Surabaya Gempol Toll Road Towing and Patrol Car Service Application Using Android-Based GPS Tracker

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***Abstract*— In today's era of rapid development of information technology, transportation is one of the most important aspects of daily life so that traffic-free toll road infrastructure has been created. However, there are challenges in toll roads, namely the occurrence of accidents or complaints complained about by consumers on the toll roads that are passed. So this research will focus on serving toll road users who have an accident or have complaints by using an android application made for consumers to send complaints or request service assistance to the toll road. The service assistance offered by the toll road in the application is a tow truck and also a patrol car so that toll road users can choose one of the services offered. The purpose of this research is to facilitate users and determine the efficiency and productivity of towing car and patrol car services and assess the effectiveness of GPS tracker implementation on towing cars and patrol cars in tracking location and travel. The results of the gps tracker test show the gps accuracy rate of 86.85% so that the position of the gps tracker tool is still accurate. Then for the features contained in the application can run smoothly without any bugs or errors.**

***Keywords*— Esp8266, Gps, Gps Tracker, Patrol Car, Tow Car.**

I. INTRODUCTION

In this era of rapid development of information technology, transportation is one of the most important aspects of daily life. High population mobility, rapid economic growth, and urban expansion have resulted in increased demand for reliable and efficient transportation services, causing the number of vehicles in Indonesia to continue to increase due to the continued growth of the country's economy which requires Indonesians to race against time, so that each individual has a personal vehicle so that his time is not lost on the trip [1]. One important aspect of transportation is the management and supervision of vehicles used in transportation services, especially in the context of toll roads. Emergencies on toll roads are often unpredicTable, and in some cases, the drivers and passengers involved in the incident do not have enough information about their exact location on the toll road. This can result in delays in the response of tow trucks and patrol cars. To solve this problem, a solution is needed that can quickly and efficiently contact the tow truck and patrol car services in emergency situations. One solution is to use GPS-based mobile application development that can be used by Surabaya-Gempol toll road users. This application will be specifically designed to meet the needs. This application is specifically designed to meet the needs of toll roads in monitoring and managing their vehicles efficiently and effectively and with this GPS tracker tool the drivers can find out the real time position of the tow truck and patrol car from the application so that the coordinates cannot be falsified.

In previous research that discusses gps has been discussed in several journals such as in the first journal written by [2] with the title "Development of Web-Based History GPS Tracker Application on Mobile" the purpose of this study is to create an application that is able to track a person's whereabouts by utilizing gps on a mobile phone by using SQLServer as a database. The next research was written by [3] with the title "Designing a Motorcycle Security System Using a Microcontroller-Based GPS Tracker on Motorized Vehicles". The purpose of this research is to be able to monitor motorized vehicles at any time and to find out if there is vehicle theft and cannot find out the position of the vehicle. This research is done by sending the last location point on a motorized vehicle via SMS which will be sent a link to google maps. Further research was conducted by [4] with the title "Motorcycle Security by Utilizing an IoT-Based GPS Tracker". This research aims to make it easier for users to see the track around the tracked object moving.

II. METHOD

A. System Design

The type of research conducted is included in the category of Science and Technology (IPTEK) development. This research will discuss the research design carried out in the form

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of systems and applications, materials and tools used, and determination of system procedures.

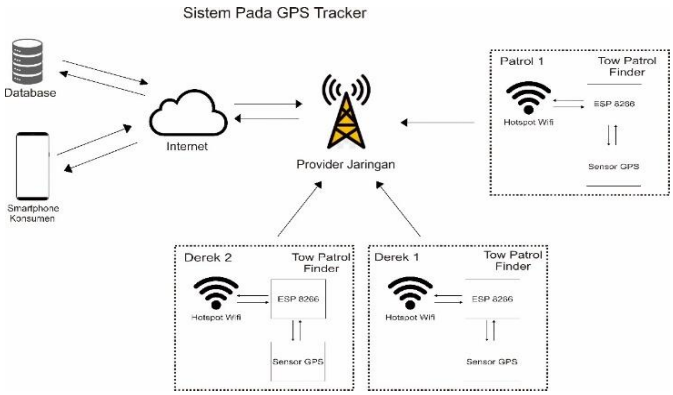

Figure 1. System Block Diagram

In Figure 1 in the gps tracker tool there is a NodeMCU Esp8266 component which is a microcontroller module designed with ESP8266 inside. Esp8266 functions as a microcontroller that manages all inputs and outputs on the GPS tracker tool [5]. In addition to Esp8266 on the GPS tracker tool there is a Neo-6M GPS Sensor that is used to get the location point and provide timely information depending on time and weather [6]. Both components are connected to the hotspot on the cellphone so that data from the gps can be uploaded to the database. The database used in this research is the Firebase database, one of the features possessed by firebase is Firebase Realtime Databse which is one of the services of firebase which aims to perform realtime database management [7].

B. *GPS Sensor Design*

In the circuit design is a circuit that is in the gps tracker tool for the Esp8266 component and the Neo-6M gps module.

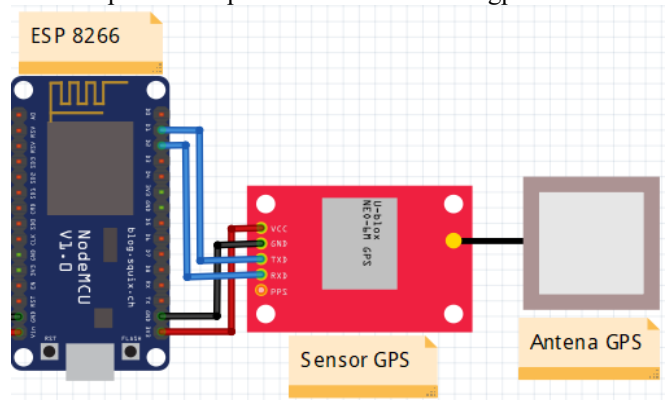

Figure 2. GPS Sensor Circuit

In Figure 2 and Table I are a circuit of the gps sensor with Esp8266, the pins connected are.

TABLE I
PIN OF NEO-6M GPS SENSOR

Sensor GPS Neo-6m	
Pin Esp8266	**Pin Sensor GPS**
3v3	VCC
Rx	D2
Tx	D1
GND	GND

C. *Schematic Design of the Overall Tool Set*

Is a series of overall tools in making gps tracker tools.

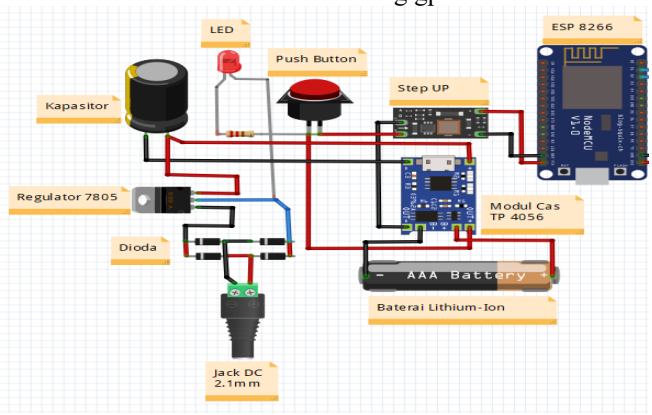

Figure 3. Overall Tool Set

In the overall circuit there is a 2.1mm DC jack which is used to charge the device with a voltage of 12V. Then there are diodes that are used to change the electric current into one direction and also to prevent alternating electric current from causing the components inside to be damaged [8]. The current will be directed to the 7805 regulator so that the voltage is reduced to 5V [9]. The remaining electric charge will be stored in the capacitor because the function of the capacitor is to store electric charge [10]. Then it will be connected to the TP4056 cas module which this module is used to cas the lithium battery [11]. The power source used to power this gps tracker tool is a lithium-ion battery that is used to store electrical energy in chemical form and then converted into electrical energy with a voltage of 3.2-4.2V [12]. The voltage from the battery will be changed to 5V which means the voltage has increased which is raised by a step up which is a component in the power supply that functions to change the voltage, to increase the voltage [13]. Then there is a push button which is used as a switch designed to turn off or activate a device or system [14]. After the tool is activated with a push button the LED light will turn on as an indicator that the gps tracker tool has turned on [15].

D. *Arduino System Planning*

Figure 4 is a flow chart that explains the course of the system on the gps tracker tool. GPS is first initialized first in order to get a valid location point, if you get a location point it will be sent to firebase.

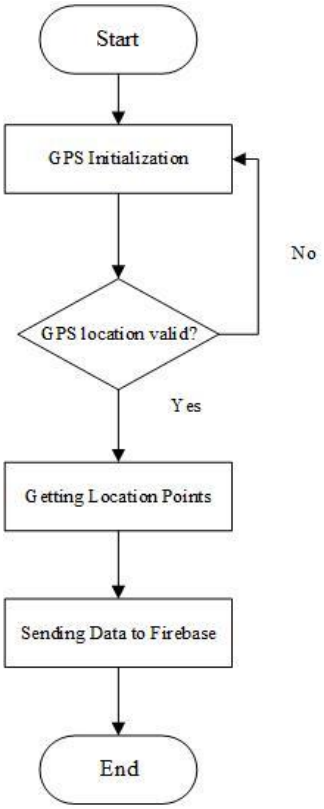

Figure 4. System Flow Diagram of the Tool

E. *Application System Planning*

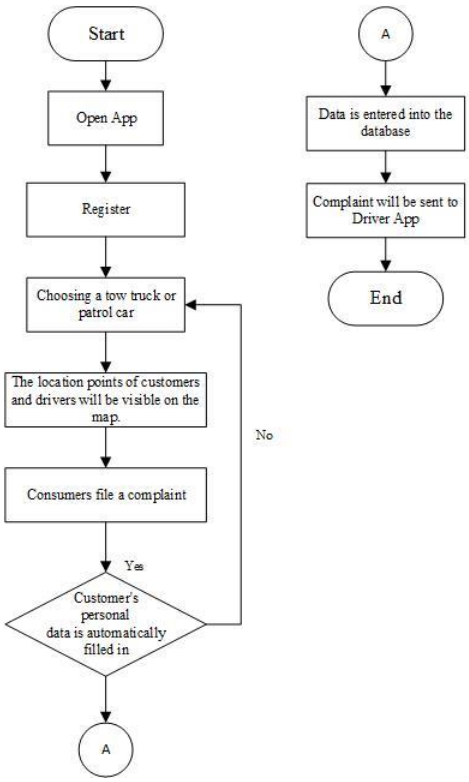

Figure 5. System Flowchart of Consumer Application

Figure 5 displays the flow of the application system for consumers. Opening the application then registering by filling in the name, cellphone number, and password after that the consumer can enter the application then the consumer chooses to use the tow truck or patrol service, if it has been selected then the consumer will be directed to fill in a new complaint then the complaint will be sent to the driver.

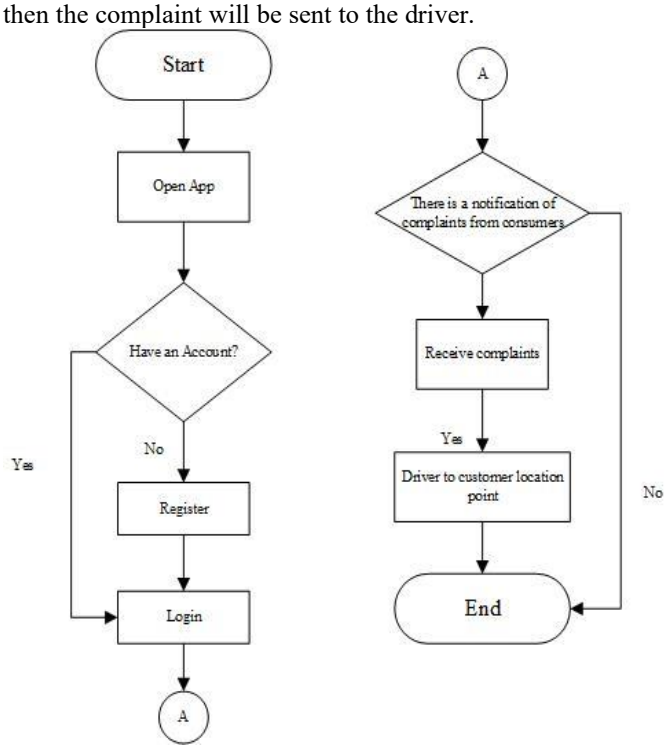

Figure 6. System Flowchart for Driver Application

Figure 6 shows the flow chart for the driver application starting from the driver registering first to create an account. If you have created an account, the driver can log in if there is an incoming order from the consumer then the driver will confirm the order.

III. RESULTS AND DISCUSSION

A. *Interface Implementation*

The following is the implementation of the interface of the Surabaya Gempol toll road towing and patrol car service application using an android-based gps tracker.

1. Implementation of towing car and patrol car application interfaces -consumers, as shown in Fig. 7.

Figure 7. Register

Register before entering the main page by filling in your name, phone number, and vehicle number, as shown in Fig. 8.

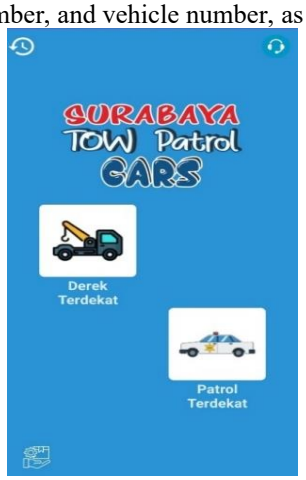

Figure 8. Main Menu

Choose tow or patrol on the main page menu depending on what you need, as shown in Fig. 9.

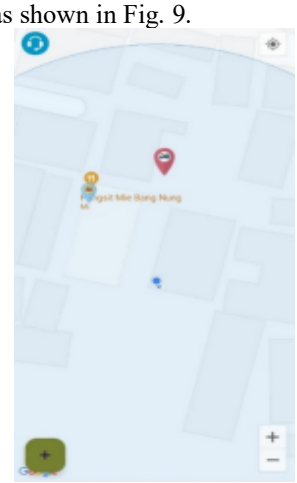

Figure 9. Map

The map display will show the position of the tow truck or patrol car and the position of your vehicle. The red marker indicates the position of the tow truck or patrol car. The blue marker indicates the position of your vehicle, as shown in Fig. 10.

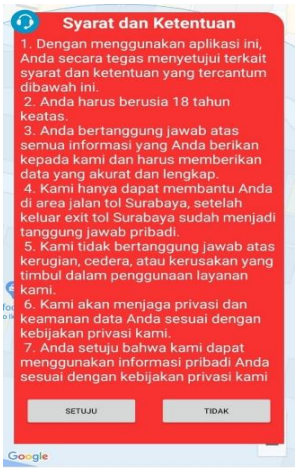

Figure 10. Terms and Conditions

Before submitting a complaint, please read the following terms and conditions first, , as shown in Fig. 11.

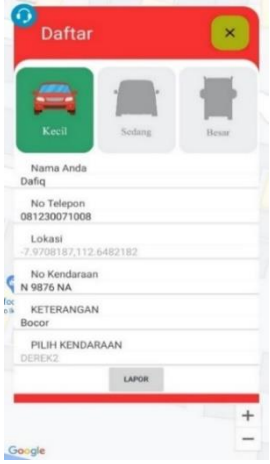

Figure 11. Complaints List

Add a new complaint order by filling out the following form. By filling in the type of car you use. The name, phone number, location, and vehicle number will be filled in automatically. Consumers only need to fill in the complaint information then press report to submit a complaint, as shown in Fig. 12.

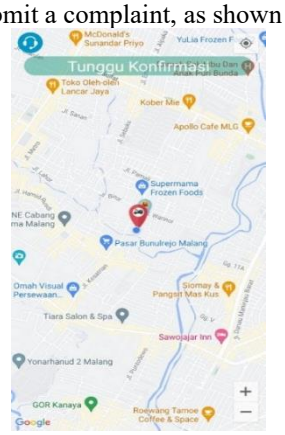

Figure 12. Waiting for Confirmation

A new complaint order is sent and waiting to be confirmed by the driver. The red marker indicates the position of the tow truck or patrol car. The blue marker indicates the position of your vehicle, as shown in Fig. 13.

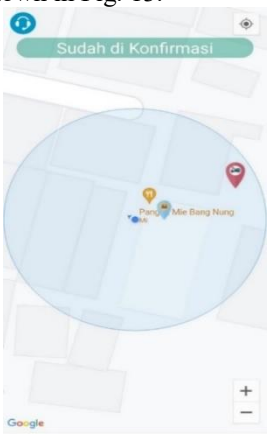

Figure 13. Confirmed

The complaint order has been confirmed by the driver. The red marker indicates the position of the tow truck or patrol car. The blue marker indicates the position of your vehicle, as shown in Fig. 14.

Figure 14. History

Orders that have been handled can be viewed again in the history menu.

2. Implementation of towing car and patrol car application interfaces driver, as shown in Fig. 15.

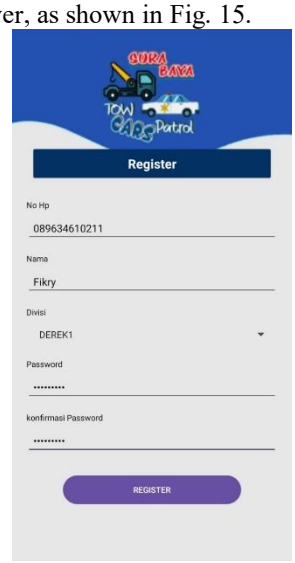

Figure 15. Register

Register to create an account before entering the application by filling in the form provided, as shown in Fig. 16.

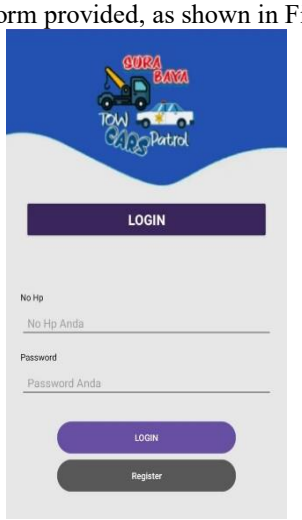

Figure 16. Login

Login if you have an account to enter the application by filling in your cellphone number and password, as shown in Fig. 17.

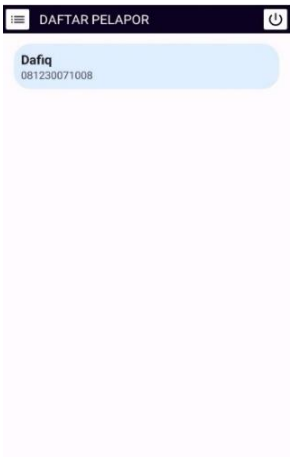

Figure 17. List of Reporter List

Complaint orders from customers will be entered into the reporter list, as shown in Fig. 18.

Figure 18. Map and Confirmation

Details of the customer will be visible and will be confirmed by the driver. The red marker indicates the position of the tow truck or patrol car. The blue marker indicates the position of your vehicle, as shown in Fig. 19.

Figure. 19 History

Completed orders can be viewed again in the history menu.

B. GPS Module Data Reading Test Results

Table II shows testing GPS data retrieval on tow trucks and patrol cars. This test aims to retrieve GPS data reading data with the condition of the device installed on the vehicle. From the results of GPS readings, the distance of GPS point displacement will be calculated using the Haversine formula because according to [18] calculations using haversine have an accuracy rate of 98.66%. Testing is done by plotting on Google Earth then the GPS tracker tool is brought to the plotting on Google Earth and then calculated using the Haversine formula so that the difference between plotting on Google Earth and the coordinates obtained on the GPS tracker tool is obtained.

TABLE II
TESTING GPS DATA RETRIEVAL ON TOW CARS

Dist-ance	Google Earth Coordinates		Gps Tracker Tool Coordinates		Error (%)
	Longitude1	Latitude1	Longitude2	Latitude2	
500 m	112.704023	-7.286646	112.704109	-7.286556	13.7
1000 m	112.707185	-7.283437	112.707085	-7.283236	24.9
1500 m	112.708282	-7.279043	112.708221	-7.279066	7.19
2000 m	112.708597	-7.274527	112.708565	-7.274663	15.5
2250 m	112.708894	-7.272209	112.708908	-7.272331	13.6
2750 m	112.698074	-7.293414	112.698074	-7.293436	2.46
3000 m	112.698067	-7.295269	112.698067	-7.295221	5.38
Average					11.81

In the test in Table 5, several samples of 500m distance have been taken so that the average difference is obtained, which is 11.81%, where this difference is still not too far away from the coordinates on Google Earth so that it can be interpreted that the coordinates on the GPS tracker tool are very accurate.

IV. CONCLUSION

Based on the test results of the Surabaya Gempol Toll Road Tow Car and Patrol Car Service Application Using Android-Based GPS Tracker, it can be concluded that the gps tracker hardware made uses Esp8266 components and Neo-6M GPS modules. Tow car and patrol car service applications are made using the Android Studio application and using the Firebase database. With this application, it will make drivers more effective in reaching consumers who need help. This can optimize the work system between drivers and consumers who need help. Based on the test results of the GPS module data reading, the average GPS accuracy value is 11.81%. from the calculation of the average value of the difference in GPS distance that the difference value obtained is not too large so that the accuracy of the GPS tracker is accurate.

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