Design Of Air Pollution Monitoring Tools In Surabaya Area Based On Nodemcu

Fajar Andhika Putra
Informatics Department
East Java Veterans National Development University
Surabaya, Indonesia
fajarhandika12@gmail.com

Annisa Fahilasari
Informatics Department
East Java Veterans National Development University
Sidoarjo, Indonesia
Nicepfdlsr23@gmail.com

Parisya Shidqi Yusyarnanda
Informatics Department
East Java Veterans National Development University
Surabaya, Indonesia
klogi99@gmail.com

***Abstract*—According to data from the Central Bureau of Statistics in 2017, traffic density in Indonesia is dominated by motorbikes, with a total of 113,030,793 units, followed by private cars with 15,493,068 units, freight cars and buses. Apart from vehicles, the presence of motorized vehicles that keeps popping up has the potential to cause an increase in air pollution. This encourages to create an air pollution measuring device, where the data obtained from this tool will be sent to an application that can be used by the public. There have been many studies related to air pollution detection before. The system that is made relies on the MCU node as a data processing center. Then send data that has been captured by the sensor and processed by the MCU node using a WIFI signal. This study uses 3 sensors to detect air pollution, namely mq2 and mq9, both sensors are sensitive to gas leaks such as smoke, CO, and propane. There are 4 pins on this sensor, namely VCC, A0, D0, and ground. Of the four pins, only pin D0 will not be used because they want more accurate data. By using radio signals, this tool will be able to transmit pollution and vehicle density data directly to the monitoring center.**

Keywords—Nodemcu; sensors; air pollution; detection

I. INTRODUCTION

According to data from the Central Bureau of Statistics in 2017, traffic density in Indonesia is dominated by motorbikes, with a total of 113,030,793 units, followed by private cars with 15,493,068 units, freight cars and buses. Apart from vehicles, the presence of motorized vehicles that keeps popping up has the potential to cause an increase in air pollution. Air containing harmful elements (such as CO and NOx) will certainly affect one's health in the long run. As reported in megapolitan.kompas.com, there are six diseases that arise due to air pollution, including Acute Respiratory Infection (ARI), Asthma (respiratory tract disorders), pneumonia (wet lungs), cancer, stroke, diabetes (Pangestu, 2019) and infertility (Diyasa, 2019).

Meanwhile, the Surabaya city government has taken steps to overcome this problem, such as creating and renovating city parks and planting trees and ornamental plants along the roads in Surabaya (finansialku, 2018). At some point a videotron has also been installed which displays the Air Pollution Standard Index. However, videotron can only be placed in a few regions. This encourages the author to make an air pollution measuring device, where the data obtained from this tool will later be sent to an application that can be used by the public.

There have been many studies related to air pollution detection before. Examples include the Vehicle Pollutant Pollution Monitoring System Via Arduino-based Gadgets by (Ardianto, 2016). This research discusses air detection using Arduino microcontroller. The second study on the IoT Based Vehicle Emission Monitoring System by (Francis, 2019) this study discusses the application of MCU nodes and sensors for detection of private vehicle engines. The third research is about Greening Internet of Things for Smart Everythings with A Green Environment Life: A Survey and Future Prospects by (Alsamhi, 2018). This research discusses the prospects for environmentally friendly IoT for the future. The writer made this research as reference material for this research. The difference from previous research is that the sensors are installed on private vehicles, whereas in this study the sensors are installed at certain points in the city.

Based on the above, the authors designed an air pollution monitoring tool that can measure air pollution and provide real-time data to make it easier for the people of Surabaya to get information about the Air Pollution Standard Index, so this research can be used as a reference in building IoT-based measuring devices.

II. SCOPE

In the research the problem include:
1. The design of air pollution monitoring devices in the city of Surabaya based on Nodemcu
2. Use of Nodemuc
3. Nodemcu-based air pollution device

III. MATERIAL AND METHODS

A. *Hardware Design*

Three sensors detect gas, smoke and dust emissions from the surrounding environment. Furthermore, the sensor will convert the gas level information into electrical quantities. The signal sent by the sensor will be received by the ADC (Analog to Digital Converter) which functions as a converter of analog data to digital data. This data will then be processed by the MCU node. The processed data will be sent directly via wifi to the Android user before it is finally displayed on the device screen, as in Fig. 1.

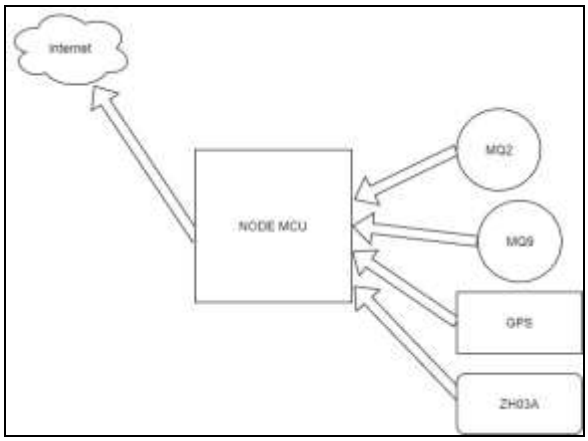

Fig. 1. Hardware Diagram Block Design

This monitoring device can be installed in vital roads that are densely motorized. This tool will monitor the level of pollution in an area, then send the results to the device of the application user who is nearby and connected to the device network.

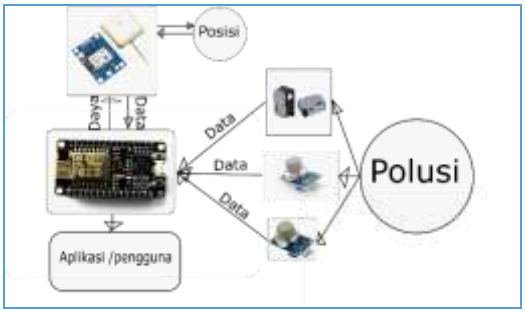

Fig. 2. Hardware Scheme Planning

Fig. 2. is a schematic depicting how the circuit works. The existing pollution will be detected by the sensor depending on the type of pollution itself. Furthermore, the sensor will send pollution concentration data to the MCU node. Finally, the MCU node will provide pollution concentration data to user applications. Position data received by the GPS module will also be sent to the user.

B. *System Design*

Our system relies on MCU nodes as data processing centers. We send data that has been captured by the sensor and processed by the MCU node using a WIFI signal.

In this study, NodeMcu is used as a microcontroller, this board has been embedded with a Wifi module so that data from the sensor can be sent directly via the internet to facilitate monitoring of the data obtained, besides that the price is relatively cheaper than other boards is also another reason why the board this is selected. Apart from the MCU nodes, here are some other modules needed in this study, as shown in Table 1.

TABLE I. MODULE LIST

1.	Sensor gas MQ2
2.	Sensor gas MQ9
3.	Sensor ZH03A
4.	GPS receiver

This study uses 3 sensors to detect air pollution, namely mq2 and mq9, both sensors are sensitive to gas leaks such as smoke, CO, and propane. There are 4 pins on this sensor, namely VCC, A0, D0, and ground. Of the four pins, only pin D0 will not be used because the author wants more accurate data

1) *GPS Reveiver*

GPS receiver is a module used to get 3D position, by looking at the position of 3 or more satellites, this module can determine latitude, longitude and latitude. This module is used to determine the position of the installed device, so that it can be monitored where the pollution data comes from, Fig. 3.

Fig. 3. GPS Reveiver

2) MCU Node

MCU node is a microcontroller that people often use for research on IoT. MCU node is the central co-coordinator of sensors and actuators. NodeMcu is equipped with a WiFi module so that it can send and receive data from the server. We use this MCU node to process data from the sensor. The data obtained is the level of dangerous gases in the air around the tool. This data is then used to determine whether the air around the appliance is at a safe level. This tool will then send the results via the app.

3) Gas Sensors MQ2

The MQ2 smoke sensor is a smoke sensor that is used as a detection sensor for Alcohol, H2, LPG, CH4, CO, Smoke, and Propane. This gas sensor is composed of SnO2 compounds, with low conductivity properties in clean air, or poor conducting properties. The conductivity of this sensor will increase if the smoke gas concentration is higher around the sensor, Fig. 4.

Fig. 4. MQ2 Sensor

4) Gas Sensor MQ9

MQ9 is a semi-conductor sensor commonly used to detect CO gas and flammable gases. This gas sensor is composed of a SnO2 compound which is a compound with low conductivity properties. This sensor detects gases by increasing and decreasing the temperature. This sensor will detect CO gas when heated to a voltage of 1.5V. Methane, propane and other flammable gases will be detected if this sensor is heated to a voltage of 5.0V, Fig. 5

Fig. 5. MQ9 Sensor

5) Gas Sensor ZH03A

The ZH03A is a common laser dust sensor module. This module uses the laser scattering principle to detect dust particles in the air. The features of this module include low error risk, real-time response and accurate data, Fig. 6

Fig. 6. ZH03A Sensor

IV. Testing And Result

The test is carried out to find out whether the tool can work according to the design or not. The sensors installed consist of semiconductor layers which are sensitive to heat. Inside the sensor element can detect the presence of gas, the sensor can change the conductivity of the gas depending on the con- Tests are carried out on the mq2 and mq9 sensors and are carried out in a closed place. The test was carried out in 2 conditions, namely in clean air and in a room full of cigarette smoke. The sensor is set to send data once every 5 seconds.

TABLE II. BEFORE CIGARETTE SMOKE

No	Node	MQ-2	MQ-9	zh03a
1	1	469	344	1
2	1	469	344	1
3	1	468	344	1
4	1	468	344	1
5	1	468	344	1
6	1	468	344	1
7	1	468	343	1
8	1	468	343	1
9	1	466	343	1
10	1	466	343	1
11	1	466	343	1
12	1	465	343	1
13	1	465	343	1
14	1	464	343	1
15	1	464	342	1
16	1	463	341	1
17	1	462	342	1
18	1	462	341	1
19	1	462	341	1
20	1	461	341	1

TABLE III. AFTER CIGARATTE SMOKE

No	Node	MQ-9	MQ-2	zh03a
1	1	559	483	1
2	1	550	496	1
3	1	560	521	1
4	1	564	528	1
5	1	555	523	1
6	1	546	522	1
7	1	538	521	1
8	1	507	491	1
9	1	474	464	1
10	1	452	452	1
11	1	437	442	1
12	1	426	435	1
13	1	416	429	1
14	1	460	447	1
15	1	488	461	1
16	1	488	477	1
17	1	494	477	1
18	1	499	482	1
19	1	502	487	1
20	1	490	494	1

Tables 2 and 3 show that up to 100 seconds the sensor has successfully read the pollution in the room. As a result, the average value obtained is that the mq9 sensor captures a value of 514.48, zh03a captures a value of 1 and mq2 is 500.72. the concentration of the gas in the air.

V. CONCLUSION

Based on the results of the design and implementation analysis, it can be concluded that: 1.) Each sensor installed can work in accordance with the design. 2.) each sensor can capture hazardous substances according to its documentation. 3.) for system development, it is suggested that later it will be able to send data to the monitoring center.

One of the ways to overcome air pollution is by raising awareness in oneself not to use motorized vehicles frequently. This air pollution detector is only a decision support tool for humans. The data recorded and displayed can be used as consideration for further decisions

VI. SUGGESTION

Suggestions for research with a title or topic that refers to this research in the future could be even better.

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