Rail information system prototype with web-based magnetic detection method

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Abstract. Trains are the most popular means of transportation by some people because it is cheap, fast, safe and comfortable. Because of carrying a sense of security, the construction of supporting infrastructure must be made safe, ranging from signs to the implementation of the door guard system in the railway crossing. Still often found in some railway crossing areas there is no guard door crossing system, so there are many accidents that resulted in the absence of a railway door guard system. The prototype was built to develop a railway control system by applying microcontroller technology, minicomputer and Hall effect sensor. The system will automatically detect the train that will pass by sending railway traffic safety information via the internet near the railway crossing. So that road users can find out early if there is a train that will pass by seeing the information monitor.

1. Introduction
Trains are the most preferred means of transportation for some people because they are cheap, fast, safe and comfortable. Because it carries a sense of security, the construction of its supporting infrastructure must be made safe, starting from its signs to the implementation of a crossing guard system for railroad crossings [1]. Frequently, there is no system for crossing the railroad guard found in some railroad crossing areas. From 2015 to August 3, 2017 it was noted that the highest number of train accidents in non-official crossings reached 274. In a study conducted in Switzerland and Russia, magnetic fields that occurred on the railroad tracks were produced by boogie-driven traction motors, the results of the study explained the magnetic fields on the railroad fluctuating [2].

The strength of the magnetic field enlarges as the locomotive speeds up, brakes, climbs or pulls more and more loaded carriages. In the aspect of vibration experienced by the rail, if the rail is going to be traversed by a train, then the rail will experience vibration [3]. The closer the train, the greater the frequency of vibrations experienced by the rail [4].

2. Research methods
In this study, a model of a magnetic field information system on the railroad will be made that can be utilized as early prevention of train accidents using the sensor hall effect. In this case, it measures the sensitivity of the hall effect sensor in capturing the magnitude of the magnetic field [5].

Modeling using block diagrams is divided into two parts, namely the block of sensor data sender to the website and the recipient block of response from the website [6]. The working principle of sending sensor data to a website is a magnetic field as an input phenomenon will be captured by the Hall effect
sensor into an analog signal and converted into a signal digital by Arduino to be sent to the website using ESP8266 which is connected to the wifi modem SSID [7]. The working principle of the recipient block response from the website is when the data has been sent to the website by ESP8266, then the website will manage the data so that it becomes an information and an order to the raspberry pi that has a wifi modem SSID to activate the GPIO pin [8], so that the servo motor and buzzer function as a security system when a magnetic field is detected. Whereas to display magnetic field information or danger signs from websites using displays. Figure 1 below is an overall block diagram.

![Figure 1. Block diagram of the overall system.](image)

The process flow diagram is intended to describe the operational processes of the system that will later be made, and so that if then there are problems it can help to solve the problem. Figure 2 process flow diagram can be seen below.
Figure 2. Process flowchart.

The website design is intended to receive data from ESP8266 and make an order to turn on the Raspberry Pi GPIO pin. Besides this, the website is designed to provide information display to road users when the magnetic field is detected. Display information on the website is divided into two parts, first display with a red column warning where this condition is when the status is not safe/active. The website will provide information that there is a magnetic field as shown in figure 3 below, so that road users cannot pass.
ATTENTION PLEASE!!!

DO NOT CROSS
TRAIN PRIORITIZE
LOVE YOUR LIFE
FAMILY WAITING FOR YOU

Figure 3. Website designing is a magnetic field.

Next displays with a blue warning column where this condition is when the status is safe / standby, the website will provide information not detecting magnetic fields as shown in Figure 4 below, so that road users can pass.

PASSING CLER
HAVE A SAFE TRIP
AND KEEP COMPLY
WITH TRAFFIC SIGNS

Figure 4. Website designing there is no magnetic field.
3. Results and discussion
Testing of Magnetic Field Detection is done at a distance of 0-500 mm to find the threshold value of the magnetic field quantity captured by the hall effect sensor, figure 5 shows the test results obtained.

Based on figure 5 above, the highest value when the magnetic field is detected by the hall effect sensor reaches 4.4 V / G which is at a distance of 0-3 mm and then drops to reach its lowest value of 2.8 V / G at a distance of 19-30 mm. The 2.8 V / G value on the sensor hall effect according to the datasheet is also referred to as the initial value or equal to "zero", because of the Hall effect sensor issues a voltage on the "Out" foot of approximately half of the input voltage. The Hall effect sensor successfully detects a magnetic field at a distance of 0-18 mm, this distance is hereinafter referred to as "there is a magnetic field", while at a distance of 19-500 mm, hereinafter referred to as "no magnetic field".

Testing the response time website is done ten times to test the website changes its appearance or not when receiving incoming data from ESP8266 and knows the time needed when the website responds and after responding, the website can be accessed via the address "www.lab-android.com/kereta". As previously known, the website appearance is designed into two parts, first the condition when there is no magnetic field detected, the second is the condition when the status is not safe / active when a magnetic field is detected. Figure 6 shows the test results obtained.

Based on figure 6, the highest value in testing when there is a magnetic field is the same as the longest time in responding to incoming data from ESP8266 or there is a magnetic field of 6 seconds on the 9th test and the lowest value is the fastest time of 4 seconds on the 5th test. The highest value in testing when there is a magnetic field is the same as the longest time after responding to incoming data from ESP8266 or after there is no magnetic field which 10 seconds on the 6th test and the lowest value equals the fastest time of 3 seconds on the 8th test. In both of these tests, there is an average and after no magnetic field is 5.8 seconds.
Testing the response time of the system when There is a Magnetic Field carried out 10x to test the response time and display of the website when the system detects the magnetic field active status, figure 7 below shows the test results obtained.

Based on figure 7 above, ESP8266 successfully sends data to the website and the website changes its appearance to be active/alarm so that it can order the output of raspberry pi to be active. The highest value in this test is the same as the longest time, the sender of sensor data to the website is 5 seconds on the third test, and 7, the recipient of the response from the website is 3 seconds in the 7th and 9th tests. The lowest value is the fastest time, the sensor data sender to the website is 3 seconds on the 5th, 7th and 9th tests, the recipient of the response from the website is 2 seconds on the 1st, 3rd and 5th tests.
Testing System Response Time When There Is No Magnetic Field is done 10x to test the response time and website display when the system does not detect the magnetic field passive status, figure 8 below shows the test results obtained.

![Graph showing response times](image)

**Figure 8.** System response time testing detects the magnetic field

Based on figure 8 on the previous page, ESP8266 does not send data to the website and the website changes its appearance to be safe / standby, so it can order the output of raspberry pi to be passive. The highest value in this test is the same as the longest time, the sender of sensor data to the website is 6 seconds on the 10th test, the recipient of the response from the website is 4 seconds on the 2nd and 4th test. The lowest value is the fastest time, the sensor data sender to the website which is 3 seconds on the 6th and 8th tests, the recipient of the response from the website is 2 seconds on the 2nd and 10th tests.

4. **Conclusion**

Based on the design, implementation and testing, conclusions can be drawn as follows: The hall effect sensor has a sensitivity to detect magnetic fields at a distance of 0-18 mm with an out voltage of 4.4-2.9 (V / G), whereas not detecting a magnetic field has an out voltage of 2.8 (V / G) at a distance of 19-500 mm. The technical response that receives data from the ESP8266 module has an average of 5.8 seconds. The response time of this device when detecting a magnetic field has the fastest time of 3 seconds for the sender of sensor data to the website at the 5th, 7th and 9th test, while the recipient of the response from the website is 2 seconds on the 1st, 3rd and 5th tests. The response time of this device when not detecting a magnetic field has the fastest time of 3 seconds for the sender of sensor data to the website in the 6th and 8th tests, the recipient of the response from the website is 2 seconds on the 2nd and 10th test.

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