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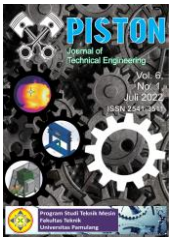

Utilization of GPS Data of Logistic Truck as a Delivery Reporting System

Istas Pratomo Manalu[a)], Albertinus Daniel Siahaan, Okaria Veronika Simanjuntak, Dedy Samhaz Pardede, and David Calvin Tobing

Teknologi Komputer, Fakultas Vokasi, Institut Teknologi Del, Laguboti,22381, Indonesia

E-mail: [a)]istas.manalu@del.ac.id

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Abstract: We propose a tracking system that can provide information from the truck coordinate analysis. Firstly, GSM will transmit the coordinates of the truck in real time via HTTP protocol to a website that has been hosted using shared hosting and displays a travel map on the Map Box API application. We also use MYSQL as a storage of truck coordinates. Reports will be generated after the truck arrives at the company. For system accuracy level, we set the delivery duration to the database every 10 seconds so that the generated path is closer to the original path. We compared our system with google maps to observe how accurate the system was built. The length difference of the track is 0.01 Km. The system also shows a very small deviation of starting point is 0.111322 meters and at the end point is 0.729938354 meters. While, the report contains truck ID, driver's identity, departure time, exact time, arrival time, distance, type of goods, quantity of goods, origin, destination, service, date, initial odometer, used odometer which later the results can be printed into a final report of truck usage.

Keywords: Truck tracking, GPS and GSM technology, reporting system, Map Box API.

Abstrak: *Kami mengusulkan sistem pelacakan yang dapat memberikan informasi dari analisis koordinat truk. Pertama, GSM akan mengirimkan koordinat truk secara real time melalui protokol HTTP ke website yang telah dihosting menggunakan shared-hosting dan menampilkan peta perjalanan pada aplikasi Map Box API. Kami juga menggunakan MYSQL sebagai penyimpanan koordinat truk. Laporan akan dibuat setelah truk tiba di perusahaan. Untuk tingkat akurasi sistem, kami mengatur durasi pengiriman ke database setiap 10 detik sehingga jalur yang dihasilkan lebih dekat dengan jalur asli. Kami membandingkan sistem kami dengan google maps untuk mengamati seberapa akurat sistem yang dibangun. Selisih panjang lintasan adalah 0,01 Km. Sistem juga menunjukkan penyimpangan yang sangat kecil dari titik awal yaitu 0,111322 meter dan pada titik akhir adalah 0,729938354 meter. Sedangkan laporan berisi ID truk, identitas pengemudi, waktu keberangkatan, waktu tepat, waktu kedatangan, jarak, jenis barang, jumlah barang, asal, tujuan, layanan, tanggal, odometer awal, odometer bekas tertera pada laporan akhir penggunaan truk.*

Kata kunci: *Truck tracking, GPS and GSM technology, reporting system, Map Box API.*

INTRODUCTION

Logistics is a set of processes consisting of planning, implementing and supervising the delivery of goods from source to destination [1]–[3]. Sources of raw materials that are not located in the same place cause the need for transportation. One of the most popular transportation for goods delivery by logistics companies is truck. Logistics companies deliver goods to various destinations on a scheduled basis. Many factors can change the company's schedule, such as the driver taking a break for a long time can change the time schedule that has been set so that the arrival time becomes longer than the estimated time. The second is that the choice of delivery route that affects time efficiency[4]–[7]. Sometimes the driver takes the initiative to take another route to avoid congestion and does not notify the administrator if there is a change in the chosen route [8]–[10]. Therefore, companies are often overwhelmed to find out the cause if there is a delay in the delivery of goods. Another factor is the condition of the truck. The company is not regular in monitoring and maintaining the truck engine.

Because of these problems, we create a tracking system that are expected to help logistics companies. This system is based on Global Positioning System (GPS) [6], [7], [11]–[15]and Internet of Things (IoT) [5], [12], [16], [17] which will provide trip reports after the trucks arrive at the company. By using this reporting system, you can ensure service quality, such as minimizing response time to send truck locations to the server, increasing productivity, reducing overtime, preventing private use of trucks and reducing operational costs [18].

We propose a tracking and reporting system capable of providing information from truck coordinate analysis. Information is presented in the form of travel data reports through the website consisting of truck position, travel time, speed and maintenance status. This information is the result of data analysis generated by GPS. Global System for Mobile Communications (GSM) will transmit the coordinates in real time via Hyper Text Transfer Protocol (HTTP) [19] to a website that has been hosted using shared hosting and displays a travel map on the Map Box Application Programming Interface (API) [2], [12], [16], [20]. We also use MYSQL as a storage of coordinates [21], [22]. Reports will be generated after the truck arrives at the company. Thus the owner of the company can obtain detailed travel information of each trucks. It is also possible that the owner of the company will know the behaviour of the driver while traveling.

SYSTEM DESIGN AND IMPLEMENTATION

General Architecture Design

The general system design as shown in Figure 1 shows that Arduino requests coordinates from satellites via GPS sensors. The satellite will send data in the form of longitude and latitude values which will then be sent by the GSM module to the internet. Then the server saves the data after receiving a transmission by the GSM provider using internet access. Furthermore, the website will retrieve data from the database server to display information such as distance, travel route, estimated trip and odometer value. This website also provides travel maps that are displayed using the map box API[23].

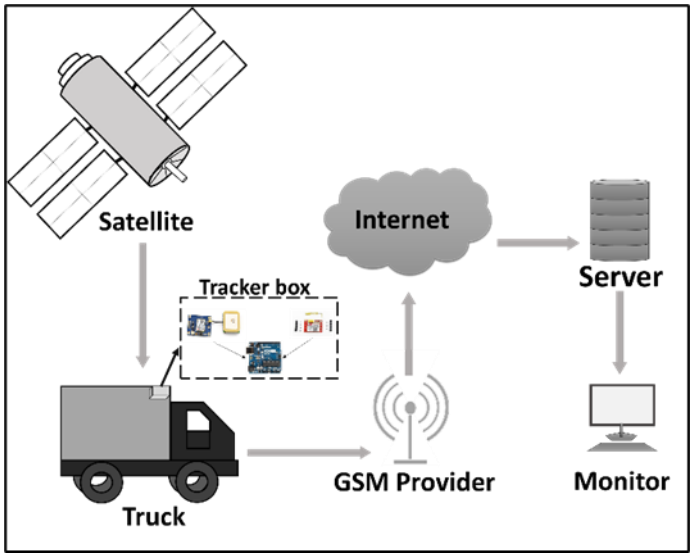

Figure 1. Satellite transmits the latitude and longitude of truck to the GPS module, then GSM module send the data to the internet and received by server company.

System Architecture Design and Communication

This system uses components such as Arduino uno AT-mega 328 as a data flow controller. We use the Neo 6m GPS Module to send longitude and latitude information to the Arduino Uno to find out the location of the Truck which will be sent to the database server. The SIM800L GSM GPRS acts as a link between Arduino and GPS, and a 1000 m-Fa capacitor is used to provide a stable voltage to the circuit [24], [25]. Meanwhile, the power used is a 10,000 m-Ah, 15 W battery.

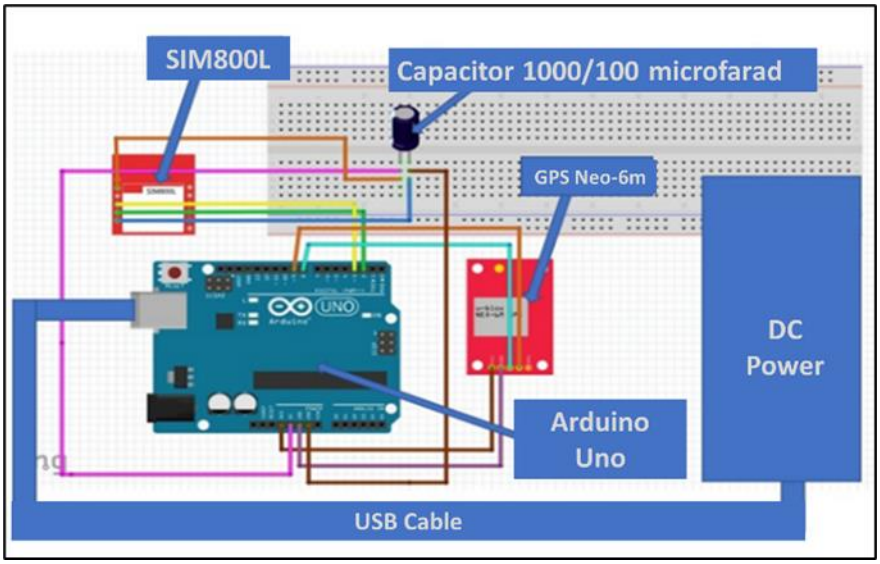

Figure 2. Hardware system design

The device is stored in a box-shaped case made of plastic to prevent damage to the device and truck body. The case is 15 cm long, 8 cm wide, and 6 cm high. According to the Figure 2, the VCC pin on the GPS as a power source is connected to 5V on the Arduino, the GND pin on the GPS is connected to the GND on the Arduino, the TX pin on the GPS as a signal sender on pin 1 Arduino and the RX pin as a signal receiver on pin 2 Arduino. The GSM SIM800L requires a power of 3.7V – 4.1V to work properly on the Arduino. Therefore, a capacitor is needed to inhibit and regulate the electric current flowing to the GSM.

Flowchart of System

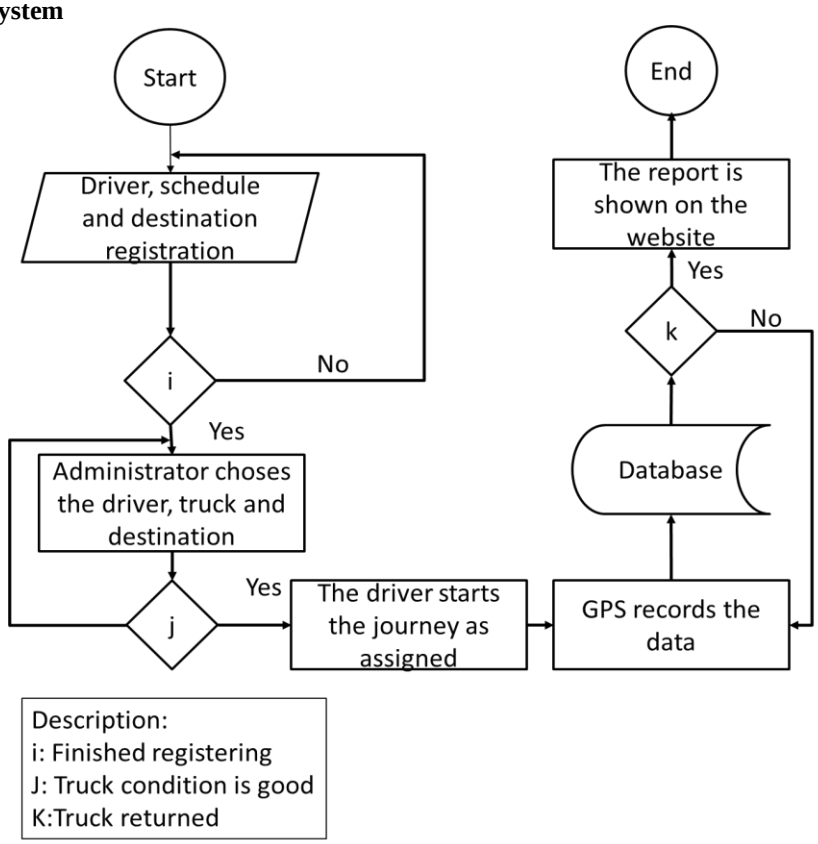

Figure 3. Flowchart system

As shown in the Figure 3, the flow of the truck trip data collection process begins after the admin registers the driver, schedule, and destination for delivery of goods. Previously, the admin must have registered all the

trucks owned by the company or trucks that will be tracked later. If the admin has finished registering the driver, schedule, and destination, then the admin can choose the driver, schedule, destination, and truck to be used. If it is not registered, it will be redirected to the truck, driver, and destination registration page.

During the trip, the GPS device on the truck will record the trip of the truck. The recorded data is in the form of latitude and longitude values and these values will be sent to the database as a data storage area. If the truck has returned to its place of origin, it means that the truck has completed its journey or delivery of goods to its destination. The data in the database after the trip will be displayed on the website. The data displayed is in the form of the path traversed by the truck.

The process of retrieving data from the database starts when the admin logs into the website. If you have not successfully logged in, you will still be redirected to the login page. If you have successfully logged in, the admin asks for truck trip data from the database through the schedule page on the website. After the admin requests travel data, the website will process the data in the database according to the admin's request. After that, the website will display a truck trip report. Ended with admin logging out of the website.

The process starts with turning on the device with power supply and the GPS and GSM modules will be active simultaneously. First, we check the GPS module whether the GPS is active or not. If the GPS is not active, it will continue to be checked until the GPS is active. If the GPS is active, the GPS will ask for data in the form of longitude and latitude from the satellite. If the data has not been obtained, then the GPS will be checked again. If the GPS has received data successfully, the data will be sent to the webserver via the GSM module on condition that GSM is connected to the GPRS network. The process is complete when the data has been sent and received on the webserver.

Hardware Connection with Arduino Uno

The implementation of the application describes the process of operating the truck monitoring program. To configure pins or relays between GSM, GPS, and Arduino, as shown in Table 1.

Table 1. Arduino Uno and GSM module relation

Arduino	SIM800L
D2	Tx
D3	Rx
VCC	3,7 V - 4,1 V
GND	GND

The SIM800L for VCC uses a 1000/100 microfarad capacitor to maintain proper current conductivity to get a good signal and for VCC it is connected to 5 V power. By combining Arduino Uno, GSM module and GPS module, it has two outputs which are sent by GSM and GPS. Data from both will be sent simultaneously. We added the Altsoftserial library because SoftwareSerial can indeed have multiple instances but cannot perform two processes at the same time. So Altsoftserial is an alternative to be able to get data simultaneously, namely the pins that provide output are D8 and D9 as shown in the Table 2.

Table 2. Arduino Uno and GPS module relation

Arduino UNO	GPS NEO-6M
D8	Tx
D9	Rx
VCC	3,3 V - 5 V
GND	GND

Figure 4. The Process of Sending Data to the Webserver

When all the hardware is connected properly, the next step is to send data to the webserver. As shown in the Figure 4, data transmission occurs using the GET method by sending the latitude and longitude directly to the URL with the data type "double" then saving the data to *gpsdata.php* and sending it directly to the webserver. Once the data reaches the database, the web application will then retrieve the data via the Restful API. The development of our web application, we use PHP, JavaScript and JSON, and Laravel Framework.

RESULT AND DISCUSSION

GPS Tracker, Database, and Route Mapping Test

The first test was carried out with 3 km to see the activity of sending data from the GPS device to the database. **Error! Reference source not found.** shows the database has successfully received data. We set the delivery duration every 10 seconds. In this experiment, the truck will be driven from the starting point (purple point) through a predetermined route until it returns to the starting point. Thus, the route drawn on the web application will be smoother as shown in Figure 5.

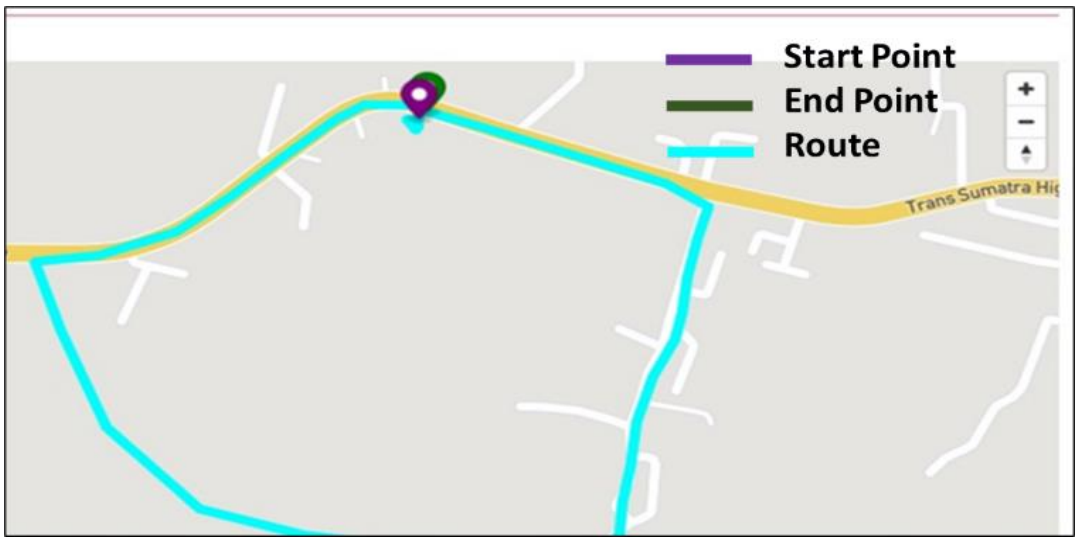

Figure 5. Coordinate mapping with data transmission every 10 seconds

Test Comparison with Google Maps

The next experiment is to test the accuracy of the tracking system. We tested the suitability of the route image between our system and the google map application and make a numerical analysis of the obtained coordinates. Both tests were carried out on the same trucks, roads and at the same time.

Figure 6. Coordinate mapping using web application

At first, we installed the tracking device on the truck with the adjusted position. In this test, a route has been determined, namely from the Lumban Silitong (purple point) to the Del Institute of Technology (green point) as shown in Figure 7. When the driver is ready, the truck follows the predetermined route. At the same time, google maps is also activated.

Figure 7. Mapping using Google map application

The length of the path drawn has a difference, where google maps describes the length of the track as 13.6 km, while the length of the track shown by our system is 13.61 km. From these results, the difference in the length of the track is 0.01km. We conclude that the path length indicated by this system is accurate.

Analysis of Device Testing Accuracy with Google Maps

The coordinates obtained will then be compared with the coordinates provided by the google map application. We take the coordinates of the starting location and the location of the truck as a reference to find out errors that may occur in the system. the number of errors can be calculated using the Euclidean formula:

$\mathbf{Z} = \sqrt{(\boldsymbol{B}-\boldsymbol{A})^2 + (\boldsymbol{D}-\boldsymbol{C})^2}$ **x** 111.322 Km

Where:

Z = distance

A = latitude value of reference

B = latitude value of module

C = longitude value of reference

D = longitude value of module

1 degree on maps = 111,322 kilometers

Table 3. Comparison Coordinates Value Between GPS Tracker and Google Map

	GPS Tracker		Google Maps		Deviation (Meter)
	Latitude	Longitude	Latitude	Longitude	
Start	-2.32847	99.04927	-2.32847	99.04927	0.1113
Finish	-2.38297	99.14862	-2.38299	99.14865	0.7299

Table 3 shows that the difference between the starting point is 0.111322 meters and at the end point is 0.729938354 meters. From the comparison results, there is a very small deviation caused by the limitations of the system. However, the system still has almost the same accuracy as the google map application.

Report System

The system report is displayed on the application website as shown in Figure 8. This website can only be accessed by company administrators. Administrators can view reports or trip status after the truck has arrived at the company. Previously, the route and estimated time had been determined by the admin on the schedule registration menu, this was intended for the driver to follow the specified route. If at the time of travel the route taken is different, then the owner can easily identify the travel status of trucks and drivers.

Plat Mobil	Asal	Tujuan	Jenis Barang	Jumlah Barang	Waktu Berangkat	Tanggal Berangkat	Waktu Sampai
Search Plat Mobil							
BK 1111 AJE	Balige	Porsea	Semen	100	15:57:00	2021-06-09	2021-06-09 16:40:00
BK 219218 AJ	Balige	Pardinggaran	Semen	20 Sak	17:00:00	2021-07-27	2021-07-27 10:15:00
BK 219218 AJ	Balige	Balige	Semenn	20 Sak	20:59:00	2021-06-04	2021-06-04 16:04:00
BK 219218 AJ	Balige	Porsea	Semen	20 Sak	15:40:00	2021-06-04	2021-06-04 16:15:00
BK 219218 AJ	Balige	Porsea	Semen	100	17:30:00	2021-06-06	2021-06-06 17:47:00

Figure 8. Detail trip report

Administrators can see the driver's identity and complete information regarding the condition of the goods at first and when the goods have been sent. After the driver arrives at the company, the admin will click the arrived button and will enter the truck report. The report contains truck ID, driver's identity, departure time, exact time, arrival time, distance, type of goods, quantity of goods, origin, destination, service, date, initial odometer, used odometer which later the results can be printed into a final report of truck usage. In the trip report, the time to leave and return to the company will be recorded. The system will detect whether the truck is past the estimated time that has been determined. If it exceeds the estimated time, a notification will appear on the trip report, so the owner can identify problems during the trip.

Distance and Odometer

Repairs on vehicles such as trucks are usually carried out if the vehicle has covered 10,000 kilometers. In the Truck Tracking system, if the truck has traveled 10,000 kilometers, a notification will appear on the website that the truck can be serviced. As can be seen in Figure9, a notification appears asking for the truck to be serviced because it has traveled more than 10,000 kilometers. On the other hand, if the truck has not traveled 10,000 kilometers, no notification will appear on the website as shown in Figure 10.

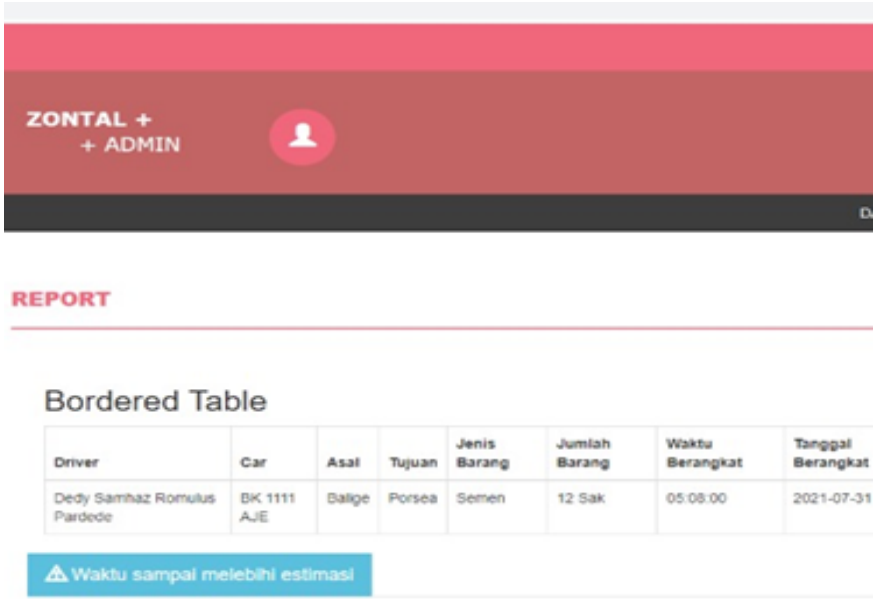

Figure 9. Truck has traveled more than 10000 Km

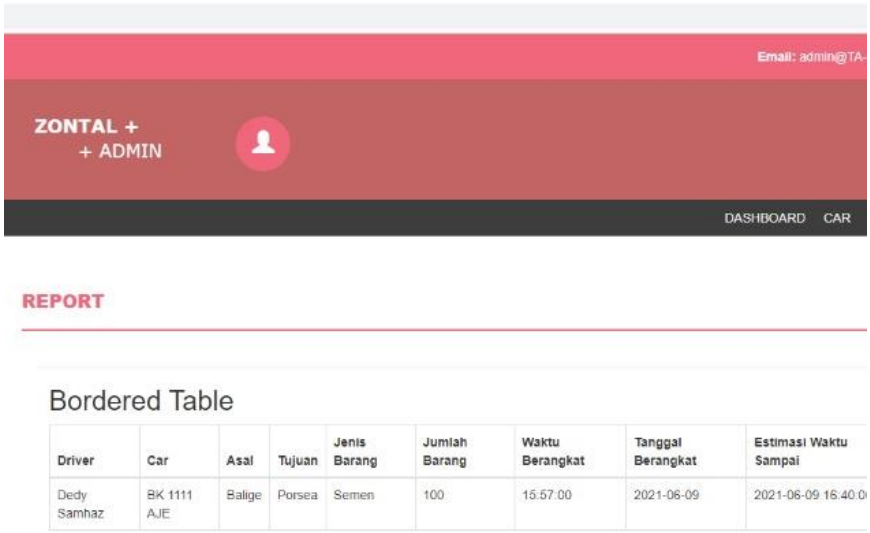

Figure 10. The truck has not traveled 10000 km

CONCLUSIONS

Based on the results of the implementation and testing of our research, it can help in monitoring the position of the truck when sending goods which provides trip details. We believe that, the system can help companies to view reports containing trip status, estimated travel time, truck condition and odometer value. The application used is a responsive web that can be accessed via the internet which is able to provide more structured reporting to the company. However, the researcher admits that there are still shortcomings in system development, in which the system must work under the internet network.

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