Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based on Internet of Things

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Abstract. Air pollution caused by exhaust emission of motor vehicles especially the two wheels contain a wide range of harmful gases that can cause disease. Therefore, emission tests are indispensable in controlling the emissions of gas that are loose into the air. However, not many people know the importance of emission testing. In addition to the emission results cannot store periodic data, the available emission test devices are also very limited. Therefore, the author proposes the feasibility “Test Monitoring system for motorised vehicles with Arduino-based Internet of Things”. In data retrieval use a simple linear regression method. In this tool the x-axis is the ADC value of the sensor while the y-axis is the value of gas levels. The greater the ADC value, the greater the PPM value is generated. Emission test data storage using the Internet of Things method. The Data that has been saved can be viewed through websites and Android apps. After several tests, there were 3.05% error percentage for HC gas and 3.91% for CO gas and data could be stored in the database. Overall this tool is worthy of use to measure the exhaust emissions of motorised vehicles.

Keywords: Emission Test, Simple Liner Regression, Internet of Things, Database

1. Introduction

Vehicle exhaust emissions contain hazardous substances such as HC (Hydrocarbons), CO (Carbon Monosikda), CO2 (Carbon Dioxide), and NOx (Nitrogen Oxides) compounds. These compounds can cause various diseases, including respiratory disease. In research published in the journal Lancet Planetary Health, researchers found that four million cases of asthma in children could be linked to air pollution, which accounts for about 13 percent of all cases of childhood asthma worldwide.

The Indonesian government has made efforts to address and prevent the impacts caused by motorized vehicles. One of them is to reduce the amount of exhaust gas emissions by issuing regulations regarding the threshold value of vehicle exhaust emissions which are listed in the Regulation of the State Minister for the Environment No.5 2006 [1]. In Madiun City, DLH (Dinas Lingkungan Hidup) has urged the public to carry out emission tests in several areas. However, these tests are still very limited. According to an explanation from Danang Hadiarto (Madiun, 3/12/2019), an employee of DLH Madiun City, DLH has conducted a weekly round of emission testing but only reached 90 vehicles. This is due to the limited emission testing equipment available, so that the implementation of supervision becomes less effective. In addition, the price of emission test equipment which tends to be expensive has made workshops reluctant to provide such equipment.
Even though the results of the emission test are very influential in determining the quality of the vehicle [2].

In general, the available emission test kits only display test data and are printed via a thermal printer. However, in this study by utilizing IoT (Internet of Things) as an advancement in technological development, an emission test device was made with regular data storage to make monitoring vehicle emissions easier and more orderly, with the title of research “Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based On Internet of Things” [3][4].

This research is an innovation to make emission test kits to monitor HC, CO and NOx gas levels by storing emission test results into a database periodically as a test history. The results of exhaust gas emission measurements can be monitored via the website in graphic form so that it is easy to understand and also via an Android smartphone as a medium that is always used. This research is expected to help government problems in overcoming air pollution from motorized vehicles by monitoring every exhaust emission produced regularly.

2. Research Methodology

In this chapter there is an explanation of the diagram system ” Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based On Internet of Things “, Figure 1 is the physical form of the test equipment that has been designed [5].

![Diagram System](image)

**Fig. 1. The physical form of the gas emission test equipment**

**Diagram System**

Figure 2 is a diagram of the system work that will be made for ” Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based On Internet of Things “.

![Diagram System](image)

**Fig. 2. Block diagram of the system**

The input is a reading from the sensor, namely the ADC value which will be processed and converted into ppm and% vol levels by the Arduino Mega 2560, then actuators such as air pumps, DC fans, and thermal printers are controlled via Arduino Mega. The results of the value conversion will be displayed on a TFT LCD (Thin Film Transistor) and sent to NodeMCU, the database is used to store
the results of measurement tools via a server connection. Admin can send data in the form of forms for user data and retrieve data in the form of test data from the database via a website managed by the admin. Users can retrieve data from the database to be displayed via the Android user application and After the test data and test history appear, it will display a graph testing.

3. The Result Data
At this stage, a test was conducted on the "Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based on the Internet of Things". This test was conducted to test the device installed in condition to function properly and to minimize errors that may occur. The purpose of carrying out testing is to determine the results of designing and making tools, analyzing errors and weaknesses of the tools, then comparing them so that if the system does not run according to planning it can be repaired.

a) Sensor Testing
This test aims to determine the value of the filtered ADC (Analog Digital Converter) generated by the sensor and ensure that the sensor can read the gas properly.

| No. | ADC     | Condition |
|-----|---------|-----------|
| 1   | 47 164  | Normal    |
| 2   | 46 165  | Normal    |
| 3   | 239 515 | Gassed    |
| 4   | 240 531 | gassed    |

In Table 1, it can be seen that the ADC value can filter 3 sensors when exposed to motor vehicle fumes and the value of the conversion results. From this it can be concluded that the sensor can work well.

b) Data Parsing Test and Website
This test aims to ensure that the data sent to the database via nodeMCU is sensor data that measures HC, CO, and NOX gas levels. The test method is to connect the Arduino Mega 2560 serial and NodeMCU via rx tx. Then connect the Arduino Mega and NodeMCU ports to the computer. Open each serial monitor to see the results. The results of this data transmission process are shown in Figure 3.

Fig. 3. Testing of sending serial data from Arduino to NodeMCU

Then testing the data received on the website and android application according to the planned system. The results of this test are shown in Figure 4 (website testing) and Figure 5 (Android application testing).
Figures 4 and 5 show that the website can function properly without problems in accordance with the planned system. The website has been able to display test data in real time as well as data collected periodically through the test history. Whereas in Figure 6 which is the test result of the Android application, it shows that the Android application can work properly without any constraints according to the previously planned system.
From the measurement results during 3 experiments on the same vehicle, the average percentage error is 3.05% for HC gas, 3.91% for CO gas.

### Table 2. Comparison result data

| No. | Sample motor | production year | Measured levels on the appliance | Status | The levels measured in the comparators | %error |
|-----|--------------|-----------------|---------------------------------|--------|----------------------------------------|--------|
|     |              |                 | HC (ppm) CO (%vol) NOx (ppm)    |        | HC (ppm) CO (%vol)                      |        |
| 1   | CB150R       | 2014            | 112 1.53 0.72                   | Approve| 112 1.63 0                         | 6.1    |
| 2   | CB150R       | 2014            | 112 1.9 0.7                    | Approve| 118 1.01 5                         | 5.08   |
| 3   | CB150R       | 2014            | 114.5 1.86 2.12                | Approve| 110 1.77 4                         | 5.08   |

Error average: 3.05 3.91

From table 3 it can be seen that the system works well by conducting several experiments on different vehicles. This proves that the emission test equipment that has been made can be used properly.

### Table 3. Test result data to several motorized vehicles

| No  | Sample Motor | Production Year | HC (ppm) | CO (%vol) | NOx (ppm) | Status |
|-----|--------------|-----------------|----------|-----------|-----------|--------|
| 1   | Honda Beat   | 2018            | 87       | 0.21      | 0.43      | Approve|
| 2   | Honda Vario 150 | 2015        | 95       | 1.43      | 1.16      | Approve|
| 3   | Honda Beat   | 2015            | 89       | 1.95      | 2.2       | Approve|
| 4   | Vixion       | 2012            | 110      | 2.83      | 3.96      | Approve|
| 5   | Scoopy       | 2017            | 91.5     | 2.41      | 3.12      | Approve|
| 6   | Honda Beat   | 2010            | 102      | 2.41      | 3.12      | Approve|
| 7   | Honda Beat   | 2014            | 92.5     | 2.35      | 3         | Approve|
| 8   | CBR150       | 2013            | 112      | 2.85      | 4         | Approve|

From table 3 it can be seen that the system works well by conducting several experiments on different vehicles. This proves that the emission test equipment that has been made can be used properly.

### 4. Conclusion

In research “Monitoring System of Motor Vehicle Feasibility Test Using Arduino Based On Internet of Things”, it can be concluded that:

a. The system designed to run well in accordance with the design objectives with an error rate of 3.05% for HC gas and 3.91% for CO gas.

b. Measured data can be stored in the database and monitored periodically, and the website and android application that has been created can be used properly and display data according to the readings of each sensor on vehicle emission levels.

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