Design of Prototype Measuring Motor Vehicles Velocity Using Hall Effect Sensor Series A-1302 based On Arduino Mega2560

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***Abstract*— This system is designed to get vehicle speed information on the highway. Because the speed of a vehicle on the highway is very influential on other road users. Even based on data taken by the National Police Traffic Corps, speed on vehicles is one of the five violations that are often committed by vehicle users. From this, the authors tried to develop a speed measurement system with the Hall Effect Sensor. The method used in this system is to place two Hall Effect sensors with a certain distance connected to the Arduino Mega2560. When the vehicle passes the first sensor, the timer will start and when the vehicle passes the second sensor, the timer will stop. The results of the construction between the travel time of the vehicle and the distance from the two sensors are what states the speed of a vehicle and will be displayed on the Liquid Crystal Display (LCD) and stored automatically on the SD Card.**

Keywords— Hall Effect Sensor, Arduino Mega2560, SD Card.

I. INTRODUCTION

In modern times such as the current motor vehicle has very much experienced development. According to a survey recorded by the Central Statistics Agency in 2016 in Indonesia, there were 129,281,079 motor vehicles while in 2017 there were 138,556,669 which means there was an increase of approximately 9,000,000 motorized vehicles [1]. In fact, according to data taken by the National Police Traffic Corps, speed on motorized vehicles is one of the five violations that are often committed by road users. That led to the idea to make a design and development device prototype measuring motor vehicle velocity using Hall Effect Sensor Series A-1302 based on Arduino Mega2560 [2].

To implement the idea, two Hall Effect Sensors Series A-1302 are needed at a certain distance to get the time difference of the vehicle when it reaches the first Hall Effect Sensor to the second Hall Effect Sensor [3]. The output from the Hall Effect Sensor will be processed by a microcontroller, Arduino Mega2560, where the results of the processing done by Arduino Mega2560 will be displayed on the Liquid Crystal Display (LCD) and stored on the SD Card. When there are vehicles that exceed the preset speed, the Arduino Mega2560 microcontroller will send a short message to the recipient's number with the help of the GSM SIM800L module [4].

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The idea was obtained from previous studies, namely research by A. S. Ramdhani entitled Designing a vehicle velocity measurement system using magnetic sensors that get the conclusion that vehicle speed measurements using low input voltage and the distance between two magnetic sensors above 30cm will produce measurements that are optimal [5]. As well as research conducted by A. S. Syifa with the Prototype of vehicle velocity detection with ultrasonic sensor based on Arduino Uno R3which concluded that the prototype was designed to run well and the need for a flat cross-section for this sensor to work optimally [6]. Vehicle speed detection using the ultrasonic principle has been carried out [7, 8] and using the principle of magnetic field detection [9]. However, most of these studies do not detect in real time and no one has done a monitoring system in the form of a warning if a speed limit violation occurs

II. RESEARCH METHOD

In this research, a motorized speed measuring device was designed using Hall Effect Sensor Series A-1302 based on Arduino Mega2560 . The main components of this device consist of Hall Effect Sensor Series A-1302, Arduino Mega2560, Real-Time Clock Type DS1307, GSM800L Module, Shield SD Card Module, LCD 4x20 and also the power supply. This device is designed to measure the speed of motorized vehicles using the Hall Effect Sensor Series A-1302 as a component of its speed gauge, while the 4x20 LCD is used as a viewer of the measurement results in addition to that the measurement results that have been displayed on the 4x20 LCD will be stored in Micro SD Memory as Data Logger. This device is also designed to give a warning in the form of a buzzer and a short message if there are vehicles whose speeds exceed the predetermined limits. The prototype design result could be seen in Figure 1.

When the object measured passes the first Hall Effect Sensor the Timer will be Start and when the object arrives at the second Hall Effect Sensor the Timer will stop. The time difference between Stop and Start will be multiplied by the distance that has been determined, the multiplication process will be carried out by Arduino Mega2560. The results of the processing carried out by Arduino Mega2560 will be displayed on the Liquid Crystal Display (LCD) 4x20 and stored on the SD Card with the help of modules SD Card besides that SD Card will also save the object time passing

through the second Hall Effect Sensor with the help of Real-Time Clock (RTC) DS1307. If there is a vehicle that violates the speed with a predetermined buzzer will sound and the GSM SIM800L module will send a short message to the recipient's cellphone, that there is a speed that exceeds a predetermined limit.

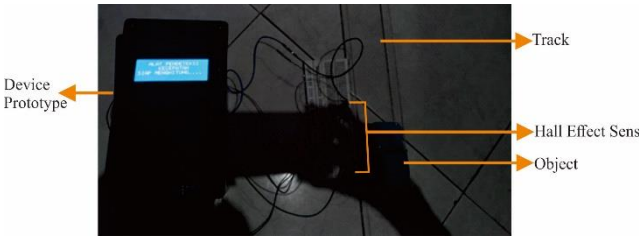

Fig. 1. Prototype of motor vehicle velocity measuring

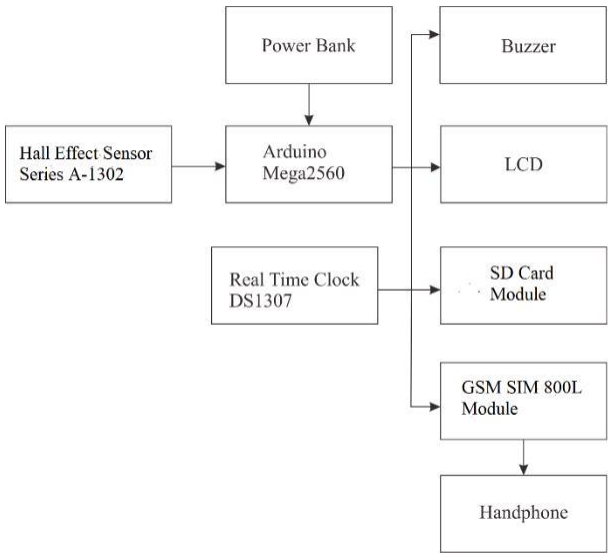

Fig. 2. Shows the block diagram design of prototype

The functions of the device or components used in this research are as follows:

- Computer Core i3 is used to program the Arduino Mega2560 microcontroller.
- Arduino Mega2560 is used as the main controller for processing design device.
- Hall Effect Sensor Series A-1302 is used as a detector for motorized vehicle whose speed will be measured.
- Liquid Crystal Display (LCD) 4x20 is used as a data viewer that has been processed by Arduino Mega2560.
- The SD Card Module is used to store data that has been processed by the Arduino Mega2560 microcontroller and has been displayed on the LCD.
- Real Time Clock (RTC) DS1307 functions as a date and time display when a vehicle is detected on a device designed and stored on the SD Card.

Converter DC Step Down XL4005 is used to reduce the voltage in accordance with the requirements of the GSM SIM800L Module.

- GSM SIM800L module functions to send a warning if there is a vehicle that is detected violating the speed that should be.
- Buzzer serves as an indicator or reminder if there are vehicles that are detected violating the speed that should be.
- Arduino IDE is used as software to manage the commands that Arduino Mega2560 must do.

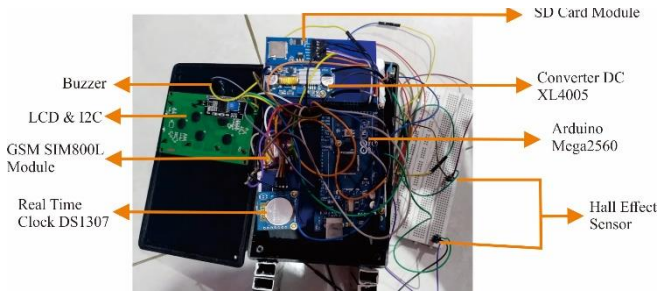

Fig. 3. Design of research device

In the prototype design of a vehicle velocity measurement device using the Hall Effect Sensor Series A-1302 (Fig. 3), data collection was carried out by two methods: using a toy car and using a motorized vehicle in actual conditions. Data retrieval in this research was carried out at the Electronic Engineering Laboratory, Integrated Laboratory of Electrical Engineering, the Universitas Lampung. Then the results of the data retrieval will be manually recalculated to ensure that the prototype of a vehicle velocity measurement device using the Hall Effect Sensor Series A-1302 can run well.

In collecting data using a toy car, a 1.2-meter track is used for the toy car to move. Starting from a distance of 10 cm between the two sensors up to 100 cm with a change in the distance between the two sensors is 10 cm per ten data. The toy car is added with a magnet so that the Hall Effect Sensor Series A-1302 can measure the velocity of the toy car (Fig. 4).

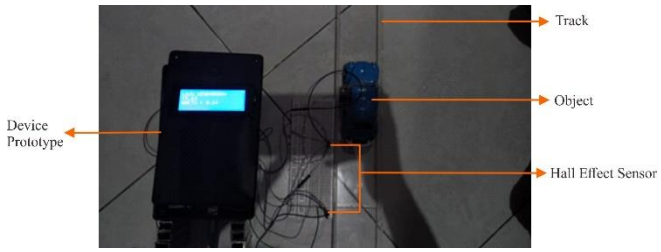

Fig. 4. Data Collection Process Using Toy Car

After the toy car passes the second Hall Effect Sensor Series A-1302 series or is set as a time stop, the Arduino Mega2560 microcontroller will process and the results will be displayed on the LCD. If there is a violation, then the buzzer will sound and the GSM SIM800L module will send a message to the destination number. Figure 5 shows the results on the cellphone screen.

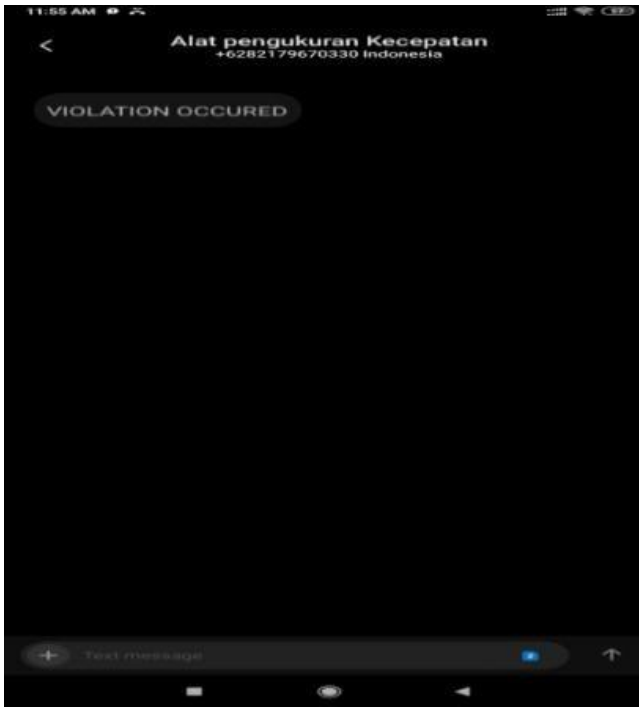

Fig. 5. Display Short Message On Recipient's Telephone Number

In collecting data with actual conditions, the object and the distance between the two Hall Effect Sensor Series A-1302 are the differentiators. The Honda Scoopy motorcycle 2019 is used as an object and 5 m is the distance used in collecting data in actual conditions, with velocities ranging from 5 km/h to 8 km/h and each velocity is taken 10 data each (Fig. 6).

Fig. 6. Data Collection Conditions In Actual Conditions

When the overall data collection is needed a tool as a place to put the Hall Effect sensor series A-1302 to detect the magnets on the motorcycle.

Fig. 7. Location of Hall Effect Sensor Series A-1302

From this location the results obtained that the Hall Effect Sensor Series A-1302 is only able to detect magnets that are on the motorcycle with the distance from the sensor to the magnets on the motor is from 5 cm to 15 cm (Fig.7).

Same of taking data on a toy car, when the motorcycle has passed the second Hall Effect Sensor Series A-1302, the Arduino Mega2560 microcontroller will process then the results will be displayed on the LCD, if there is a violation the buzzer will sound and the GSM SIM800L module will send a message on the recipient's number.

III. Result And Discussion

The first step is to conduct a laboratory-scale trial using a toy car at the distance between the first sensor and the second sensor of 10 cm. The result obtained have an average deviation of 0.0025, an average error value of 0.00003% and an accuracy value of 99.999948%.

The second step is still laboratory scale using toy car with a distance sensor from 10—100 cm. The result obtained an average deviation of 0.0002, an average error value of 0.0000004% and an accuracy value of 99.99996%.

The third step with actual condition at the distance between the first sensor and the second sensor of 5 m. The result obtained have an average deviation of 1.1912, an average error value of 31.47% and an accuracy value of 68.5226%.

The next step with actual condition the velocity of speedometer is 5 km/h—8 km/h. The result obtained an average deviation of 1.4959, an average error value of 31.461875% and an accuracy value of 68.538125%.

In this research, linear regression calculation is done with the equation:

$$y = a + bx \quad (1)$$

The y value is the measured value on the speedometer while the x value is the output value of the designed device. a is a constant and b is a coefficient of the value of the variable x.

So from the equation get the following results (Fig. 8):

$$y = 0.991x + 1.4991 \quad (2)$$

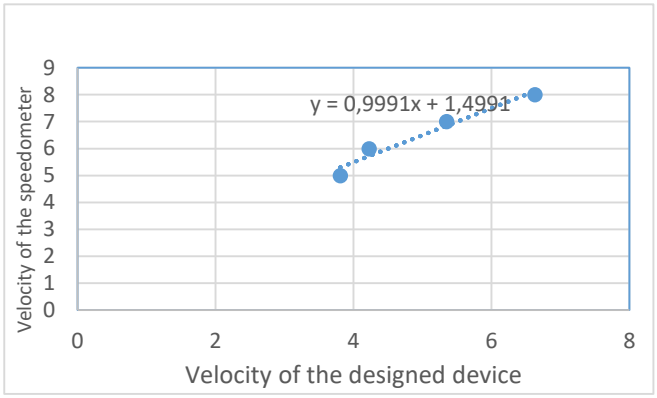

Fig. 8. Linier Regression Chart

In addition to using linear regression equations, this research also uses calculations using polynomial regression (Fig. 9). So the results obtained are as follows:

$$y = -0.2157x^2 + 3.2552x - 4.1308 \quad (3)$$

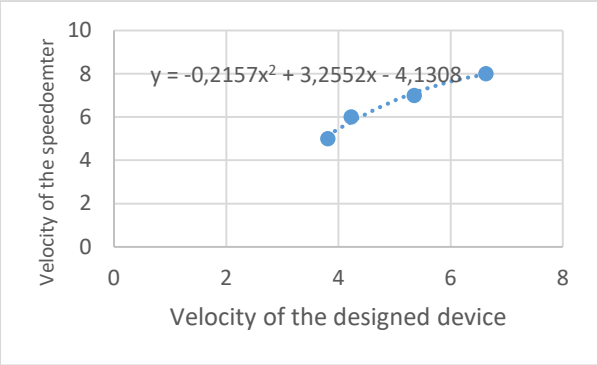

Fig. 9. Polynomial Regression Chart

After getting the correlation equation between the velocity value on the design device and the velocity value on the speedometer, then the value can be used to calculate the velocity value on the design tool by entering Equation 2 or Equation 3 in the program that has been made.

After using linear regression equations get an error of 3.5831% while in the polynomial regression equation get an error of 2.1342%.

After analyzing, there are several factors that influence the level of error value of the measurement data on the design device, factors that affect the error value include the following:

- Wiring between sensors, wiring between sensor one and sensor two is very influential on the accuracy of the data generated by the device that has been designed. Because it is very vulnerable to broken cables or there is an error cable.
- The level of accuracy of the sensor, the level of accuracy of each sensor is different, therefore this is very influential on the data that will be generated by the device that has been designed.

IV. Conclusion

After making the design and analysis, it can be concluded that the design and development device prototype measuring motor vehicle velocity using Hall Effect Sensor series a-1302 based on Arduino Mega2560 has been realized. The function of this designed device is to measure the velocity of a motorized vehicle, where velocity data will be stored on the SD card and displayed on a 4 x 20 Liquid Crystal Display (LCD) and when there are vehicles whose speeds exceed the speed they should be, the buzzer will turn on and the GSM SIM800L Module will send a short message with an average error value of 2.1342%.

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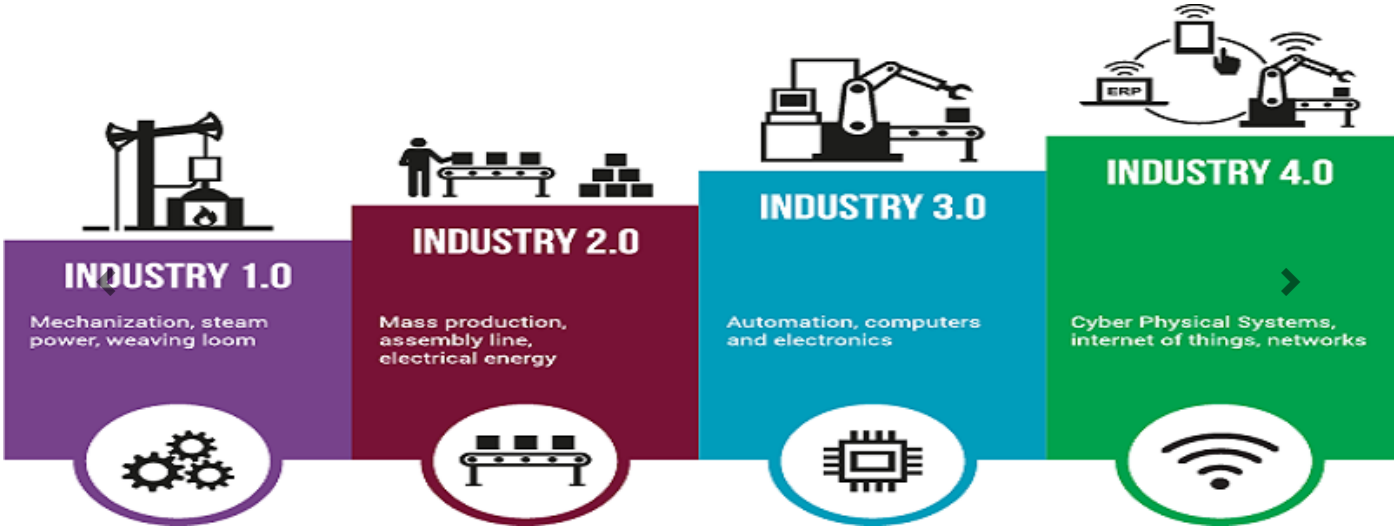

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