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PROTOTYPE OF INSPECTION EXHAUST BRAKE VEHICLE BASED MICROCONTROLLER

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Abstract

Technical requirement checking relating exhaust brake on vehicle inspection is still lacking because there is no additional equipment which can helps to ensure the exhaust brake works. From that case a set of research is conducted to help inspectors to ensure the exhaust brake works normally by using microcontroller based prototype. This research aims to design and implement the inspect equipment of exhaust brake using sound sensor DFr and air Sensor. The process requires 3 inspectors and by using this tool, inspectors could ensure the exhaust brake works or not for hino vehicle. This research shows that measuring by using this auxiliary tool for checking the exhaust brake could inform the fluctuation of sound produced by vehicle machine and decreasing air on exhaust brake system. The result of its prototype testing, the sound sensor is able to detect the increasing of sound and if the sound level reaches 80 dB, there will be a green as warning LED and l2c LCD displays the noise level and the prototype could works properly, the accuracy percentage is 97% and for the air Sensor's accuracy is 92%

Keywords : *prototype, air and sound sensor, microcontroller*

I. Introduction

Transportation accidents that have been concluded by the National Transportation Safety Committee (KNKT), Convey the results of the investigation into the AD 1507 EH Tour Bus Single Car traffic accident. Side crash at Bukit Bego, Karang Kulon, Wukirsari, Imogiri District, Bantul Regency, Special Region of Yogyakarta which resulted in 14 deaths, 4 people seriously injured and 29 people slightly injured. Accidents caused by brake system failure. The failure of the brake system occurred due to one of the factors being that the Exhaust Brake did not function as an additional brake. The vehicle's braking load increases rapidly if it is not supplemented with additional brake assistance in the form of an Exhaust Brake so that the primary brake system is easily overloaded and damaged due to excessive heat, which will cause traffic accidents in the vehicle [1]. Vehicles for transporting goods and public transportation, which are vehicles that are required to undergo periodic inspections. In accordance with Article 49 of Law Number 22 of 2009 concerning Road Traffic and Transportation (UULLAJ). In the left test, there is an examination of the technical requirements in Government Regulation Number 55 of 2012 in Article 80 which reads "In addition to having to be equipped with the main brake and parking brake as referred to in Article 64 paragraph (2) letters c and d,

Motor Vehicles with a JBB of more than 7,000 (seven thousand) kilograms must be equipped with slowing brakes. This retarding brake must function by carrying out inspections with tools or without tools so that you can really ensure that the function of the Exhaust Brake is working. Based on this background, it is necessary to provide tools to ensure inspection of the exhaust brake function on motorized vehicles is carried out on vehicles.

II. Related research

A. Previous Research

This research adopts the journal from Design and Build Applications for Sales and Purchase of Goods at the Kartika Samara Grawira Prabumulihan Cooperative [2]. This research explains that design is the activity of translating analysis results into software packages and then creating the system or improving an existing system. The results of this research are software applications that are implemented for sales and purchasing applications at the Kartika Samara Grawira Prabumulih cooperative. Using the PHP programming language with the database used is Mysql and using other supporting programs, namely Macromedia Dreamweaver and XAMPP.

Explanation of the research above, the difference with this research lies in the object under study where in research by Nurhayati implements applications for sales. As for this writing, it has translated the results of the analysis from the literature study into the form of a microcontroller-based Exhaust Brake inspection tool on motorized vehicles so that it can assist examiners in examining the Exhaust Brake on examining the technical requirements of motorized vehicles.

B. Design of Exhaust Brake inspection aids

The DFR sound sensor as input indicates noise at the Exhaust Brake. Then Arduino processes the resulting input, then the LCD and LED are output, displaying information data [3]. Module form for the sound detection system on the.

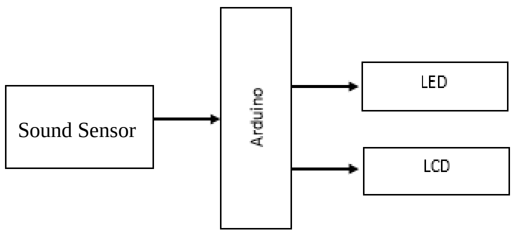

Fig 1. Sound sensor system design.

To create a module that uses the DFR sound sensor as an input to detect noise from an exhaust brake, then processes the input using Arduino, and displays the data on an LCD and LED as output.

Fig 2. Sound detection device on a vehicle engine

A sound detection system in a vehicle engine to monitor sound changes when the Exhaust Brake is engaged. To clarify the air sensor scheme in 3 steps.

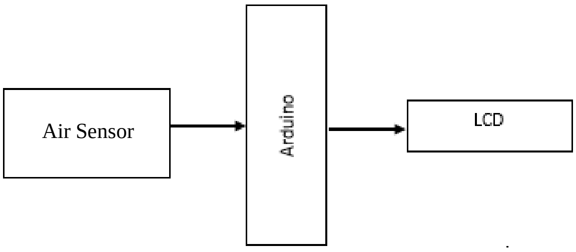

Fig 3. Air Sensor System Design.

An air sensor when the Exhaust Brake is activated. Then, Arduino processes the generated input, and an LCD [4] serves as the output to display information. The module for air detection in the exhaust system can be seen in Fig 4.

Fig 4. Air detection device on a vehicle.

An air detection system in the vehicle's exhaust system to monitor changes in airflow when the Exhaust Brake is engaged. Fig 5 will illustrate the implementation of the device in the vehicle.

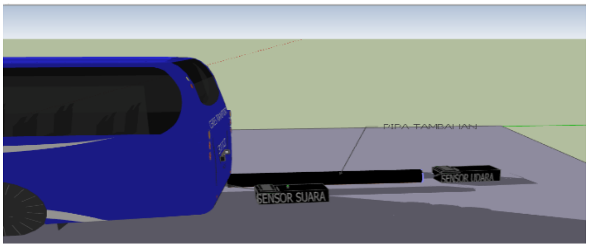

Fig 5. Design of the tool application system on the vehicle

Design this image using Sketch Up is a 3D modeling program and also includes features to facilitate placement of models in Google Earth. This application is designed to be easier, the design display immediately looks good without having to wait for the rendering process first and can import DWG, 3Ds and all image file types [5]. This research describes the engine design at the rear of the vehicle because the sound sensor is placed at the rear of the vehicle. The research flow diagram of the Brake Exhaust inspection tool system is as depicted in Fig 6. Starting from the formulation of the problem is a very important thing in the research. The problem formulation describes the solution to an interesting problem. The main problem in this research is how important exhaust brakes are. After that, a literature study was carried out by looking for references, journals and media related to sound sensors and components related to the design of Exhaust Brake noise and braking air detection tools and creating a design for the tool to be used.

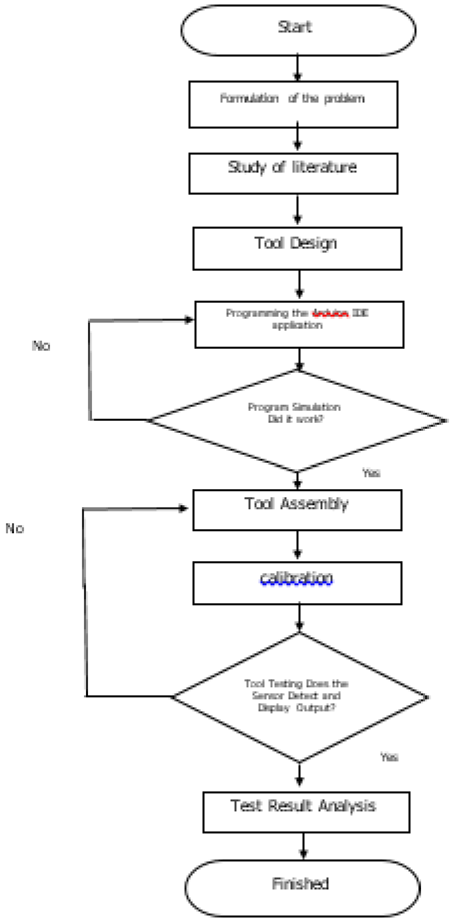

Fig 6. Research flow

In Fig 7, the design illustrates how to use the device by utilizing a speedometer tester to determine whether there is an increase or decrease in sound and air when the Exhaust Brake is engaged.

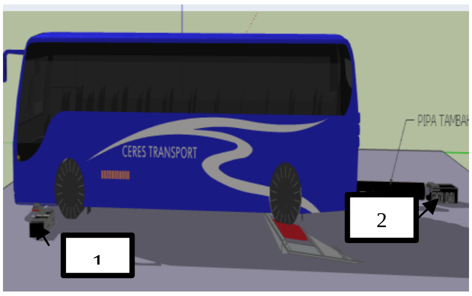

Fig 7. Design of tool use

A sound sensor that has been integrated with an Arduino and placed near the vehicle's engine system functions to read increases or decreases and displays them on an LCD. The green LED has the function of providing a warning when the sound reaches 80 dB.

An air sensor that has been assembled and placed on an additional pipe is used to detect changes in airflow when the Exhaust Brake is activated, and the data is displayed on an I2C LCD Air sensors numbered 2, which have been assembled and placed on additional pipes, are used to detect changes in airflow when the Exhaust Brake is activated, and the data is displayed on an I2C LCD.

III. Method

Experimental method [4]. in this study conducted research directly by assembling the design and experimenting on the design of the Exhaust Brake tool so that the results of the experimental data were obtained and analyzed. In principle, this study wants to analyze the results of the performance of the tool that has been designed and wants to know whether there is an increase in sound when the Exhaust Brake is used because in the hino manual book if there is an increase in sound when the Exhaust Brake is used, the Exhaust Brake is declared to function whereas in the design of the air sensor is there a decrease when the air is Exhaust Brake closes the exhaust holes on the vehicle

The data collection technique in this study is based on data in Pulogadung (UPUBKB), the following are the stages carried out by researchers in collecting data Testing Equipment on Vehicles

Tool testing is carried out on the Exhaust Brake with a microcontroller-based design tool. Before the tool is used, the process of calibrating the tool first, calibration is carried out by comparing the results of the Sound Level Meter noise measurement with the design measuring tool, then calibrating the air sensor tool with an air pressure gauge in testing after that the exhaust brake is checked to find out whether there is an increase in sound and a decrease in air during testing. The following is a table of experimental design tools. In Fig 8 is a picture of instrument calibration using a sound level meter.

Fig 8. Calibration of the sound level meter

This calibration process is carried out with a sound level meter [6].that has been calibrated by the ministry of transportation and the calibration validity period is valid until 2024, while the instrument calibration for air sensors uses the tools available in motor vehicle testing, which is shown in fig. 9.

Fig 9. Calibration tool for air sensors

The air sensor was calibrated using a digital pressure gauge, and the sensor's results were compared with the equipment available in the motor vehicle testing facility.

IV. Results and Discussion

A. Design

The Exhaust Brake inspection assistance tool is aided by a microcontroller-based device. This tool can serve as a reference to determine whether the Exhaust Brake is functioning or not. In Fig 10, the calibration process of the tool using a sound level meter sensor is depicted.

Fig. 10. Calibration of the sound sensor

Calibration is a series of activities that establish a relationship between the values indicated by a measuring instrument [7]. This calibration involves using sounds generated by the vehicle's exhaust system at a test distance of 2 meters in front of the vehicle, and the results are presented in Table 1.

Tbl 1. Result of instrument calibration on the vehicle

NO	No Vehicle	Sound Sensor	Sound Level Meter	Accuracy	*Error*
1	B 7669 TAA	76 dB	74 dB	97%	97%
2	B 9504 SXS	89 dB	80 dB	90%	10%
3	B 7397 II	110 Db	110 Db	100%	0%
4	B 7528 TGD	93 dB	87 dB	94%	6%
5	B 7537 TAA	95 dB	93 dB	98%	2%
6	B 9909 URU	94 dB	93 dB	99%	1%
7	B 9565 SAK	118 dB	116 dB	98%	2%

8	B 7506 TGD	120 dB	119 dB	99%	1%
9	B 7722 TGC	90 dB	94 dB	96%	4%
10	B 7929 TAA	95 dB	97 dB	98%	2%
11	B 7922 TAA	111 dB	112 dB	99%	1%
12	B 7927 TAA	86 dB	86 dB	100%	0%
13	B 9916 BXA	90 dB	88 dB	98%	2%
14	B 7017 SGX	94dB	94dB	100%	0%
15	B 7056 TGA	74dB	77dB	98%	2%

In Table 1, it can be observed that the calibration of the sound sensor with the previously calibrated sound level meter by the Ministry of Transportation resulted in an average accuracy of 98% and an error value of 2%. Therefore, it can be concluded that the sound sensor device that has been created exhibits good accuracy. The subsequent calibration is performed on the air sensor, as shown in Fig 11.

Fig. 11. Air sensor calibration

This calibration uses air produced by a compressor engine and the results are in tbl 2.

Tbl 2. Air sensor calibration results

NO	Air Pressure Sensor	Prototype Weathergl ass	Accuracy	*Error*
1	1.24	1.14	92%	8%
2	0.47	0.31	64%	34%
3	2.41	2	73%	27%
4	0.34	0.37	91%	9%
5	0.54	0.64	81%	19%
6	0.76	0.66	87%	13%
7	3.41	3.41	100%	0%
8	1.42	1.47	96%	4%
9	3.21	3.21	100%	0%
10	1.15	1.15	100%	0%
11	1.22	1.2	98%	2%
12	4.21	4.27	99%	1%
13	0.65	0.59	91%	9%
14	0.84	0.81	96%	4%
15	0.12	0.13	92%	8%

It can be observed that the calibration of the air sensor with the existing air measuring instrument in the testing facility resulted in an average accuracy of 92% and an error value of 8%. Therefore, it can be concluded that the sound sensor device that has been created exhibits good accuracy[8].

B. *Testing the device on the vehicle*

The data collection procedure was conducted using a speedometer tester tool. This was done to determine the decrease in air when the Exhaust Brake is used and to capture the sound and air generated when the Exhaust Brake is activated in the engine and at the vehicle's exhaust. Fig 12 illustrates the data collection process in the exhaust system for the air sensor.

Fig. 12. Installation of the sensor in the vehicle's exhaust system

The picture above is the process of installing an air sensor on a Hino F1030 vehicle to determine the air drop when the Exhaust Brake is used on the vehicle and the experimental results data is in tbl 3.

Tbl 3. Test results of the tool on the vehicle

No	Speed	The Air in the ***Exhaust Brake OFF***	The Air in the ***Exhaust Brake ON***
1	30 Km/h	2.4 Psi	1.21 Psi
2	30 Km/h	2.6 Psi	1.33 Psi
3	30 Km/h	2.6 Psi	1.33 Psi
4	40 Km/h	3.1 Psi	1.55 Psi
5	40 Km/h	3.23 Psi	1.6 Psi
6	40 Km/h	3.2 Psi	1.61 Psi
7	50 Km/h	3.81 Psi	1.88 Psi
8	50 Km/h	3.85 Psi	1.82 Psi
9	50 Km/h	3.83 Psi	1.81 Psi
10	60 Km/h	4.45 Psi	2.42 Psi
11	60 Km/h	4.39 Psi	2.31 Psi
12	60 Km/h	4.42 Psi	2.3 Psi

The results of data collection on the exhaust system for the highest air produced were at a speed of 60 km/h. When the Exhaust Brake is used, the air experiences a decrease in air where the largest decrease is at a speed of 60 Km/h
The result is 52% and the experimental graphic display for the exhaust system for the sensor is in Fig 13.

Fig. 14.. Image of sensor installation on the machine

The results of data collection on the exhaust system for the highest air produced were at a speed of 60 km/h. When the Exhaust Brake is used, the air experiences a decrease where the largest decrease is at a speed of 60 Km/h. The resulting decrease is 52% for taking the engine sound section, Fig 14.

Tbl 4. Test results of the tool on the vehicle

No	Speed	Sound on Engine Exhaust Brake ON	Sound on Engine Exhaust Brake OFF
1	30 Km/h	88 dB	89 dB
2	30 Km/h	90 dB	94 dB
3	30 Km/h	89 dB	91 dB
4	40 Km/h	90 dB	94 dB
5	40 Km/h	90 dB	93 dB
6	40 Km/h	92 dB	96 dB
7	50 Km/h	105 dB	108 dB
8	50 Km/h	109 dB	112 dB
9	50 Km/h	111 dB	115 dB
10	60 Km/h	116 dB	121 dB
11	60 Km/h	115 dB	120 dB
12	60 Km/h	115 dB	120 dB

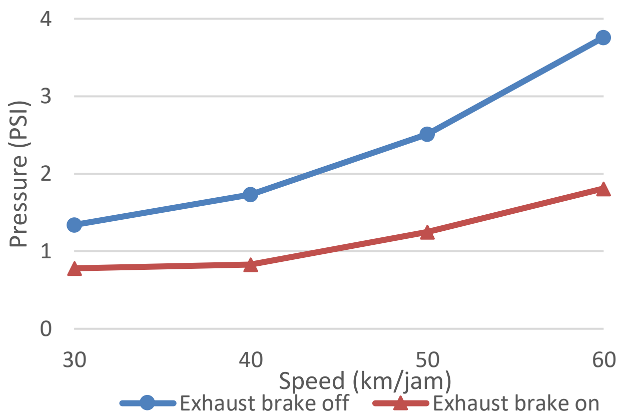

Fig 13. Graph of average test results on vehicles

Based on the graph of test results using an air sensor in Fig 13, it can be seen that there is a decrease in air pressure when the exhaust brake is used. In three trials at a speed of 60 km/h when using the exhaust brake, there was an average decrease in air pressure of 51%. In experiments with a speed of 50 km/h, the average decrease in air pressure produced was 50%. At a speed of 40 km/h, there is an average decrease in air pressure of 50%, while at a speed of 30 km/h, the average decrease in air pressure produced is 41%.

The results of data on the use of air sensors in the exhaust system before and after using the exhaust brake show that when the exhaust brake is activated at a speed of 30 km/h, the smallest drop in air pressure is produced. Meanwhile, the largest drop in air pressure occurs at a speed of 60 km/h. This indicates that the greater the speed produced, the greater the drop in air pressure that occurs when the exhaust brake is used.

The results of data collection on the exhaust system for the highest air produced were at a speed of 60 km/h. When the Exhaust Brake is used, the air experiences a decrease where the largest decrease is at a speed of 60 Km/h. The resulting decrease is 52% for taking the engine sound section, Fig 14.

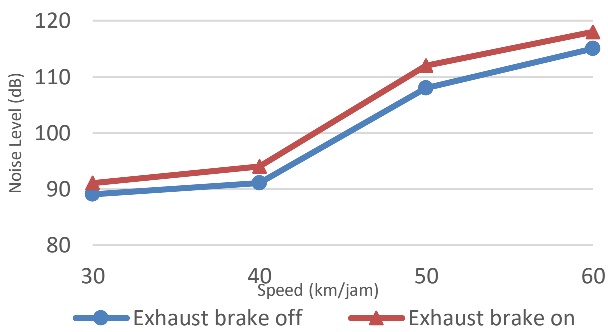

Fig. 15. Graph of the experimental results of the tool on the Exhaust Brake

Fig 15 shows an increase in sound at each speed during testing. This shows that there is an effect of increasing the sound when the Exhaust brake is used on the vehicle's engine. In the experiment the Exhaust brake was used at a speed of 60 km/h in 3 trials, there was an average increase in engine sound of 4%. At a speed of 50 km/h, there is an average increase in sound of 3%, and at a speed of 40 km/h there is an average increase in sound of 3%. Meanwhile, at a speed of 30 km/h, there is an average increase in engine sound by 2%. The results of this data show that the highest increase in sound in vehicle engines occurs at a speed of 60 km/h, while the lowest increase in sound occurs at a speed of 30 km/h. This indicates that the greater the speed in the Exhaust brake test, the greater the sound increase when the Exhaust brake is used. This indicates that in this experiment, the exhaust brake will work more optimally at a speed of 60 km/h because the sound effect produced is greater.

V. CONCLUSION

This design performance uses sound sensors as input and output readers. When the noise reaches 80 dB, a warning will appear via the LCD display, and simultaneously the LED will light up to alert motor vehicle testers about the increase in sound. This tool has an accuracy rate of 97%, which is obtained through calibration using a sound level meter.

Part from that, the performance of the tool also involves an air sensor which functions as an input receiver and produces output. When air passes through the sensor, the output will be displayed via the I2c LCD to indicate whether there is an increase or decrease in air. This tool has an accuracy rate of 92%, which is also calibrated with an air pressure reading device in testing motorized vehicles.

The tool that has been created can be of assistance to testers, because with this tool, they can easily detect an increase in sound in the vehicle engine. This has important implications, because in the Hino manual, a raised sound can be an indicator that the exhaust brake is working. On the other hand, if there is a decrease in air, it could indicate that the exhaust can block the exhaust port and the exhaust braking system is running. The use of this tool provides additional information for motor vehicle testers to make conclusions about whether the exhaust brake is working or not.

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