Design of overloading detection systems on vehicles using Arduino

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Abstract. Developing countries such as Indonesia are currently continuously conducting development activities in the economic sector. The role of transportation facilities is very important. The reason is that economic movement is not only centered on one particular area but also reaches out and involves other regions. Distribution of goods and services requires safe and convenient transportation and good road infrastructure. In practice, many heavy vehicles carry a very excessive transport load. This is due to the large distribution needs of goods to minimize operational costs. The negative impacts of overloading include the risk of accidents and road damage. This study aims to use a prototype method by utilizing the implementation of a load control system using a proximity sensor run by Arduino Uno. This concept utilizes proximity sensors to regulate transportation loads according to the standards of the Republic of Indonesia and monitor violations in real-time. The results of the study resulted in a prototype capable of detecting overload based on load height and suspension changes for loads.

1. Introduction
Damage to existing roads in Indonesia is a routine problem that must be faced every year. The road maintenance program carried out so far is deemed incapable of solving the problem of road construction damage that is faster than the planned age [1]. Damage to roads that has occurred has been accelerating because the roads are overloaded beyond their planning capacity. Damage to roads results in a high cost economy because travel times are longer and vehicles are also damaged more quickly. In addition, population growth and prosperity are one of the causes of the increase in road traffic accidents because of the increasing number of people traveling but not directly proportional to public awareness of the importance of maintenance public facilities [2, 3]. Whether drivers of cars, motorbikes, or other vehicles, of course, all have multiple safety objectives that don't want to be bargained with anything. However, now driving safety planning does not seem sufficient only from the point of view of the vehicle user. The rise of road accidents caused by goods transporting vehicles as a result of overloading causes concern for other road users and people living around the road. In addition to causing casualties, truckloads that exceed their capacity can also cause damage to the road body.

Road infrastructure can affect the condition and pace of the economy in Indonesia [1]. Damaged roads become obstructions in a supply-chain process. The impact of road damage also results in reduced vehicle life, more frequent replacement of spare parts, and the function of the road structure cannot serve optimally [4, 5]. Based on existing data, road damage is caused by errors in planning, design, and implementation in the field, uneven road maintenance and repair [6, 7], poor drainage systems [6], and the behavior and habits of road users [2,3,8]. The behavior and habits of road users, especially trucks that load beyond the tonnage limit [9,10,11]. The dominance of heavy truck or tronton vehicles that are often passed because being in the factory area will make roads break down faster, and there need to be
road repairs every year on provincial roads such as holes and puddles that harm road users and ultimately disrupt the economy in Indonesia. The solution to overcome this problem is an automatic control system that is needed to create a load control system [12,13] that uses a proximity sensor that is run by Arduino Uno. This study aims to use a prototype method by utilizing the implementation of a load control system by Arduino Uno utilizes proximity sensors to regulate transport loads according to the standards of the Republic of Indonesia and monitoring violations in real time.

2. Literature and method

2.1. Literature
Here are some of the previous research that became the basis of this research:

a. In research conducted by Yanling Liu et al., they have utilized vibrations to gather vibration information. Raspberry pi is used as a center for information collection equipment. Use circuits to convert simple analog signals to become digital/computerized signals associated with remote systems. Still use the classic SVM model to organize information and decide the status of the vehicle [14].

b. Kattimani et al. conducted research by prioritizing the practicality of the vehicle load control framework through the load cell strain size implemented in the vehicle, the single-chip microcontroller gets data that is transmitted and obtained through sensors and calculates the overall vehicle load. If the vehicle is overloaded, the microcontroller will give directional commands to the vehicle frame to prevent starting the frame system [15].

c. In Research conducted by Jai Ganesh they make a system that has proposed using the dynamic method for estimation of truckload weight based on the compression of the suspension. This framework utilizes ultrasonic sensors for the dynamic estimation of load weight. These sensors are appended to the base of the truck’s holder. At the point when the truck is stacked, the heaviness of the load causes compression of the suspension of the truck; because of this there is variation in distance delivered by ultrasonic sensors [16]

2.2. Method
This planner system starts with the creation of programs as well as adjustments to the tools and needs of materials used, then is organized into a program using the C# language created with the Arduino IDE application. The completed program will be sent into Arduino Uno [16]. After the process is completed Arduino will process coding scripts that we have compiled in the program that are useful in activating sensors and system support tools connected to Arduino Uno. In this system, the sensor used is an ultrasonic sensor with an HC-SR04 model that serves as a distance reader sensor of an object or object, attached to the body and bottom of the modified vehicle prototype, which can be seen in Fig 1.

![Figure 1. Location of Implementation Sensor](image-url)
The flow of the process is begin from ultrasonic sensor 1 to measure the lower distance (truck suspension), if the measured distance is small, less than standard, then the process will recalculate. The process continues when the distance is large or minimal according to the standard. Overloading on vehicle-type goods is calculated from the total axis load distributed from vehicle load and load itself. The difference in the number of axes on the truck results in load levels that can be loaded. In this study, the standard limit for B (weight) is 20, and T (height) is 10. Once the first sensor detects a large distance, then the relay will be at a low position, and the second ultrasonic sensor will identify the connection with the payload height, if the distance appears large, then the relay is at a low position, and the monitor will display the stater on status, but if the data obtained is small then the relay will be at a high position and the monitor will display the stater off and will send the data to the server, flowchart rule of the sensor shown in figure 2.

![Flowchart Rule of Sensor](image_url)

**Figure 2. Flowchart Rule of Sensor**

### 2.3 Black-Box testing
Black box testing is useful to test the state of the system ranging from functions or features. The black box testing is also useful for defining inputs, conditions and testing the functional specifications of the program

### 3. Result and discussion

#### 3.1. Result
The system is automated, as the system re-scans through the sensor at all times specified in the script, and the system is specific only to the distance input of the ultrasonic sensor as the input used to read the suspension and payload height. The data that has been processed is handed over to the relay then the data will be transferred to the receiver through the information system as a history of violations that have been committed, if the load and high load are excessive, then the machine is off, if the payload and high standard payload then the machine lives. The active sensor will begin to function by detecting the distance from an object with an ultrasonic sensor attached to a miniature vehicle, adjusting commands
that have been programmed and have been installed in the Arduino Uno. Then the sensor sends data to Arduino Uno to be processed according to the program script stipulated in Arduino Uno. After the process is complete, the system will produce the output or output of the program displayed to the LCD and sent via gsm/GPRS module to the information system that has been prepared. Fig 3 is an overview of the Design of Overloading Detection Systems On Vehicles Using Arduino:

**Figure 3.** Design of overloading detection systems on vehicles using arduino

### 3.2. Discussion

The result of the implementation of the payload detection system on this vehicle is that with both ultrasonic sensors that detect objects with a distance of more than the limit it will appear on monitors B (Weight) and T (Height) will display the size of the already detection sensor and under the engine will be written On and the relay will connect the electrical path so that the car marker lights live as a sign the car starter engine is on. The resizing of both ultrasonic sensors with a delay of about 3 - 5 seconds ensures the size of the sensor.

Conducted 2 tests, Test 1 : with input from sensor 1 (B) is 35 and T is 25, and test 2 : with input from sensor 1 (B) is 122 and T is 5. Based on the rule of sensor that has been created on Fig. 2 and the limit of T is 20 and B is 10, hence generating the stater on (“Mesin Start”) on for test 1 as in figure 4, while for testing 2 produces a stater off (“Mesin Mati”) as seen in figure 5.

**Figure 4.** Result of test 1
Figure 5. Result of test 2

When the result of the rule of the sensor is the machine is off, then the data will be sent to the server to send SMS notification, as seen in figure 6.

Figure 6. Result of implementation server and SMS notification on prototype

Testing on this prototype was done using black-box testing and getting valid results for black-box testing.

4. Conclusion

Using the transmission detection system in Arduino Uno-based vehicles can make driver get used to obeying. Using Arduino Uno-based Vehicle Load Detection System, can reduce violations due to overload and high payload, because Implementation the transmission detection system in Arduino Uno-based vehicles, it can reduce road damage due to excess vehicle tones and The use of Load Detection System in Arduino Uno-based Vehicles, this can increase efficiency and effectiveness in managing the life of vehicles and also can make driver get used to obeying the rules.

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