International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 6 (2018) pp. 3975-3978

Design tool of Motor Vehicle Emissions Measurement Devices with Based on Arduino Nano with Android Smartphone Viewer

Lukman Hakim [1)], Zuriah Sitorus [2)], Muhammad Muzakky Al Maududy [3)]

[1,2)] Department of Physics, Faculty of Mathematics and Natural Sciences, University of North Sumatra
Jalan Bioteknologi No.1 Campus USU, Medan, 20155, Indonesia.

Abstract

Motor vehicles exhaust emissions containing harmful pollutant gases that can damage the environment and cause health problems for humans. To control the emission levels of vehicles, a motor vehicle emissions measurement is made. The purpose of this tool is to facilitate consumer to be aware of the exhaust emissions level.

The hardware used in this tool include Smartphone as a viewer, Arduino nano as the brains of this device, Bluetooth module as an intermediary between the device with arduino, and sensors as content measure of gases resulting from engines combustion, while the softwares used are Arduino IDE and App Inventor. The method used in this study is an experimental method that consists of data collection, data analysis, construction and testing. Carbon monoxide (CO) and hydro carbon (HC) can be measured and monitored by looking at the data displayed on android smartphone. Testing is done with three categories, namely: measurement with 1000 rpm, 2000 and 3000 rpm. Based on the results of tests performed it is known that the average error of HC gas measurement is 4% and the averaged error of CO gas measurement is CO 3.3%. The error is likely to occur due to the ability of gas sensors MQ-2 and MQ-7 to be less sensitive when measuring gas levels with a variety of interferences.

Keywords: Arduino Nano, Bluetooth, Hydrocarbons (HC), Carbon Monoxide (CO).Android Smartphone

INTRODUCTION

Motor vehicles have long been a source of air pollutants in many major cities of the world. The toxic gases of millions of exhaust every day cause serious problems in many countries including Indonesia, where gasoline-fueled vehicles are also one of the biggest sources of air pollutants in the industry and households. Air pollution from motor vehicles, power plants, industry and households account for 70% of the pollution in the world with the composition of the quantity of carbon monoxide (CO) 99%, hydrocarbons (HC) 89%, and nitrogen oxides (NOx) 73% and other particulates that include lead, sulfur oxide and dust particles. [1]

The growing number of motor vehicles with various brands and types will increase consumption of fuel oil and cause effects of air pollution. The increase in fuel consumption is very reasonable if seen data from the Association of Indonesian Automotive Industries (Gaikindo) stated that the number of motor vehicle sales increased significantly.

The number of vehicles in Indonesia based on data from the Central Bureau of Statistics of the Republic of Indonesia from 2010 to 2014 showed the enhancement in the number of vehicles that extraordinary.

Seeing the problem, it is imperative for the government and the motor vehicle industry in Indonesia to be aware of as early as possible the effects of hazards caused by exhaust emissions pollutants and together to minimize air pollution caused by exhaust emissions pollutants and environmentally friendly. [2]

Among the harmful gases , coming out of exhaust fumes are Hydrocarbon and Carbonmonoxide. Hydrocarbons are toxic gases for humans, carcinogenic hydrocarbons can be harmful because hydrocarbons in the air undergo chemical photo reactions that can be more harmful gases than their origin (to peroxiasetyl nitrate, ketones, and aldihides) so that the medium to high concentrations hydrocarbons can cause health problems especially on the mucous membranes, eyes, nose and throat and if accumulated in a long time hydrocarbons cause cancer. [3]

Carbonmonoxide (CO) is compound gas toxic ones formed as a result of incomplete combustion in the process of motor work, CO gas is relatively unstable and tends to react with other elements, CO can be converted to carbon dioxide (CO2) with the help of less oxygen and heat, CO is measured in% pervolume or in ppm but in the automotive industry according to the measuring instrument used is often measured in% per volume [4]

Motor vehicle exhaust emission threshold is the maximum limit of substances or contaminants that may be discharged directly from the vehicle exhaust gas pipe. The standard emission of stationary sources which is the default level of noise consists of the standard of noise level, the standard of vibration level and the standard of soundness. While the standard of emission source source comes from motor vehicle fumes.

For control of air pollution from mobile sources include supervision of compliance threshold of exhaust emission, inspection of exhaust emissions for new type of motor

vehicle and old motor vehicle, ambient air quality monitoring around the road, inspection of vehicle exhaust emission in road and material procurement burn free oil Lead and diesel sulfur low as per international standards.

Regarding motor vehicles shall be regulated in the Regulation of the State Minister of the Environment Number 05 Year 2006 concerning Threshold of Emission of Motor Vehicle Disposal. [5]

RESEARCH METHODS

The block diagram used in this study can be seen as in the following figure

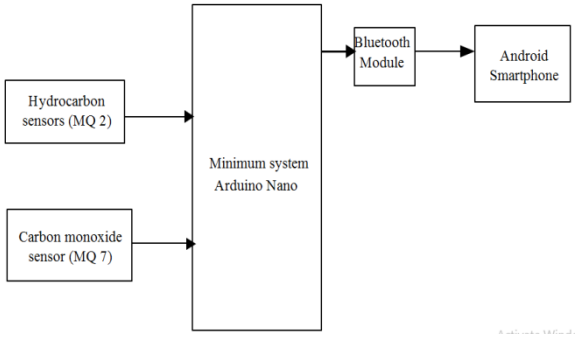


Figure 1. System block diagram

In this study, the design tool using MQ-7 and MQ-2 sensors, where both sensors function to detect and estimate the content of hydrocarbon compounds (HC) and carbon monoxide (CO) compounds by detecting gas levels in the vehicle exhaust pipe.

Both sensors are then connected to an arduino nano microcontroller, in this microcontroller data derived from the MQ-7 and MQ-2 sensors which are still in the form of voltage converted to gas concentration (ppm).

Then the data already in conversion is sent to the bluetooth module HC-05 and then received using applications that have been specially designed to receive data derived from the design tool.

Applications in this experiment are designed using App Inventor, while programming on the arduino nano microcontroller in the program by using arduino IDE software sent using a computer USB port.

The data obtained in the study then compared with standard equipment owned by Toyota auto shop 2000. After being tested and calibrated, the design tool is used to measure some cars.

RESEARCH RESULT

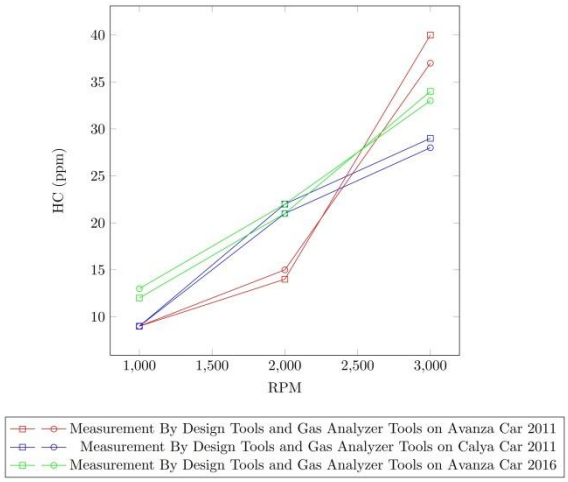
Calibrate Tools with Tools

Measure the Standard

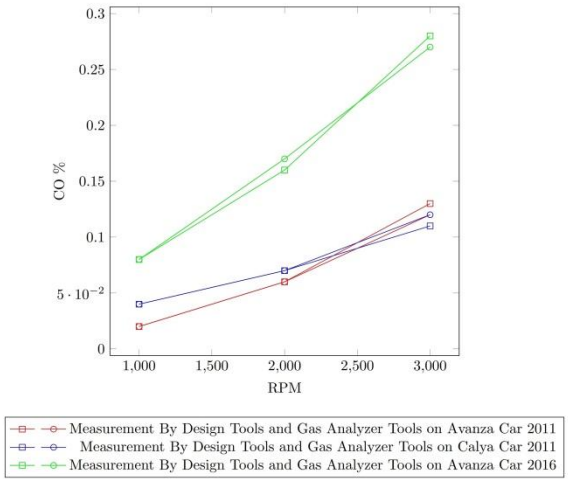
In order for the measurement value in accordance with the standard gauge, it is necessary to do a calibration to compare the tool with already terstandard that is the gas Analyzer Analyzer Auto 200 0 Medan which is located at Jalan Sisingamangaraja No. 8 Medan .

Setela h finished calibrated design tool used to test vehicle emissions with "Gas Analyzer" with n pengukura results can be seen in the graph below this.

Graph 1. HC Measurement with Standard Design and Tool Tools



Graph 2. Measurement of CO with Standard Devices and Tools



To know the% error can be calculated in the following ways:

$$\%error = \frac{\text{value of design tool} - \text{value of standard tool}}{\text{value of standard tool}} x100\%$$

From the table data measurement tool design with the standard tool,
then it can be calculated the average% error of the measurement tool design that is:

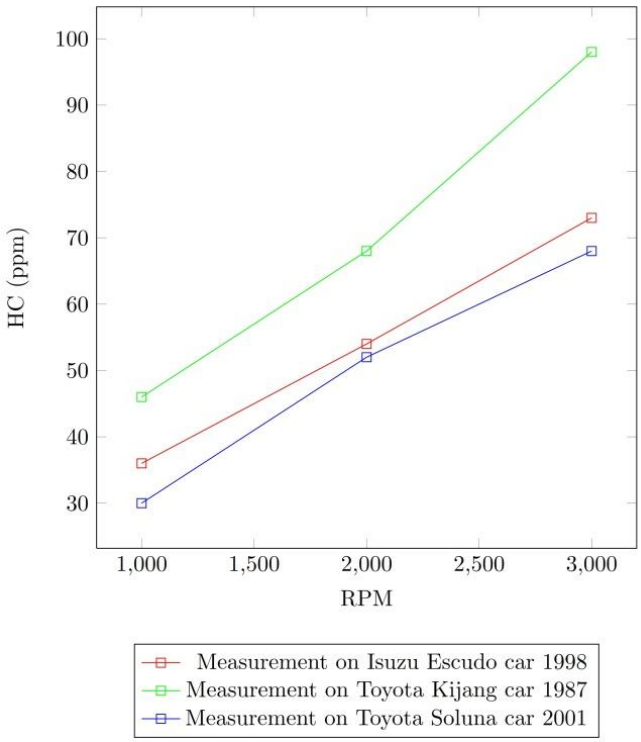
$$\%\text{ error design tool for HC gas} = \frac{\text{Total \% error}}{\text{the number of measurements}} = \frac{36}{9} = 4\%$$

$$\%\text{ error design tool for CO gas} = \frac{\text{Total \% error}}{\text{the number of measurements}} = \frac{30}{9} = 3{,}3\%$$

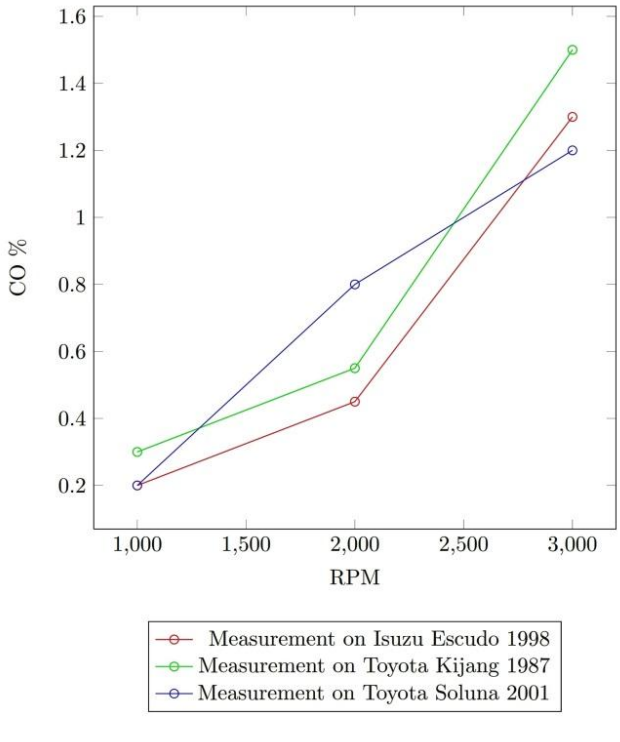
Thus, the average% of the correction for HC gas is 4%, while for CO gas is 3.3%.

Testing Tool After Calibration

Once calibrated with the standard "Gas Analyzer" tool, the design tool is used to measure car emissions, with the same as before, just not using the standard "Gas Analyzer" toolad previously used for calibration. Here's the table of measurement results after calibration



Graph 3. HC Measurement with Design Tool After Calibration



Graph 4. CO Measurement with Design Tool After Calibration

CONCLUSION

Based on the results of tool design and testing tools that have been done, can be drawn conclusion as follows.

1. After calibrating the equipment and comparing the results of the measurement of the design tool with the "gas analyzer", it is found that the percentage of HC gas measurement is 4% and the CO gas measurement is 3.3%. Overall parts of tools that have been built can work well as planned.
2. By sending data from design tools through bluetooth communications media to android smartphone, believed to be able to facilitate the measurement of vehicle exhaust emissions and become an alternative to measuring vehicle exhaust emissions

BIBLIOGRAPHY

[1] Kristiana Ervin. 2011. *Design of Carbon Monoxide (Co) Gas Disposal Device Detector in Motor Vehicles.* Semarang

[2] Decree of State Minister of Environment No.045 th 1997. *Air Pollution Standard Index*

[3] Soemirat . July. 1994. Environmental Health. Gadjahmada University Press . Yogyakarta

[4] Petter A Weller. 1989. *Fachkunde Fahrzeugtechnik.* Holland Johenshands Germany.

[5] Regulation of the State Minister of Environment Number 05 Year 2006 . *About the Exhaust Emissions Limit of Old Motor Vehicle*