Available Online: https://proceeding.researchsynergypress.com/index.php/cset/index
RSF Conference Series: Engineering and Technology
ISSN 2809-6843 (Online) | 2809-6878 (Print)
Volume 2 Number 2 (2022): 49-57

Vehicle Accident Detection Monitoring System with Web Server and Telegram

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Abstract

Every year the number of vehicles in Indonesia is increasing; this is also directly proportional to the accidents that occur. With the increasing number of victims of vehicle accidents, serious handling is needed. The average number of accident victims who die in Indonesia is three people every hour due to road accidents. Therefore, serious and fast post-accident handling is needed to reduce the number of fatalities due to accidents. The tool's purpose is to maximize post-accident handling, so research is carried out to make an internet-based vehicle accident information tool. The tool that is made can detect the accident's location to speed up post-accident handling using the internet with the latest location information sent and photos of the driver's last condition after the accident. The research method used in this research is Research and Development (R&D) in designing internet-based vehicle accident information tools as a communication medium for sending data, telegram, social media applications, and web servers are used as vehicle monitoring simulations. The accident information system is designed to use a vibration sensor as a trigger and an accelerometer sensor to detect the degree of vehicle tilt. Tests were carried out on tools made and applied directly to vehicles by changing the slope of the vehicle as an accident simulation. The information tool can send the location and photos of the driver's current condition after the accident simulation is detected to telegram and the web server.

Keywords: *Accident, Telegram, Internet of Things, Web Server, Crash Location*

INTRODUCTION

Transportation is one of the supports in everyday life, all the movements we do today depend on transportation. Several modes of transportation can be accessed in Indonesia. The land transportation modes are further divided into two: road and rail, sea and air transportation. All this transportation aims to serve the increasingly high mobility of the people at this time. With the increasing mobility of people, people want easy and practical transportation. Impact of the high public interest, they finally prefer private transportation. The positive impact is that transportation continues progressing regarding technology, comfort, and safety. In comparison, the negative impact is the increasing number of vehicles each year which eventually causes various problems. Based on data from the Central Statistics Agency in 2017 in Indonesia, the number of vehicles was recorded at 118,922,708. This number continues to increase; in 2020, it was recorded at 136,137,451 vehicles. The impact of the increasing number of vehicles causes various problems, one of which is traffic accidents. A traffic accident is a collision between a vehicle and a vehicle or with other objects that cause damage and sometimes causes injuries and even death (Collaboration, 2011). Victims of death due to accidents also cannot be underestimated because, according to data

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DOI: 10.31098/cset.v2i2.558

obtained from the Indonesian Police, an average of 3 people die every hour due to road accidents. Several factors also influence the accident. Five factors cause accidents; first, the human factor that most often occurs is traffic violations committed by someone, such as crossing the road carelessly. Second, the driving factor is caused by the loss of driver concentration. Third, road factors and damaged road conditions also influence accidents. Fourth, the motor vehicle factor relates to the feasibility of the vehicle operating on the road. Fifth, natural factors cannot be controlled because they depend on natural conditions such as rain (Enggarsasi, 2017). Of the many accidents that claim victims, it is necessary to pay attention to post-accident handling to reduce the number of fatalities due to road accidents. To realize this, technology is needed that can provide information quickly and precisely. Technology that can monitor and provide information from vehicles that have an accident. Especially the location information to speed up the handling after the accident.

LITERATURE REVIEW

The research that has been done is a speed monitoring tool using the internet by Darmawan (2020). This study aims to monitor the rate of motorized vehicles from a distance, especially vehicles used by teenagers who often have accidents due to driving at high speeds—the main components of the nodemcu esp8266 microcontroller and the ublox neo 6M GPS module. The result of the tool made is monitoring vehicle speed remotely connected to an internet connection. The following research is the design of a website-based car and location security system by Kariema and Ijran (2018). This study aims to develop a security system for motorized vehicles. This study uses the Arduino system as the central controller. It utilizes the Neo 6M GPS module as a location tracker and a fire sensor as a fire detector. The information obtained is processed by the WiFi module and sent to the monitoring website. The results tool can detect the location, smoke in the cabin, and the engine's status on or off. The above data is sent to the website as vehicle monitoring. The following research is a simulation tool for GPS tracking tools based on the internet of things with a telegram bot by Ningartuti (2021). This study aims to control the vehicle and make monitoring its speed and location easier. The components used are nodemcu esp 8266, speed sensor, and GPS module. The results obtained are the vehicle's location and the car's speed, whose data is sent by telegram. With some of the research references above, the author will make an accident detection information tool with monitoring via webserver and telegram. The difference between the tools made in previous studies is the addition of the Arduino esp32cam camera module to take pictures, the mpu6050 accelerometer sensor to detect the slope of the vehicle, and the 801S vibration sensor. This study uses a webserver for vehicle monitoring by sending the car's location and photos of the driver in the event of an accident, as well as the telegram bot application as a provider of information to the closest people whom the system has determined.

A. Traffic Accidents

Traffic accidents in Indonesia are increasingly worrying because there are many victims due to accidents ranging from minor injuries to victims of death. According to Law No. 22 of 2009, a traffic accident is an event on the road that is unexpected and unintentionally involving a vehicle with or without other road users resulting in human casualties or property loss. Accidents occur unintentionally and unplanned, which can cause material loss of life.

B. Velocity

Speed is the average distance a motorized or non-motorized vehicle can travel in a section of the road at a particular time. Vehicle speed is influenced by human factors, vehicles, infrastructure, traffic flow, weather conditions, and the natural environment (Kawulur et al., 2013). One way to reduce the number of road accidents is to limit vehicle speed. Speed restrictions are regulations that limit the rate or speed of vehicles to reduce traffic accidents on the highway. To limit this speed, general rules or special rules are used to limit low speeds due to crowds, around schools, many activities on the road, energy saving, or road conditions. Since about a third of traffic accident victims die from speeding, speed limits are a powerful tool for controlling the number of road traffic fatalities (Sinaulanan et al., 2015).

C. Internet of Things

The internet of things is the result of researchers' thinking to optimize existing technologies such as sensor media, Radio Frequency Identification (RFID), wireless sensor networks, and other bright objects that allow humans to interact more easily with all these equipment through the internet network (Junaidi, 2015). The basic idea of IoT is to connect multiple devices in one network and exchange data with other devices. Currently, the development of the way IoT works is undergoing rapid growth, such as the addition of security and blockchain capabilities. IoT impacts government agencies, industry, education, and health (Wilianto & Kurniawan, 2018). From this, we can conclude that the Internet of Things (IoT) is a computer system with devices connected to the internet and connected to other devices. The Internet of Things (IoT) has become an integral part of our daily lives. Many of the instruments we use are connected to the internet and have many advantages because they can be more efficient and convenient. One of the Internet of Things (IoT) uses monitoring the vehicle's condition while traveling.

D. ESP32CAM

The ESP32CAM is a dual-mode module containing WiFi and Bluetooth that uses an antenna and a PCB board core based on the ESP32 chip. This module can operate independently as a minimal system. This module is a WiFi module with an OV2640 camera. This module can be used for various purposes, such as CCTV, photography, etc. ESP32CAM is a development of Arduino, a module designed to support IoT products. The ESP32CAM has a WiFi module embedded directly on the PCB, so it can connect directly to WiFi without adding devices such as a WiFi module (Fauzan, 2020).

E. Accelerometer MPU6050 Sensor

An accelerometer is a sensor designed to measure acceleration, detect and measure vibration, or measure acceleration due to Earth's gravity. Accelerometers can also be used to measure vibrations generated by vehicles, buildings, and machinery and to measure vibrations occurring within the Earth, engine vibrations, and dynamic distances and speeds with or without the influence of the Earth's gravitational attraction. (Zakaria et al., 2017). This sensor motion detection relies on three axes working simultaneously: the x-axis, y-axis, and z-axis. The MPU6050 sensor is very reliable because there are 16 analog bits, where each channel contains a MEMS accelerometer and a MEMS gyro.

RESEARCH METHOD

The researcher used the Research and Development (R&D) research method in this study. Research Research and Development (R&D) is a method that innovates to make research more interesting and adapted to specific learning objectives, be it the development of new products or existing products (Muqdamien et al., 2021). Research & development refers to the model of Analyzing, Design, Development, Implementation, and Evaluation by Robert Maribe Branch with the development process as follows:

A. Literature Studies

The literature study conducted by the researcher is to look for references that contain theories or materials related to the design of vehicle accident information providers and also look for components that will be used in assembling the tools that the author will make. The references are in the form of journals, books, research reports, pictures related to research, and other sources on the internet that are actual.

B. Tool Concept

The concept of the tool is to determine the software components and hardware components needed in the manufacture of the tool. The software components of this tool consist of the Arduino IDE program, notepad++, and fritzing. The hardware components consist of nodemcu, esp32cam, GPS, mpu6050 accelerometer, 801S vibration sensor, and OLED display.

C. Program Verification

It aims to ensure that the program that works on the tool is made as expected.

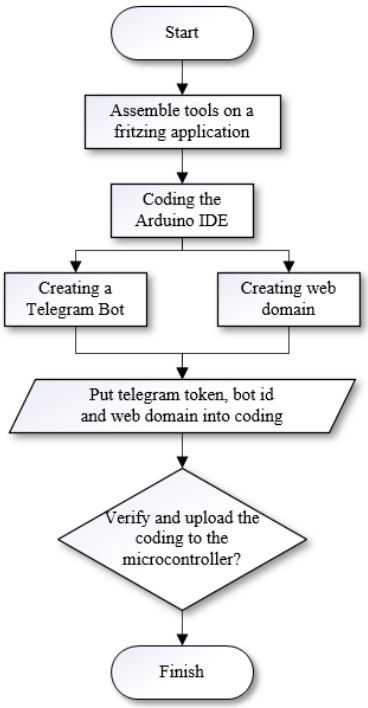

Figure 1. Program verification flow chart

First, assembling the tools in the fritzing application with predetermined hardware components, then coding on the Arduino IDE and uploading it. After the Arduino IDE program has been running well, proceed to create a telegram bot by entering a token and bot id and creating a domain that will be used as data storage on the web server. Then change the Arduino IDE coding to be able to enter the token, bot id, and web server domain. Furthermore, the process of finalizing the program so the tool can work as expected.

D. Tool Assembly

The hardware components determined in the literature study are assembled according to the needs of the required tool functions.

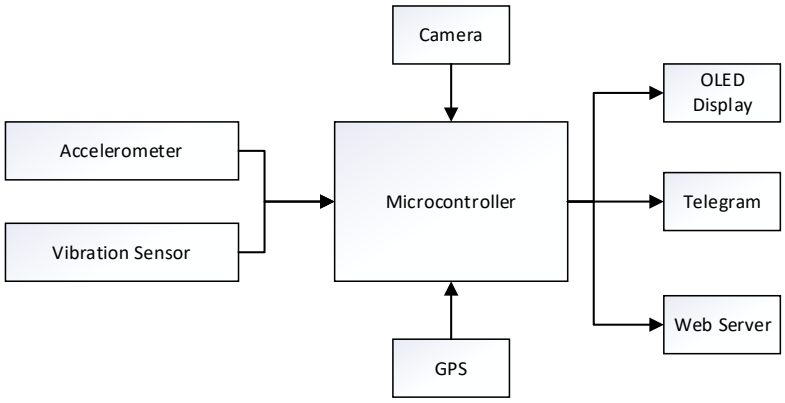

Figure 2. Block diagram

The system in this tool consists of 4 inputs and three outputs. The accelerometer and vibration sensor act as triggers for accident detection, then the camera and GPS will send data if the accident detection conditions have been met to the OLED display, telegram, and web server.

E. Trial and Diagnostic

Tool testing is carried out to ensure that all components, both hardware, and software, can work as expected. Among them are the completeness of the tool, the performance of each element in the device, the synchronization of the data sent and received, and the validity of the data.

FINDINGS AND DISCUSSION

The design of the accident information tool is built from a system consisting of various components connected, a sender circuit and a receiver circuit. In the sending course, the accelerometer and vibration sensor are tasked with detecting accidents that occur; it is assumed that the microcontroller will process the slope and vibration of the vehicle. The driver accepts accidents with a pitch of 45° on the X and Y axes, and 10,000 vibrations are detected. As a processor, the microcontroller will receive tilt and vibration data sent by the accelerometer and vibration sensors. If the information sent by the sensor detects tilt and vibration does not exceed the limit, the microcontroller will not send accident information to the telegram or web server. Meanwhile, suppose the information sent by the sensor detects excessive tilt and vibration. In that case, the

microcontroller will send accident information in the form of the accident's location and the driver's latest photo.

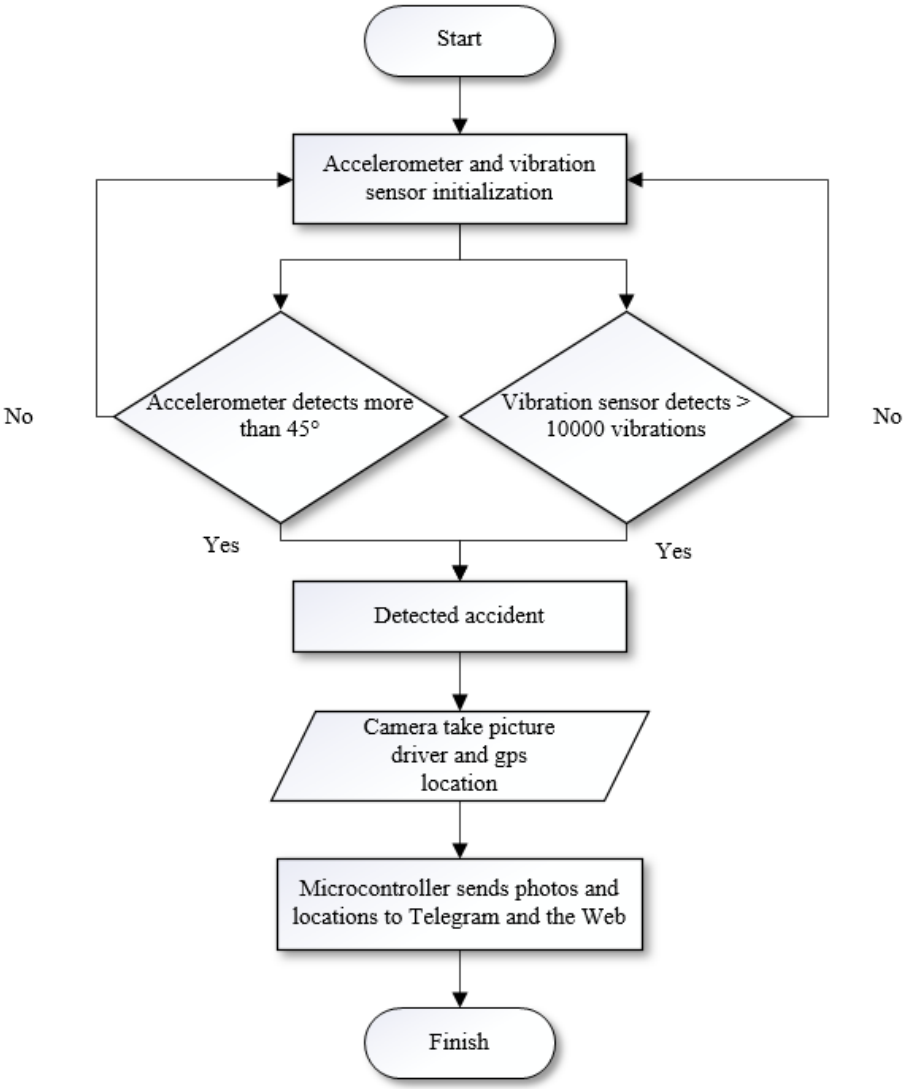

Figure 3. Flow chart device monitoring accident

Table 1. The results of the application of the accident information tool on the vehicle

Vehicle Condition	Telegram		Web Server		Information
	Photo	Location	Photo	Location	
Idle Vehicles	×	×	×	×	The slope has not met the 45° limit
Running vehicles	×	×	×	×	The slope has not met the 45° limit

Vehicles experienced vibrations > 10000	√	√	√	√	Location coordinates received; GPS position good
Y-axis tilt= 15°	×	×	×	×	The slope has not met the 45° limit
Y-axis tilt= 30°	×	×	×	×	The slope has not met the 45° limit
Y-axis tilt= 45°	√	√	√	√	Location coordinates received; GPS position good
Y-axis tilt= 65°	√	√	√	√	Location coordinates received; GPS position good
X-axis tilt= 10°	×	×	×	×	The slope has not met the 25° limit
X-axis tilt= 15°	×	×	×	×	The slope has not met the 25° limit
X-axis tilt= 25°	√	√	√	√	Location coordinates received; GPS position good

Testing the slope of the Y-axis and X-axis on the vehicle is simulated if the vehicle has an accident such as overturning and overturning. The Y axis is manufactured with a slope > 45°, and the X axis is simulated with a pitch> 25°. For vibration, sensors must measure vibration > 10000.

Figure 4. Tilt Y-axis = 45°

With the simulation detecting an accident due to the Y-axis tilt > 45°, the microcontroller will send location data prepared by GPS and a photo of the driver's last captured condition to Telegram and Web Server.

Figure 5. Receipt of location data and photos via Telegram with Y-axis simulation > 45°

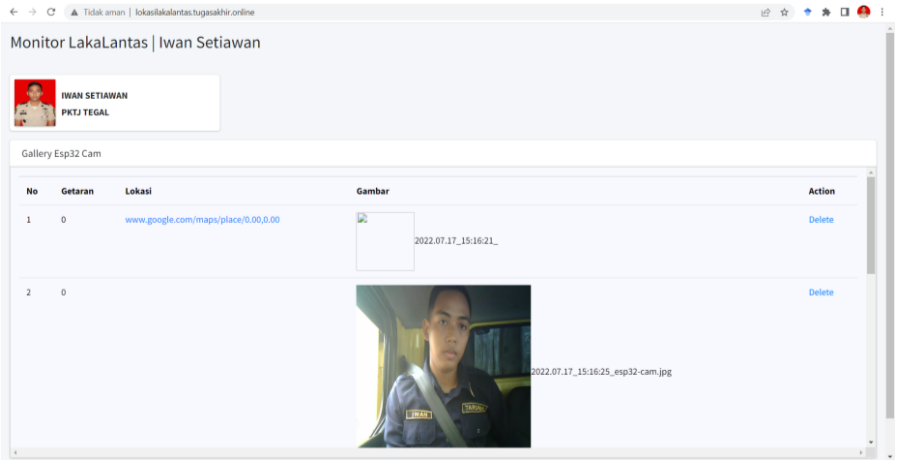

Figure 6. Receiving location data and photos via Web Server with Y-axis simulation > 45°

CONCLUSION AND FURTHER RESEARCH

The vehicle accident information monitoring tool uses two sensors as accident triggers, namely the accelerometer to see the slope of the vehicle and the vibration sensor to see the vibrations that occur in the vehicle. From the simulation of vehicle accidents that have been carried out, the tool can work well by sending data in the form of photos and the last GPS location if there is a slope on the Y-axis> 45°, X-axis > 25°, and the vibration sensor exceeds 10,000. Disadvantages of the designed tool include the extended reading of GPS coordinates and sometimes not being detected because the GPS signal strength is not good. The accuracy of the coordinates sent from the GPS,

when compared to the actual location of the device, has a reasonably significant accuracy deviation of about 400 meters. When uploading photos to the web server, sometimes there are repeated submissions, and the images are not uploaded completely. To overcome the errors, the program needs to be repaired to make it lighter, and the tool needs to be reset periodically so that the microcontroller can usually work again. For further research, the hardware components used can be improved by replacing the microcontroller, which is faster and can be well integrated. GPS accuracy needs to be improved so that the reading of point coordinates is quicker and the location data sent is more accurate. Development of monitoring software with applications based on Android or iOS that are more mobile to reach more users.

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