

Design And Development of Overheat Detector based on Arduino Mega On Four-Wheeled Vehicle Brake System

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ABSTRACT

The aim of this research is to design a motor vehicle braking system trainer, so that it can be used as a test site for overheating detection devices in the brake system. The preparation of the design concept is divided into two designs, namely the design of the braking trainer and also the design of the software application in the form of a simulation of an overheating detection system. The stages of sensor installation are carried out to the setting and installation of the heat detection sensor is in accordance with the system plan that has been made, while the placement of the sensor is intended to detect heat from the front and rear braking systems. Programming is also carried out using Arduino software to program the input obtained from the sensor so that it can be displayed on the monitor display. Based on this, a prototype for detecting the brake system for four-wheeled motorized vehicles based on Arduino Mega can be produced. temperature. The four sensors used are able to provide data input and serve as a thermal reference for the conditions of the front and rear brakes, both from brake lining thermals and brake fluid thermals. This prototype also needs further development to be applied to real vehicles and to be able to determine the most effective location for the sensor so that it can provide the best information to the driver.

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1. INTRODUCTION

According to a survey conducted by the National Transportation Safety Committee (Komite Nasional Keselamatan Transportasi, KNKT), several factors causing traffic accidents include human factors, infrastructure factors, and other environmental factors. Judging from the factors above, the vehicle factor in this case means that vehicles rank second after the human factor as a cause of traffic accidents [1]. Motorized vehicles that are mass-developed and mass-produced certainly pay attention to safety factors to ensure the safety of their drivers [2][3]. In several cases of traffic accidents, the brakes did not work properly [4][5]. In this case, the test still applies to Motorized Vehicles with Compulsory Inspection. To facilitate the smooth inspection of motorized vehicles [6], a functioning and properly calibrated test equipment is needed in accordance with the Regulation of the Minister of Transportation of the Republic of Indonesia No. 133 Motor vehicle braking systems use disc brakes and drum brakes [7][8]. The working principle of the brake system is basically that when the brake pedal is pressed, the master cylinder will push brake fluid to the brake drum pistons thereby pushing the brake shoes to move forward [9][10].

Friction will generate heat and heat in the brake system including brake linings and drums/discs [11]. In addition, overloading can also affect the braking performance of motorized vehicles [12] and cause failure in four-wheeled motorized vehicles [13]. It starts with the appearance of excess heat in the brake system [14]. Two things happen when the brake system overheats [15], heat build-up in the brake pads [16] and heat-producing gases which cause the brakes to slip and is commonly known as corrosion [17][18]. This prompted researchers to design a brake system overheating detector on four-wheeled motorized vehicles [19]. For that we need research on this braking system. From the description above, this research will discuss "Design and Build of Overheat Detector System Brakes of Four-Wheel Motorized Vehicles Based on Arduino Mega" The aim of this research is to determine how the overheating detector works on the braking system of road four motorized vehicles and to find out whether this overheating detector is functioning properly or not.

2. RESEARCH METHOD

This research was conducted in the laboratory of the Bali Land Transportation Polytechnic Jalan Batuyang No. 109 X Gianyar. The sample used in this study is a frame made of the main material, namely iron. This frame is associated with an electric motor as the prime mover for the design prototype of this electric motorcycle [22]. After installing all the electrical components and systems from the electric motor, then a detailed check is carried out on the main chassis to find out the deformation of the chassis [23]. After the observation is complete, data is collected according to the variables that have been set, so that data calculations can be carried out according to the required data requirements. The variables used in this study to obtain data consisted of: Independent variables, namely loading (60, 90, 120, 150 kg). The dependent variable is the stress/strain of the material, and the Control Variable is software and design [24]. The data collection technique used is to measure the efficiency of the object and record the data used in the research. The data is the loading value, thermal value and efficiency value. In the testing process, a minimum of 3 (three) people is needed as operators, documenting the testing process, observing and recording the test results of the object under study. Testing is carried out according to the procedure for using assistive devices, namely software applications. After testing, the data analysis technique used is descriptive analysis method. To facilitate the analysis process, the test results are displayed in the form of tables and graphs [25]. The next step is to explain the data in the tables and graphs into sentences so that they are easy to read, understand, and present so that they can find answers to the problems under study.

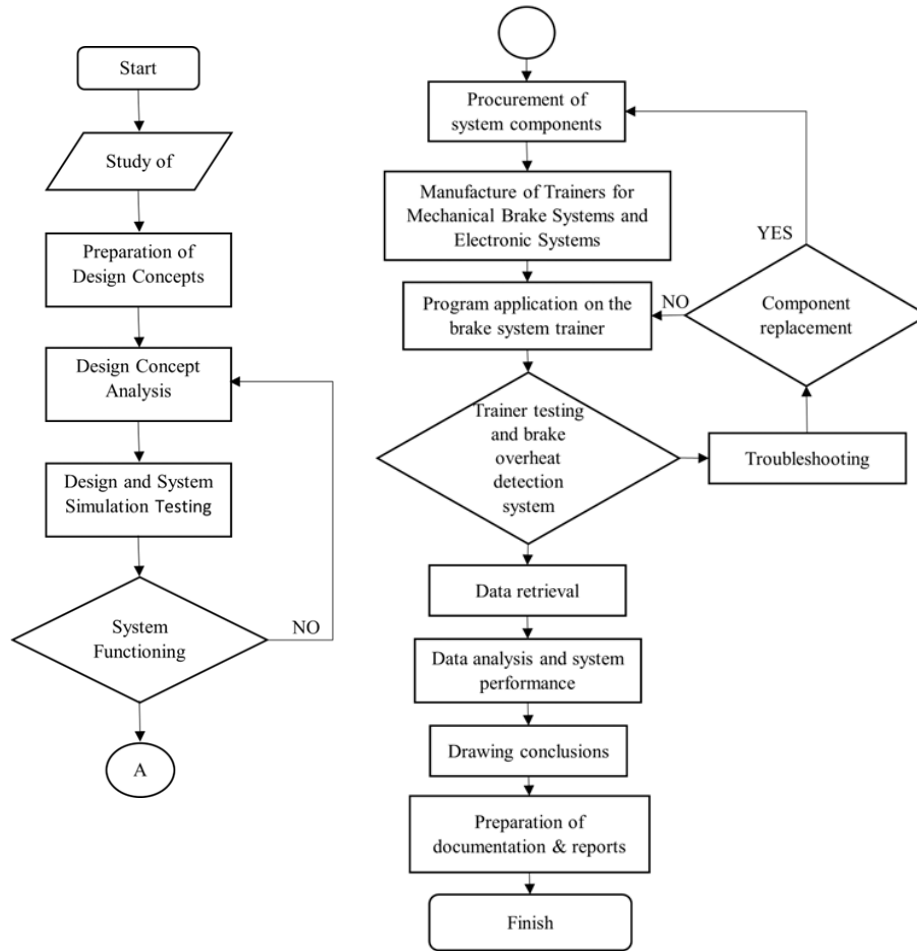


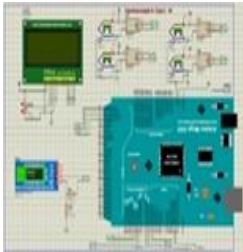
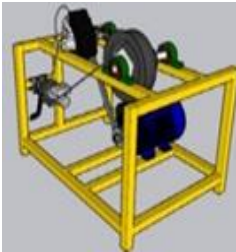
Figure 1. Research Scheme

3. RESULTS AND DISCUSSION

3.1. Preparation of System Design Concept

The design based on the predetermined research scheme will produce several system design concepts, including:

Table 1 – Compiler of System Desing Concepts

Results	Information
 (a)  (b)	(a) Design of a braking system trainer and a series of overheating detection systems on Proteus and also a processor that uses an Arduino Mega 2560. (b) Braking trainer design concept. The trainer design concept starts from modeling both two dimensions and three dimensions of the trainer, making it easier to work on the trainer. The trainer design was drawn using a 3D application.



(c)



(d)

Finishing the braking system trainer and construction of an overheating detector.

- (c) The process that has been carried out is to purchase materials to make the trainer frame. The next process is cutting the frame material according to the needs and planned design. Another step that is also carried out is purchasing braking system components that will be installed on the trainer, which includes : drum brakes, backing plate brake shoe lock, spring and brake shoe lever mechanism, master cylinder, disk brake, backing plates, wheel bearings, knuckle set, brake caliper, disc brake pads, brake pedal, brake flexible hose, brake pipe, brake pipe t-joint, brake master, wheel cylinder
- (d) Installation on the box after testing. Work on the overheating detection system. The system circuit is adjusted to the simulation circuit that has been created. Check the performance of the sensors and processor first before installing the system as a whole.

The preparation of the design concept is divided into two designs, namely the design of the braking trainer and also the design of the software application in the form of a simulation of an overheating detection system. Beginning with the planning and design of the brake system trainer. the brake system trainer design uses the sketchup application so that the components and trainer plans can be seen in detail.

a. Braking Trainer Design Concept

The trainer design concept starts with modeling both two dimensions and 3 dimensions of the trainer, making it easier for the trainer to work. The trainer design is drawn using a three (3) dimensional application, as shown in Table 1.

b. Overheat Detection System Design Concept in Brake System

This design was made in the proteus program as a basis for assembling the overheating detection system hardware. The main purpose of doing this design is to minimize errors that result in damage to system components. The damage to the system is emphasized in electronic components, both in the form of sensors and also connectivity that displays on the LCD and also the processor that uses the Arduino Mega 2560. Constraints on sensors are still an important point in programming, so the design of electronic systems still encounters obstacles, especially related to the measuring temperature owned by the sensor and availability in the market. so that the next process is still focused on working on the braking system trainer.

3.2. Sensor Installation

This stage is carried out by setting and installing heat detection sensors according to the system plan that has been made, while placing sensors to detect heat from the front and rear braking systems. The components that are monitored and are very likely to cause heat are on the brake linings and also on the brake fluid. So that the sensor application is done by placing it on the front brake lining and on the brake fluid inlet in the front brake caliper For drum brake systems that are applied to the rear brakes, the location of the sensor to detect heat on the brake pads is positioned at the rear of the brake drum holder (Backing plate brake system). while for the brake fluid heat detection sensor, it is positioned on the brake pipe line leading to the rear. It can be clearly seen in Figure 2 below:

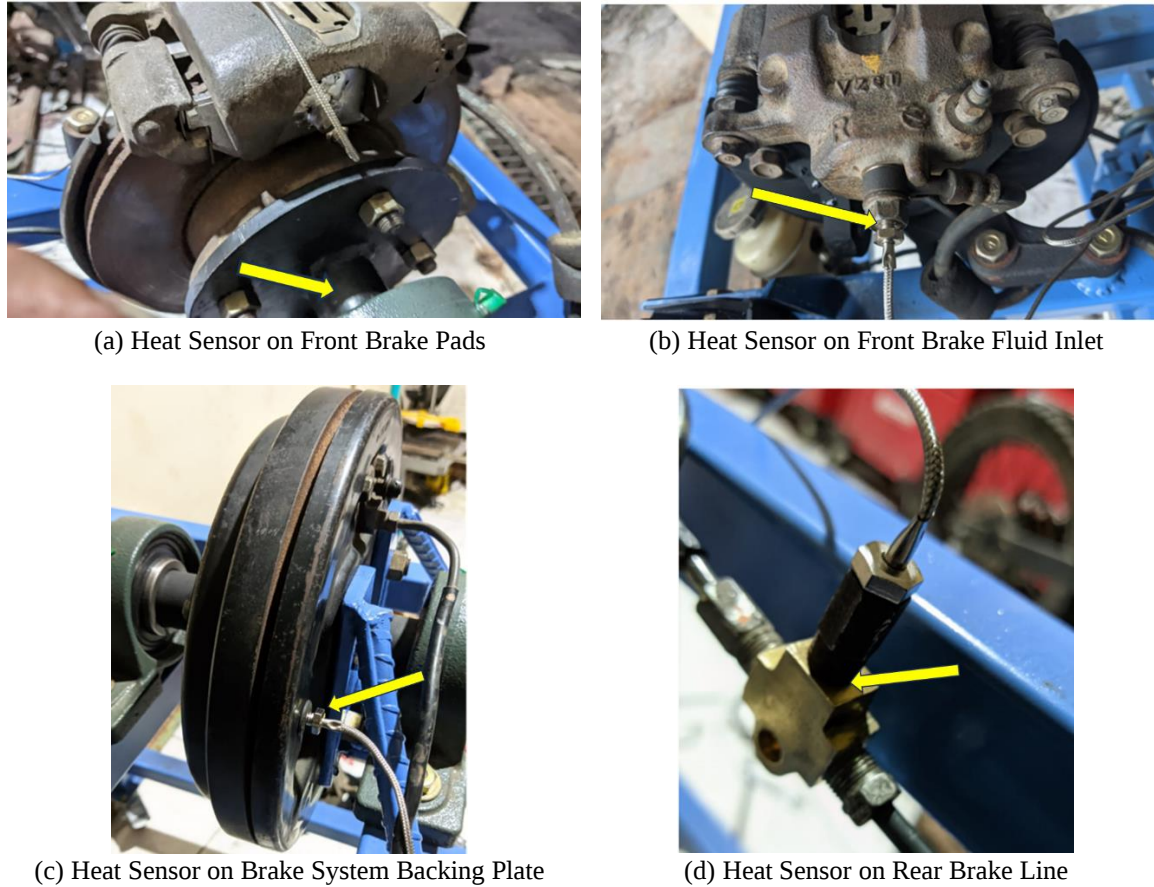


Figure 2. System Work

3.3. System Testing

Testing the system as a whole is the final stage to determine the performance of the design that has been made. The technical obstacle for the braking system trainer is said to be heavy to operate because of the frictional force on the brake system. This resulted in a technical problem, namely damage to the electric motor which is the prime mover of the trainer. Damage occurs due to the operation of the brake system which restrains the work of the electric motor. So that the stage of testing the performance of the heat detection system is carried out using the help of a sensor heater, namely heating the parts on the brake pads. The results of testing the performance of the overhear detection system were carried out in several stages, namely through testing the performance of the heat sensor with the LCS viewer on the heat detector, testing the connection and display on the android application, and testing the overhear detection warning system.



Figure 3. Sensor Performance Testing with LCD Display

Sensor performance testing was carried out by applying heat to one of the heat detection sensors, and it was proven that there was a significant increase in the monitor which can be seen from the Arduino application and can also be seen on the LCD display of the overhear detector. Subsequent tests were carried out by

providing a heating trigger to the other sensors, and the result was also obtained that a change occurred and the viewer was able to display the highest temperature of the four (4) sensors that were set in the braking system.

Table 2 – Heat Designation Results

°C	Experiment									
	1	2	3	4	5	6	7	8	9	10
Temperature 1	30,75	30,00	29,56	29,78	29,40	29,34	29,13	29,13	29,11	29,08
Temperature 2	28,75	28,56	28,34	28,25	28,43	28,12	28,10	28,15	28,34	28,23
Temperature 3	30,00	29,50	29,30	29,34	29,15	29,11	29,10	29,15	29,09	29,10
Temperature 4	29,75	29,50	29,45	29,23	29,88	29,55	29,33	29,30	29,34	29,11

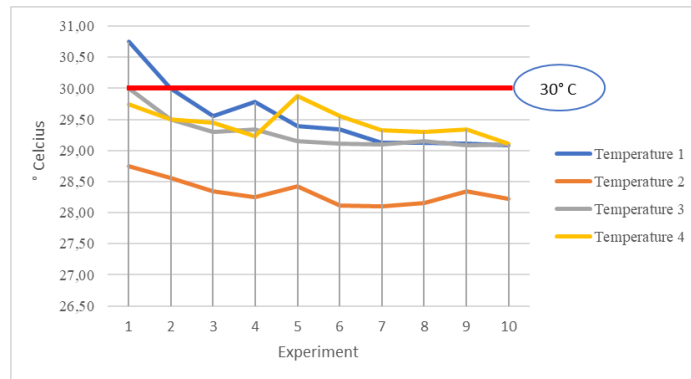


Figure 4. Heat Designation Results Chart

The second test was carried out using the Serial Bluetooth Terminal application embedded on an Android phone. Checking connectivity from Bluetooth is carried out immediately and can display the results of the appointment according to the indication on the LCD display of the overheat detection system. The last test was carried out by setting the program first, to check the performance of the warning system, which was done by setting it to a temperature of 38 C.

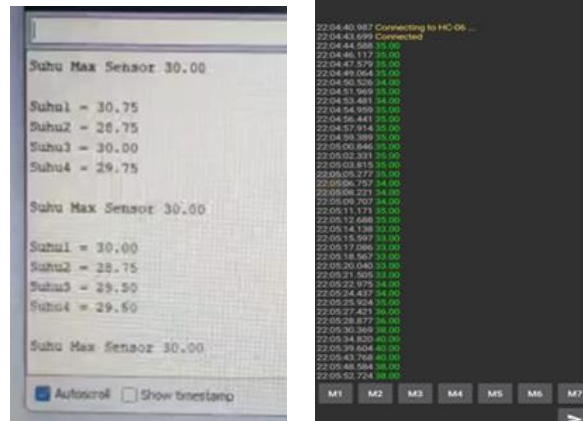


Figure 5. Testing the Connection and Display on the Android Application

System testing was carried out by giving a hot trigger until it reached a temperature of 38 C. and it was proven that when the temperature reading on the LCD showed 38, a buzzer will appear, as a warning signal to the driver. this will give a warning to the driver regarding overheating conditions in the vehicle's braking system. Result of heat indication on android application, Result of testing LCD display on overheat detector, Designation of overheat detection warning system.

4. CONCLUSION

The conclusions that can be drawn based on the results of the research that has been conducted up to the time this report was compiled, are as follows. Making an overheat detector can work according to changes in temperature and is able to show values through the display of the tool and can also be displayed on an android phone. The warning system can also work well in accordance with the settings given to the system. This research can be continued by applying it practically to the vehicle and whether it is able to change the driver's habits to determine the characteristics of the vehicle he is driving, especially the braking system which is the main point in this research. With the accuracy produced by the tool to inform the condition of the brake system to the driver, it is hoped that it will familiarize the driver to treat the vehicle according to the ability and safety limits of the vehicle. Safe behavior and also road safety will be improved.

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