http://infor.seaninstitute.org/index.php/infokum/index
JURNAL INFOKUM, Volume 9, No.1, Desember 2020 ISSN : 2302-9706

APPLICATION OF SMART ENVIRONMENT WITH FUZZY LOGIC METHOD BASED ON INTERNET OF THINGS

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Abstract

In Indonesia, air pollution is a very concern, many risks are resulting from air pollution, including the risk of blood cancer. But many people are not aware of this as a result, many are affected by respiratory infections, asthma, and lung cancer due to air pollution. Along with technological developments, a new concept emerged, namely the Internet of things, from the development of the Internet of Things, which resulted in many discoveries, one of which was the Smart Environment. With Smart Environment we can monitor the quality level of an environment, one of which is air quality. The amount of information related to air pollution is the reason for the author to make a tool that uses the Nodemcu microcontroller-based MQ7 sensor which is expected to help reduce the risk generated from air pollution, especially carbon monoxide (CO). This tool also applies the concept of the internet of things so that the results of sensor readings can be monitored online from anywhere and anytime in realtime. There is a classification of air pollution levels in this tool including healthy air, unhealthy air, and dangerous air, healthy air is in the value range 0-100 PPM, unhealthy air is in the value range of 100-200 PPM, and dangerous air is in the value range> 200 PPM. Fuzzy logic was chosen as the method in this research because this method is suitable for most real-time problems such as making decisions to determine the level of air pollution that is uncertain and changing. The results of the MQ7 sensor detection of carbon monoxide are monitored through the Indonesian-made Internet of Things platform, Antares.id.
Keywords*:* internet of things, smart environment, MQ7, node mcu, fuzzy logic

1. Introduction

Air is one of the sources of life for living things that are given by God and can be obtained freely. The good and bad quality of air can affect human health and activities. Clean air can make a person feel comfortable in being, so they can do activities properly and healthily. Since a long time ago, air pollution in Indonesia has been very worrying, there are so many risks resulting from air pollution, one of the most dangerous is the risk of blood cancer. But many people do not realize this, as a result many are affected by respiratory infections, asthma, and lung cancer due to air pollution.

With the development of the digitalization era, monitoring everything can be done from anywhere by utilizing the concept of the Internet of things, from the development of the Internet these things have resulted in many discoveries, one of which is the Smart Environment. With the Smart Environment, we can assess the level of environmental quality, one of which is air quality. A lot of information related to air pollution is the reason for the author to make a tool that uses the Nodemcu microcontroller-based MQ7 sensor which is expected to help reduce the damage caused by air pollution, especially carbon monoxide (CO).

On this occasion, in connection with the application of technology to monitor air pollution, a tool was designed to monitor air pollution levels, especially carbon monoxide (CO). This tool uses the MQ7 sensor and is based on the NodeMCU microcontroller which is expected to help reduce the risk generated from carbon monoxide.

By applying the concept of the internet of things, the results of sensor readings can be monitored online from anywhere and anytime in realtime through the Internet of things platform, namely Antares.id. The fuzzy method is applied to this tool to perform the classification process of carbon monoxide levels

2. Literatur Riview

Air is an important aspect of human life and other living things. Air as an environmental component that needs to be protected and improved to provide optimal support for living things (1). The cleaner air, it will create a sense of comfort to all living things, especially humans, so that humans can carry out activities properly and happily (2). The main source of air pollution is generated from transportation, almost 15% of the pollutants produced are hydro-carbon pollutants and approximately 60% are carbon monoxide pollutants. The main pollutant is carbon monoxide which accounts for almost half of all air pollutants (3).

Internet of Things or commonly known as the abbreviation IoT can be interpreted as the ability of various devices that can connect and exchange information via the internet network. By utilizing the internet of things, it is very possible for communication, control, data sharing, a collaboration between devices by using internet connectivity which is a link between devices continuously, so that the work done by humans becomes more efficient and saves a lot of time (4). Smart environment is a part or dimension of a smart city that specializes in how to produce a smart environment. The assessment criteria here include process continuity as well as better resource management (5). NodeMcu is embedded hardware that is used quite often for IoT projects ranging from simple to complex. Three wifi modes are owned by NodeMcu, namely access point, wifi station, and both. Antares. id is a website that provides internet of things technology services. Antares.id Service in the form of a cloud which can also be used to display the parameter data being tested.

Fuzzy logic is a partial truth concept resulting from an increase in Boolean logic. The characteristic of this logic is that it has a vague value between right and wrong, black and white. So that fuzzy logic is very useful for solving problems that have a degree of uncertainty (6). In an effort to achieve certain goals, problems or problems become the basis for decision making, by selecting various alternative alternatives proposed for problem-solving so that the intended objectives can be implemented properly and effectively (7).

Based on these things, the authors made a tool to measure carbon monoxide levels using the MQ7 sensor and the Nodemcu Microcontroller with the Fuzzy Logic method. The sensor detection results will repeat on the Antares.id website page. so that carbon monoxide levels can be done in realtime.

3. Method

Fuzzy logic was chosen as the method in this research. Electronics, computer networks, and embedded systems are suitable domains for implementing fuzzy logic because fuzzy logic is a problem control system methodology. Software, hardware, or a combination, can also be a place to apply the fuzzy logic methodology (8). To make decisions, controlling mechanics and estimating something can take advantage of fuzzy logic. In a fuzzy set, there is a membership function that has a range of 0 to 1. It is different from crisp logic which has a value that is strictly true or false. Crisp logic has an emphatically false or true value. Meanwhile, fuzzy logic is logic that has a gray value or fuzziness between true or false. Crisp logic has a value of false = 0.0 and true value = 1.0, while fuzzy logic has a value of 0.0 to 1.0. Fuzzy logic can present the size of linguistic variables such as "busy", "medium", "quiet", etc (9).

The carbon monoxide level detector has 3 linguistic variables including healthy, unhealthy, and dangerous. Then an input will be obtained to the MQ7 sensor which detects carbon monoxide levels between 0-300 PPM, then linguistic variables are generated from the description of the range of values.

Table 1. Fuzzy Sets

No.	*Status Variable*	*Carbon Monoxide Levels*
1.	Healthy Air	0 - 100 PPM
2.	Unhealthy Air	100 - 200 PPM
3.	Dangerous Air	200 - 300 PPM

From the following range of values for carbon monoxide levels, when the MQ7 sensor detects carbon monoxide levels in the 0-100 range, it will display the carbon monoxide level number and the message "Healthy Air" on the Antares web. If the MQ7 sensor detects carbon monoxide levels in the 100-200 range, it will display the carbon monoxide level number and the message "Unhealthy Air" on the Antares web, likewise when the MQ7 sensor detects carbon monoxide levels at a value > 200 its will display the carbon monoxide level number and a message "Dangerous Air" on the Antares web. To simplify the process of designing tools, block diagrams are needed because block diagrams are very helpful in the design process. Therefore, a system block diagram is made as shown in Figure 1 below.

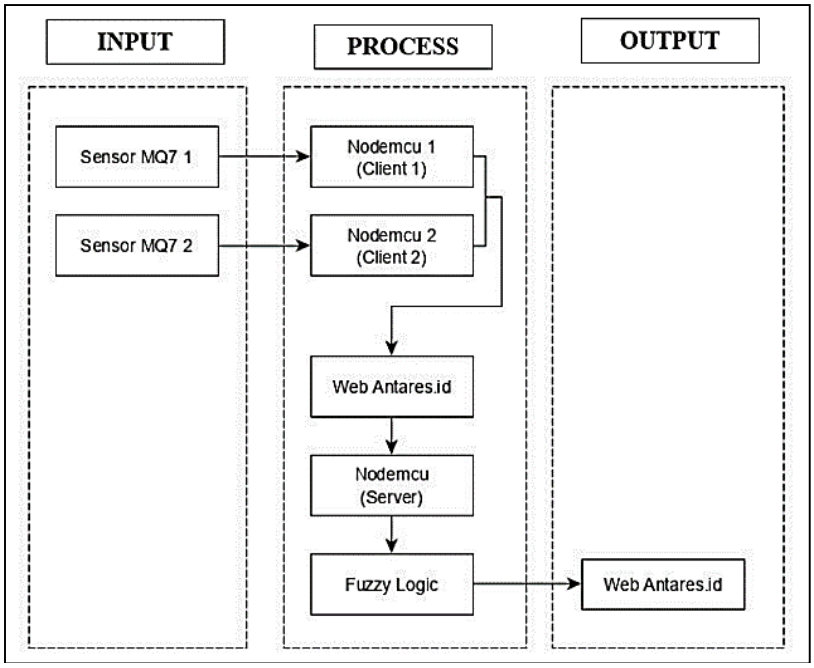

Figure 1. Block Diagram Tool

The block diagram illustrates the system for detecting carbon monoxide levels. The explanation regarding the block diagram series in the image is when the MQ7 1 and MQ7 2 sensors detect the presence of carbon monoxide, Nodemcu 1 and Nodemcu 2 process the data and send it to the Antares.id web, after the data is in Antares.id then the server takes the data and performs a fuzzy logic process after that sends the results to Antares.id web.

The system can be interpreted as a collection of elements, subsystems, or components that are related to each other which have the purpose of achieving certain goals. Therefore, a subsystem design of the system is needed. The component design is shown in Figure 2

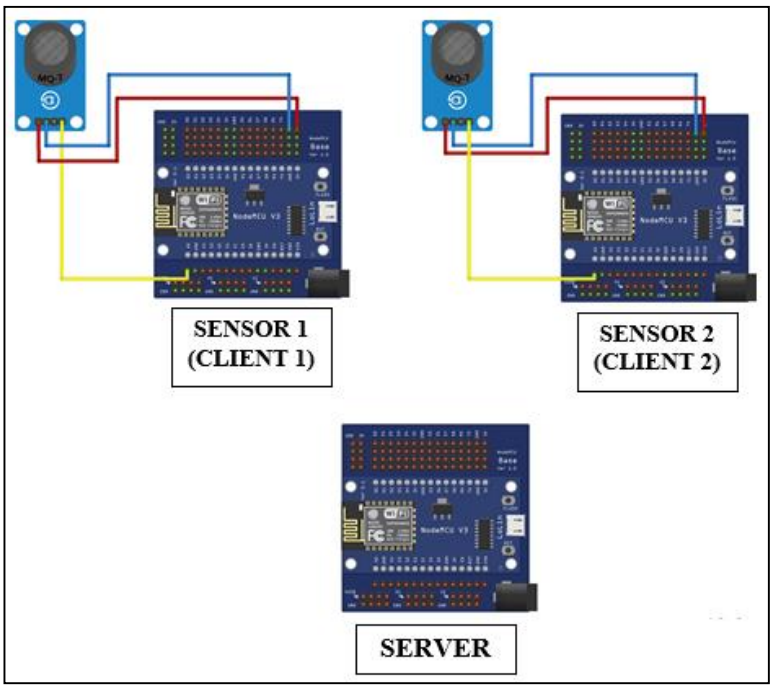

Figure 2. Design of System Components

To facilitate programming, a flowchart or flowchart is needed. With the flowchart, it can show the procedures in the programming process so that it is more focused. The flow chart will break down the programming process into smaller segments written with graphic symbols (10).

The position of component placement is the result of consideration of the level of ease of repair and replacement of components in case of damage, the ease of detecting damage in the event of a breakdown, and the level of ease of the assembly process. After the position of the component placement is determined then proceed with the working process whose final goal is the testing process (11). Therefore a flowchart of program instructions is made with the flowchart display of the carbon monoxide detector in Figure 3.Figure 3 below shows a flow chart of a carbon monoxide detector. The detection system designed is an automatic detection system using the fuzzy logic method with the output in the form of air quality information on the Antares.id website. The working principle is that after start. If the sensor is on, a repeated process occurs in determining the carbon monoxide level by the MQ7 sensor.

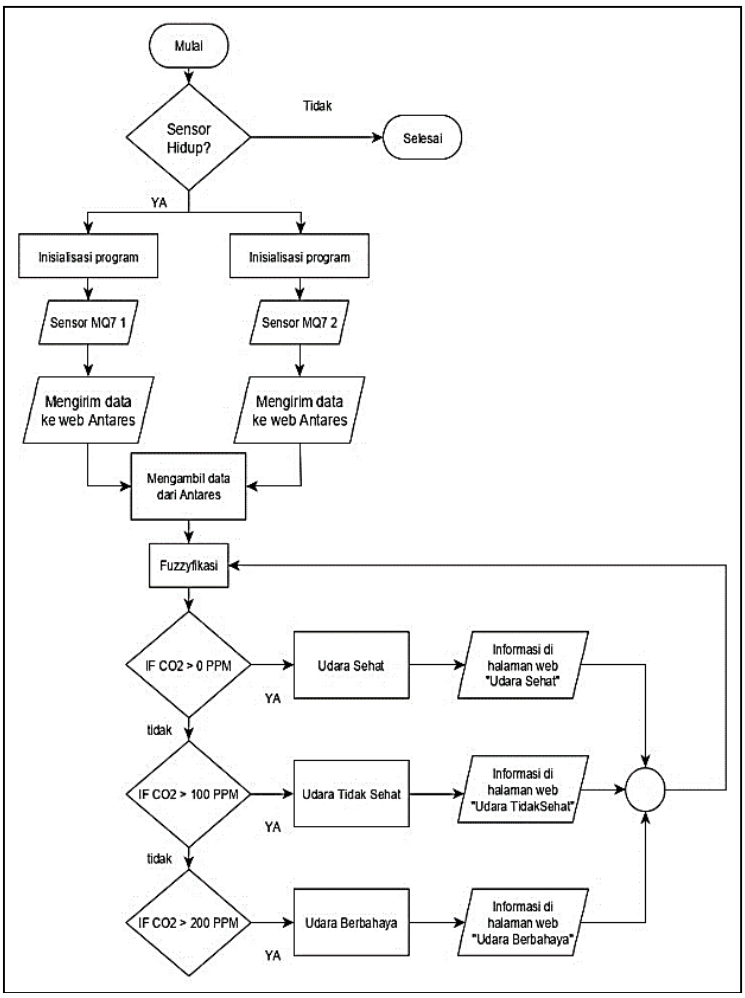

Figure 3. System Flowchart

4. Results and Discussion

From the research conducted, it was found that the sensor is good or not as an input and what factors can affect the lack of sensor performance efficiency. In addition, the susceptibility of components to Nair is a factor that can reduce the performance of the tool. However, this carbon monoxide detector can be efficiently implemented in places suspected to have high carbon monoxide levels so that it can help people avoid diseases caused by carbon monoxide with website-based information that can provide real-time information to the public in order to reduce the impact. badly due to carbon monoxide. The image below is the result of designing a carbon monoxide monitoring tool. All components of the carbon monoxide monitoring tool are properly installed and ready to run

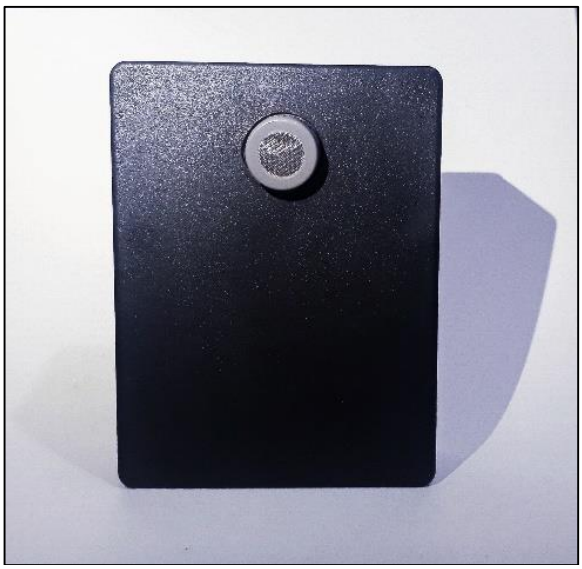

Figure 4. Carbon monoxide Detector Hardware

Hardware design is carried out on a fuzzy system which is divided into three parts. Part 1 is a series of inputs, namely the MQ7 sensor which is used to detect carbon monoxide levels. Part 2 is the microcontroller component and the Antares.id website. Nodemcu microcontroller functions to process input data from the MQ7 sensor and send it to the Antares.id website

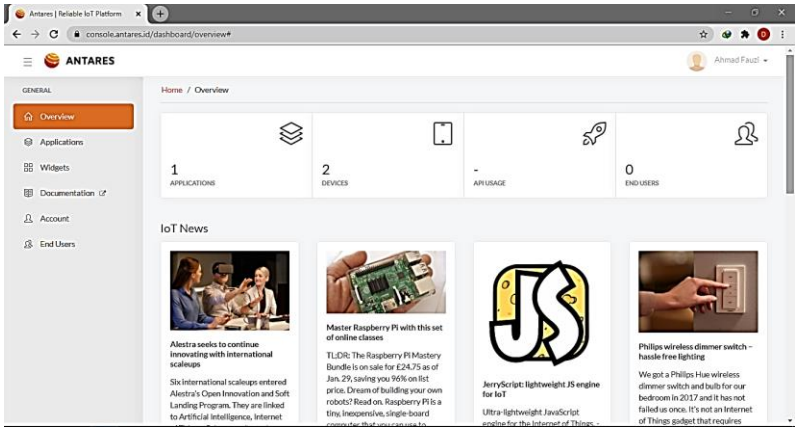

Figure 5. The appearance of the Antares.id Website

after the data has been sent to the Antares.id website en then the server which also uses the Nodemcu microcontroller retrieves data from the Antares.id website and do fuzzy processing.

Figure 6. Fuzzy logic on the Arduino IDE

Part 3, after the fuzzy process is complete, the fuzzy output results are sent to the Antares website in the form of air quality status.

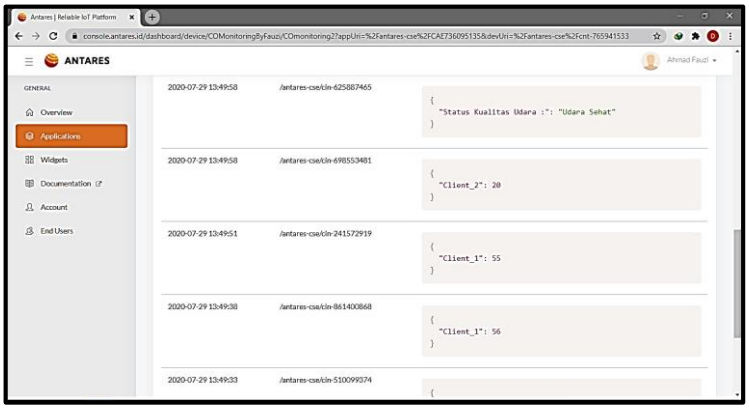

Figure 7. Test Results on the Antares.id Website

In this testing phase, two MQ7 sensors that have been placed in a place at different angles will detect carbon monoxide, then monitor it. Based on the conditions that allow it to be displayed on the Antares.id website is healthy air, unhealthy air, and dangerous air.

Table 2. Test Results

No	*Experiment Location*	*MQ7 - 1 Sensor Value*	*MQ7 - 2 Sensor Value*	*Output On the Antares.id Web*
1	Empty room	16	14	Udara Sehat
2	Room with mosquito coils	158	162	Udara Tidak Sehat
3	Smoking room	328	326	Udara Berbahaya
4	The parking lot in front of the H. Anif UIN Medan building	65	72	Healthy Air

	at 09.00-10.00 AM			
5	The parking lot in front of the H. Anif UIN Medan building at 12.00-14.00 PM	112	108	Unhealthy Air
6	The parking lot in front of the H. Anif UIN Medan building at 16.00-18.00 PM	172	168	Unhealthy Air
7	The rear parking lot of the building H. Anif UIN Medan at 09.00-10.00 AM	94	106	Unhealthy Air
8	The rear parking lot of the building H. Anif UIN Medan at 12.00-14.00 PM	147	149	Unhealthy Air
9	The rear parking lot of the building H. Anif UIN Medan at 16.00-18.00 PM	311	297	Dangerous Air
10	Postgraduate building parking at 12.00-13.00 PM	124	128	Unhealthy Air
11	Postgraduate building parking at 16.00-18.00 PM	124	128	Unhealthy Air

5. Conclusions

After conducting a literature study, analysis, design, and testing of a carbon monoxide detector using the MQ7 sensor, Nodemcu microcontroller, and the Antares web application.id with fuzzy logic, it can be concluded that this carbon monoxide detector can detect carbon monoxide levels well. The MQ7 sensor is used to detect carbon monoxide levels. If the MQ7 sensor detects carbon monoxide levels in the range 0 - 100 it will display the carbon monoxide level number and the message "Healthy Air" on the Antares website, If the MQ7 sensor detects carbon monoxide levels

in the range 0 - 200 it will display the carbon monoxide level numbers and a message "Unhealthy Air" on the Antares website, likewise when the MQ7 sensor detects carbon monoxide levels at a value> 200 its will display the carbon monoxide level number and the message "Dangerous" on the Antares website.

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