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Prototype Emission Testing Tools for L3 Category Vehicle

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Abstract. The purpose of this research is to help the Department of Transportation in supplying emission testing tool which achievable and can used by citizens which mean as portable emission testing tools. This research using experimental method by measuring carbon monoxide (Co), hydrogen (Hc), and nitrogen oxide (Nox) using sensor which connected to smartphone. The result of the research is prototype vehicle emission testing tools L3 category or motorcycle category. The problem is the expensive price to get the vehicle emission testing tools. Then, comparison between emission testing tools with vehicle no comparable each other. There for, it necessary to develop alternative emission testing tools. This prototype vehicle emission testing tools using approach same parameter with existing testing tools. This tool is expected to assist the public in testing the emissions of private vehicles, before being tested by Department of Transportation.

1. Introduction

According to the Ministry of Environment of Republic of Indonesia, approximately 70% of the air pollution caused by vehicle exhausted emissions. Vehicle exhaust emissions that exceed the specified thresholds may harm health and damage the environment. Then the emissions tests performed to measure levels of exhaust gas emission conditions as well as a motorcycle. One of the vehicle type is a L3 category vehicle. L3 Category is a motorcycle with a cylinder capacity of more than 50 cm^3 or with a design maximum speed of over 50 km/h, regardless of their motive with the parameters of the chemical compound tested i.e. carbon monoxide (CO), hydrogen (HC), oxides of nitrogen (NOx) [1,3].

However, the availability of emissions testing tool for L3 category is still limited. Based on the exposure to that already described, then carried out research on the development of a prototype of the vehicle emissions testing tool category L3 was performed. By utilizing Raspberry Pi and CO, HC and NOx gas sensor module as input devices the threshold assessment of emissions in the emissions testing system, then when the system finds the smoke from a vehicle that is directed to the sensor, the system will work to measure the levels of emissions from vehicles, and Raspberry Pi will forward it to server [4, 7].

In previous studies, still has weaknesses such as the resulting data is less accurate and interface not interest because still desktop platform [2]. But, this research improved to calibrate sensors are used and to calculate of CO, HO, and NOx gas sensor more details. Then, this tools can be easy to use caused based on mobile platform.

2. Method

Construction of the prototype vehicle emissions testing tool L3 category is the development tool used for emission tests to know the information content of the substances found on the vehicle's emission L3 category that can help the emission test activities. This system using gas sensor module as input devices sampling, is associated with a mini PC Raspberry Pi are controlled through the application to process and as information output media generated from an emissions test. Prototype test emissions category L3 this user can find out the information content of the substance a hydrocarbon (HC), carbon monoxide (CO) and Nitrogen oxide (Nox) on vehicles that be compared to the raw quality of emissions, so that we can get information regarding graduation or whether the vehicle emissions test. Users can control the emissions test using the test tool application web-based. Can be show in figure 1 [4, 6, 7].

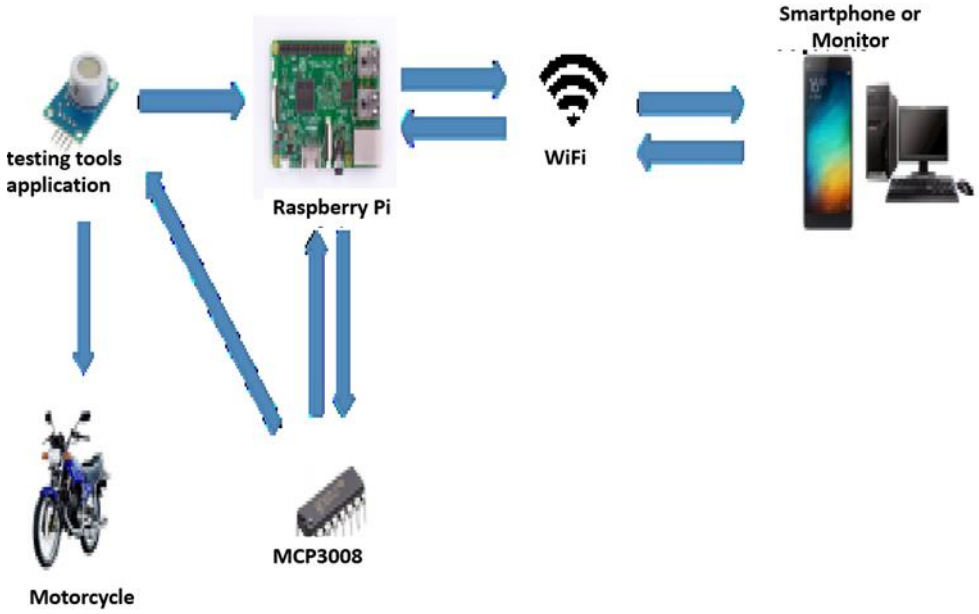

Figure 1. Architecture system.

The Smartphone screen or monitor screen as User Interface (UI) for prototype emission testing tools application using the Wi-Fi network. The captured emissions sample data will be shown in the emission testing tools application. Wi-Fi network is used as an intermediate data exchange between raspberry and Smartphone. Then, Raspberry Pi is used to control the device needed for emission sampling. Raspberry pi undertaken appropriate command instruction application test emissions. Raspberry pi sending information to the test results to the database server through the internet network. MCP3008 is used to read an analog input function to convert analog data on gas sensors to digital data. Gas sensors are used to take a sample for testing emissions. Gas sensors are used i.e. MQ-2 to detect Hydrocarbons (HC), MQ-7 to detect carbon monoxide (CO) and MQ-135 to detect Nitrogen oxide (NOx). Samples taken come from the exhaust motor which is the vehicle categories L3. The sensor is directed to the exhaust motor to take samples of emissions that would send the sample data from the sensors to the raspberries for processing [6, 7].

3. Results and discussion

This test is the Idle method where the vehicle in the condition is already lit up with normal engine rotation when the gas pedal is not pressed. In testing the tool performed 3 stages include the taking of samples from the test vehicle emissions in the test Hall, data retrieval tool prototype of emissions test sample and calculation of the difference between data drawn from tests using prototypes and test emissions. Based on government regulations regarding the emission threshold values and procedures in the sampling of emissions, then sampling is limited for 30 minutes [5].

Testing the detection of emission is the process by which a device prototype to detect the content of gas in the vehicle and display information about the contents of the vehicle emissions. These tests are done using idle method where the motorcycle in case of normal. As shown in figure 2-3.

Figure 2. Sampling using prototype.

Figure 3. Prototype emission testing tools.

The tool is taking samples for 30 seconds for the next emissions test measurements will be performed. During the process of sampling test tool using a funnel as a tool to take gas in the exhaust motorcycle. The use of the funnel meant so that during sampling no gas content only from the motor that can be measured, so that the accuracy could be better. During testing in this study used 3 types of gas content container so that you can note the difference on each container, in order to know which are the most excellent. In Figure 2 the sample calculation will be displayed on the Smartphone screen to facilitate the use of prototypes, test equipment emissions. The screen will display the value for CO, HC and NOx. Over 30 programs to detect will run and after 30 seconds the program will stop automatically to do the calculation, which in the end results will display the results in the form of captions "Passed" or "Not Passed" [8, 9].

After the test is taken from the average gas content of each tested based on the differences between the data from emission testing of tools and prototypes from the porch of the test vehicle. Because of the difference in the average of the contents of very large gas then it can be concluded based on:

- Prototype of emissions testing tool produces higher value from the test tool test Hall vehicle emissions in the city of Bandung.
- Testing using gas container type 3 get the average smallest delta i.e. 0.41% CO and HC PPM 64.89, so it can be inferred that a reservoir of gas type 3 better performance.
- Testing using prototype less emissions test tool maximum for not sucking gas.
- The size of a container of gas and gas sensor Position largely determine the sensitivity of sampling.

The comparison result can be shown on table 1. [1, 10, 11].

Table 1. Results current emission testing tools.

Test	Type of Gas		
	CO (%)	HO (ppm)	Nox (ppm)
1	0.67	36	0.21
2	0.62	37	0.12
3	0.63	36	0.09
4	0.66	37	0.09
5	0.68	38	0.11

For comparison results with of prototype emission testing tools can be shown on table 2.

Table 2. Results prototype emission testing tools.

Test	Type of Gas		
	CO (%)	HO (ppm)	Nox (ppm)
1	0.6	25.21	-
2	0.01	84.51	-
3	0.65	73.21	-
4	0.65	72.62	-
5	0.57	68.62	-

4. Conclusions

Based on result research of prototype emission testing tools L3 category vehicle can be drawn some conclusions are prototype of emission testing tool can be used to measure the gas emissions which produced by vehicles, especially the L3 category vehicles that produce unhealthy vehicle fumes, so that air pollution can be minimized. Then, this prototypes of emissions testing tool may be used in a non-formal manner or may be used out of the emission test schedule, so that people can use the tool to perform non-formal emissions testing.

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