of the 2023 International Conference on Information Technology and Engineering (ICITE 2023)*, Advances in Intelligent Systems Research 179,
https://doi.org/10.2991/978-94-6463-338-2_29

safe [11], [12]. Air quality data monitoring features through Internet of Things (IoT) platform [13] With indoor type or basement in order to accommodate Parked vehicles. Conditions like this resulting in the quantity of human interaction With the surrounding environment being very tall [14]. Previous research. One of them Is research on IoT (IoT) technology [15].This tool detect using real-time methods. Then the data obtained will be sent to the Thingspeak cloud with IoT-based. The detection system will provide notifications to users.

2. MATERIALS AND METHODS

2.1. Materials

The materials used in this study are hardware and software equipment. Hardware is needed to design internet-based systems that use Arduino microcontrollers, Fan and Mq-135 gas sensors to read data from gas concentrations, and ESP 8266 modules for connection to the internet. At the same time, the software tools used include Arduino IDE, PHP for creating a web-based system view, then MYSQL software for managing and creating databases from the server side that contain various information using the SQL language.

2.2. Methods

Primary data collection method by observing directly in the field. Observing is not only seeing, but also recording, calculating, measuring, and recording events. The observation method can also be interpreted as the observation and recording systematically of the phenomena studied, techniques or approaches to obtain primary data by directly observing the data object. The methods used in data collection are interviews, observations, library study analysis, and internet browsing analysis as shown in the Flowchart Figure 1.

The data analysis methods that will be carried out in this study are model design, model testing, and analysis of the resulting model. A test model to develop an IoT-based indoor air quality monitoring system in a hygiene benchmark against air pollution by detecting Co and Co2 gases that have been made. Next, analyze the results associated with the hardware model simulation and review the results.

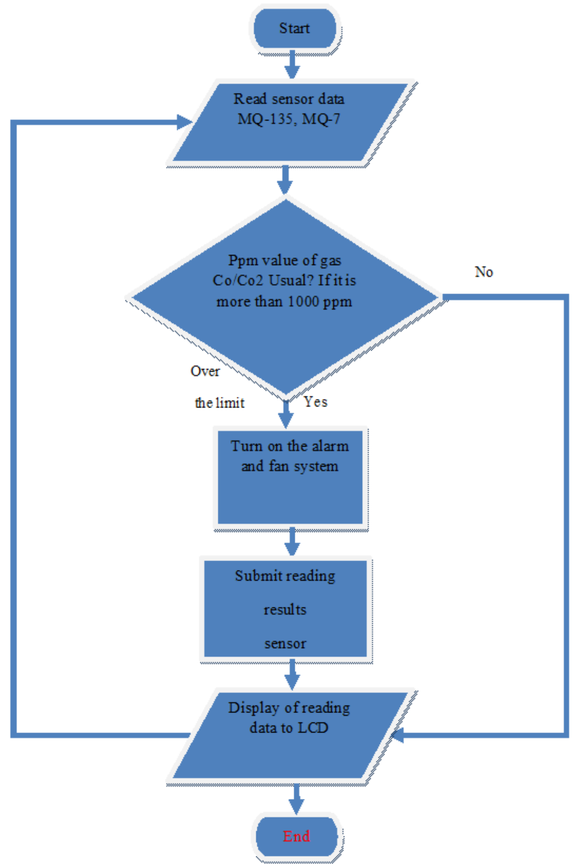

FIGURE 1. System Design Flowchart

3. RESULTS AND DISCUSSION

The results of system modeling are presented in Figure 2. The air quality monitoring system modeling was designed by involving several devices such as the MQ-135 gas sensor for Co (Carbon Monoxide) and MQ-7 for Co2 (Carbon Dioxide), 16x2 LCD and 05v DC Fan, Buzzer for alarm, and ESP8266 for connection access to the data base.

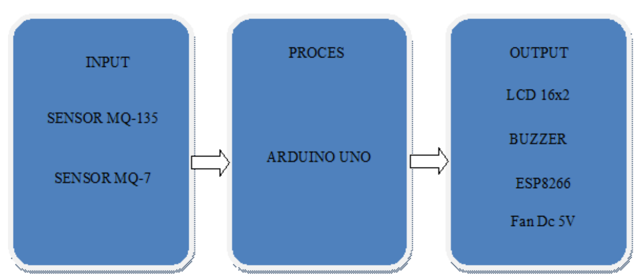

FIGURE 2. System Model

System design is system proposed by the researcher based on the study of literature studies and location surveys conducted in stages previously. The design of this Internet of Things-based air quality monitoring (IoT) system uses the ESP8266 module as a microcontroller and website as a control or monitoring tool. This system consists of a carbon monoxide detector (Co)and a carbon dioxide detector (Co2) previously.

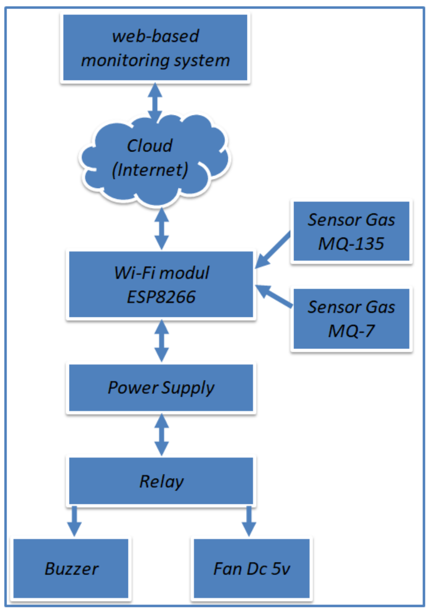

FIGURE 3. System planning

The way this system works is:

• Power Supply will provide energy to the system through arduino uno relays and modules, so that all equipment can work and function properly.

• Arduino UNO microcontroller will read the gas (Co)carbon monoxide with the help of the MQ-135 sensor, detect the movement (Co2) of carbon dioxide around MQ-7 and then send the data to a web database in PPM format (parts-per million) to then display on the website.

• The ESP8266 module will also read commands that have been sent by the Website Server in TCP / IP format which will then be changed by providing "HIGH" or "LOW" logic on certain Pins by relays to set on / off bazzers and fans.

• Cloud (internet) by utilizing WiFi to be the center of connection between the system and the website, with this system system can run as expected.

3.1. HARDWARE DESIGN

The study used a series consisting of esp8266 microcontrollers, buzzers, jumper cables, MQ-135, MQ-7, and dc5v fans, LCD displays and LED lights. A schematic image of the component circuit is presented in the following figure.

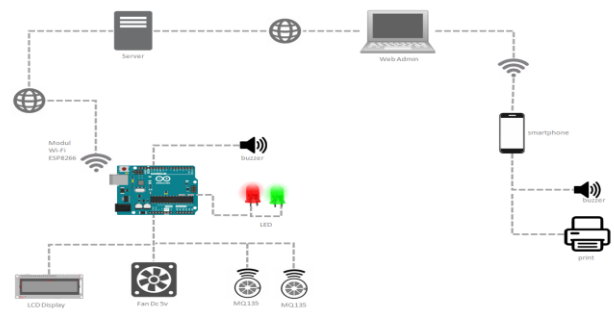

FIGURE 4. Component scheme

The following is a series of image connections resulting from the design of gas cylinder leak detection warning devices with ARDUINO UNO-based ESP8266

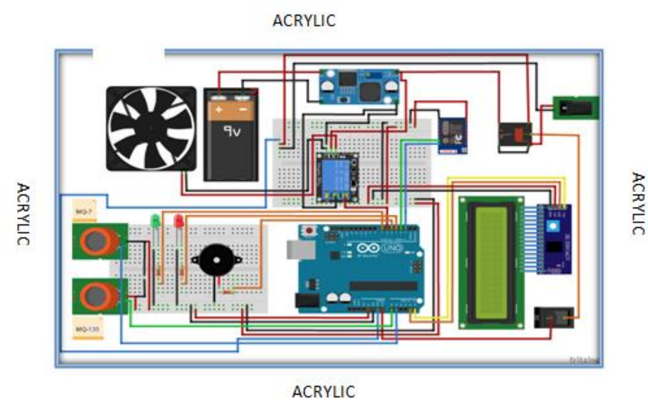

FIGURE 5. Connection Design

a. The TX I/O (Input/Output) Pin on the Arduino is connected to the RX Pin on the ESP8266 as the data receiving path from arduino to ESP8266.

b. The RX I/O (Input/Output) Pin on the Arduino is connected to the TX PIN on the ESP8266 as the data delivery path from esp8266 to Arduino.

c. Analog0 on Arduino is connected to MQ-135 on ESP8266 as the sending and receiving channel of carbon monoxide gas data (Co) from ESP8266 to Arduino.

d. Pin 6 on the Arduino is connected to the 5 V DC Fan pin on the Relay as the activation channel and off from arduino to ESP8266.

e. Analog1 on arduino is connected with MQ-7 on ESP8266 as the sending and receiving channel of carbon dioxide gas data (Co2) from ESP8266 to Arduino.The following is a series of image connections resulting from the design of gas cylinder leak detection warning devices with ARDUINO UNO-based ESP8266

This system uses Arduino UNO, buzzer and also air sensor quality tool. When the gas level approaches the sensor, the system then Arduino UNO will send data for the next buzzer will give a notification in the form of sound and LED lights that turn on.

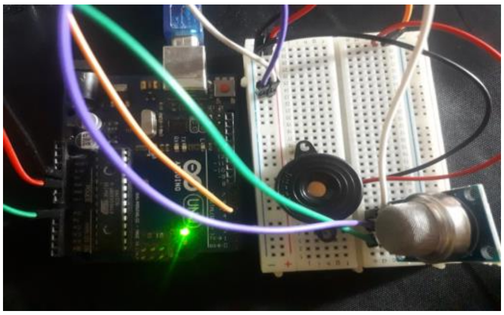

FIGURE 6. Whiteboard circuit

The assembly of this admin tool uses several components, namely Arduino UNO, and also MQ-135 and MQ-7 sensors. Tool assembly can be seen the design of this mechanical tool aims to find out the placement and installation of sensor devices.

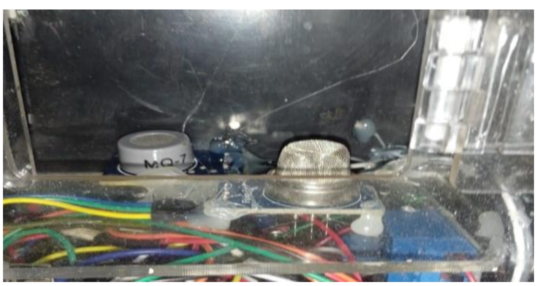

FIGURE 7. Design Sensor

Mechanical realization is shown in the figure below, the assembly of this gas sensor connection tool uses several components, namely arduino uno, jumper cable, Battray Holder, relay, Stepdown and also ESP8266 Tool assembly can be seen in the image, This room is designed with small dimensions so that gas sensors can detect quickly in case of leaking gas carbon monoxide detector (Co)and a carbon dioxide detector(Co2).

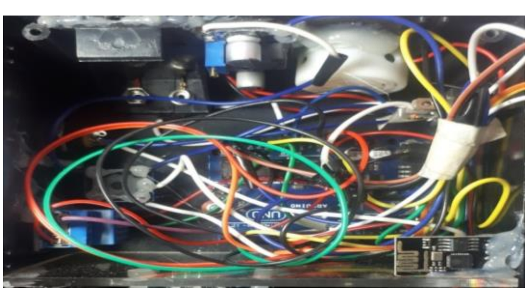

FIGURE 8. Connection ESP8266

The most important circuit for electronic systems is a power supply is a device that serves to convert AC current into DC current the source of electrical voltage derived from a 5V 2 amper adapter through the arduino jack so that the series of module devices can turn on.

FIGURE 9. Adaptor 5V 2 amper

The realized mechanic is in the form of a mockup of a square with dimensions of 55cm x 30cm x 5cm by using acrylic material 1.3cm thick for room building and square plastic for microcontroller runway.

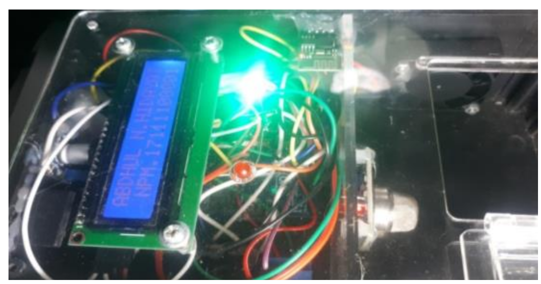

FIGURE 10. Connection ESP8266

Realization for gas sensors and buzzers, When the device detects air pollution levels that do not exceed the limits the device will still read but only through the LCD screen of the monitor and not sent to the database the room is equipped with a gas sensor and buzzer.

FIGURE 11. Design Room

The Admin Web Login Page view on the admin web is a page to sign in to the system in a way
Enter your username and password. The login page can be seen in the Page image used by the admin to perform the admin login process. Admin login forms are used as protection to protect admin forms from unauthorized people. This form serves to enter the web by entering.

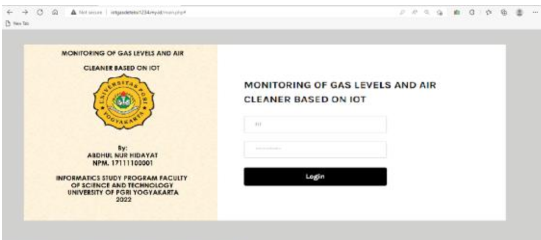

FIGURE 12. Halaman Login

The home page is the initial view after the admin or user is logged in. This page is the view of the web homepage used. in the form of a page displaying a description of the date and time when carbon monoxide (Co) gas or (Co2) carbon dioxide was detected in PPM units through the ESP8266 Wi-Fi network module connected to the MQ-135 and MQ-7 sensors that automatically transmit data on the amount of gas when it exceeds the safe threshold of 1000PPM for humans according to the journal health.

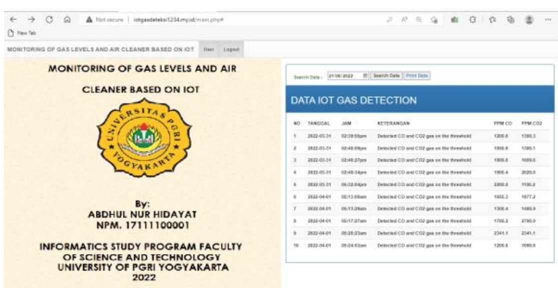

FIGURE 13. Halaman Beranda

This page is a page that displays a list of user names registered in the gas level monitoring application in the IoT-based room each user can add, edit, delete, or read gas levels by the admin in accordance with the application user data of the registered user.

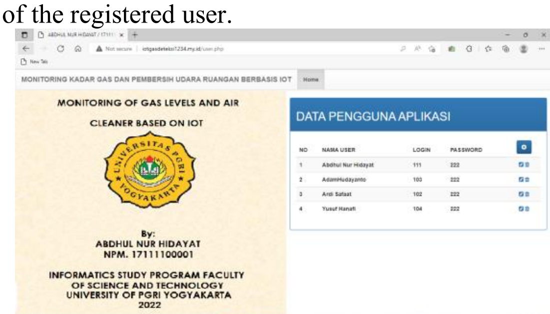

FIGURE 14. Halaman Nama User

This page is a page that displays the data search page that has been detected by gas sensor devices based on the safe limits of gas levels that have been created by admin according to the journal of environmental health of air pollutants. Based on the table below shows that the gas concentration test according to the test and gas conversion calculations have an average difference of 1200.5 ppm (parts per million) from the test the gas concentration.

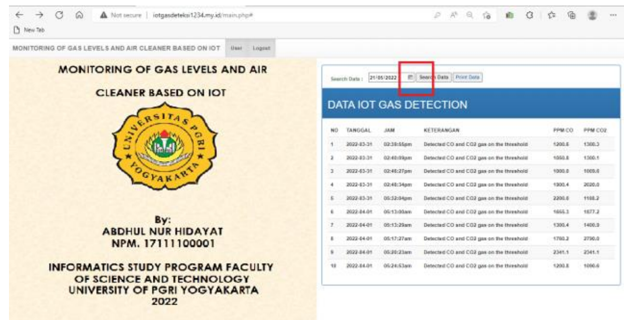

FIGURE 15. Location Utilization

CONCLUSION

The study concluded that this study has successfully built a prototype system of gas levels monitoring in the room with IoT-based, webserver Applications that as a whole function well the system can monitor cigarette smoke, alcohol, LPG gas, webserver application users can regulate a person's access rights to the room. In addition, a web-based system has been built that can be used to detect and monitor air pollution in addition to the buzzer warning alarm and exhaust 5v dc fan also works well so that air pollution can be detected so as to minimize the danger due to gas leaks because gas level monitoring devices are placed indoors. The results of testing the Prototype System monitoring gas levels in the room based on IoT showed that the system can run well..

ACKNOWLEDGMENTS

We want to thank the Faculty of Science and Technology, and the Institute of Research and Community Services (LPPM) Universitas PGRI Yogyakarta for supporting this research.

REFERENCES

[1] C. Arnold, D. Kiel, and K. Voigt, “Innovative Business Models for the Industrial Internet of Things,” 2017, doi: 10.1007/s00501-017-0667-7.

[2] T. Kurfess, “A brief discussion on the trends of habilitating technologies for Industry 4.0 and Smart manufacturing,” *Manuf. Lett.*, vol. 15, pp. 60–63, 2018, doi: 10.1016/j.mfglet.2018.02.011.

[3] X. Xiao, W. Shufang, Z. Le-jun, and F. Zhi-yong, "Evaluating of dynamic service matching strategy for social manufacturing in cloud environment," *Futur. Gener. Comput. Syst.*, vol. 91, pp. 311–326, 2019, doi: 10.1016/j.future.2018.08.028.

[4] P. Zheng *et al.*, "Smart manufacturing systems for Industry 4 . 0 : Conceptual framework , scenarios , and future perspectives," vol. 13, no. 2, pp. 137–150, 2018.

[5] Y. Lu, "Journal of Industrial Information Integration Industry 4 . 0 : A survey on technologies , applications and open research issues," *J. Ind. Inf. Integr.*, vol. 6, pp. 1–10, 2017, doi: 10.1016/j.jii.2017.04.005.

[6] P. Jiang, K. Ding, and J. Leng, "Towards a cyber-physical-social-connected and service-oriented manufacturing paradigm : Social Manufacturing," *Manuf. Lett.*, vol. 7, pp. 15–21, 2016, doi: 10.1016/j.mfglet.2015.12.002.

[7] Y. Zhou, G. Xiong, T. Nyberg, B. Mohajeri, and S. Bao, "Social Manufacturing Realizing Personalization Production : A state-of-the-art Review," *2016 IEEE Int. Conf. Serv. Oper. Logist. Informatics*, pp. 7–11, 2016, doi: 10.1109/SOLI.2016.7551653.

[8] G. Xiong, S. Member, F. Wang, T. R. Nyberg, and X. Shang, "From Mind to Products : Towards Social Manufacturing and Service," *IEEE/CAA J. Autom. Sin.*, vol. 5, no. 1, pp. 47–57, 2018, doi: 10.1109/JAS.2017.7510742.

[9] P. Jiang and J. Leng, "The configuration of social manufacturing : a social intelligence way toward service-oriented manufacturing Pingyu Jiang * and Jiewu Leng," *Int. J. Manuf. Res.*, vol. 12, no. 1, pp. 4–19, 2017.

[10] W. Guo and P. Jiang, "ScienceDirect Product Service Systems for Social Manufacturing : A new service system with Product Service Systems for Social Manufacturing : A new service system with Manufacturing : A new new service service system system with with Product Service Servi," *IFAC Pap.*, vol. 52, no. 13, pp. 749–754, 2016, doi: 10.1016/j.ifacol.2019.11.205.

[11] X. Shang *et al.*, "Social Manufacturing for High-end Apparel Customization," *IEEE/CAA J. Autom. Sin.*, vol. 5, no. 2, pp. 489–500, 2018, doi: 10.1109/JAS.2017.7510832.

[12] K. D. P. Jiang, "Social Sensors (S 2 ensors): A Kind of Hardware-Software- Integrated Mediators for Social Manufacturing Systems Under Mass Individualization," *Chinese J. Mech. Eng.*, 2017, doi: 10.1007/s10033-017-0167-4.

[13] B. Santoso and M. W. Sari, "Design of Student Attendance System Using Internet of Things (IoT) Technology," in *Journal of Physics: Conference Series*, 2019. doi: 10.1088/1742-6596/1254/1/012064.

[14] K. Ding, P. Jiang, and S. Su, "RFID-enabled social manufacturing system for inter-enterprise monitoring and dispatching of integrated production and transportation tasks," *Robot. Comput. Integr. Manuf.*, vol. 49, no. July 2017, pp. 120–133, 2018, doi: 10.1016/j.rcim.2017.06.009.

[15] M. W. Sari, Herianto, I. G. B. B. Dharma, and A. E. Tontowi, "Design of Product Monitoring System Using Internet of Things Technology for Smart Manufacturing," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 835, pp. 1–7, 2020, doi: 10.1088/1757-899X/835/1/012048.