

## GPS Application System of Waste Operational Activity of Bandung Regional Sanitation Company

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**Abstract:** Sanitation is the important factor for sustainability of human life. In order to realize a clean environment, so that, the issue of waste becomes a major issue. The increasing number of people in Bandung and also their activities make the problems about waste become more complex. The sufficiency of operational vehicles for waste transportation at regional sanitation company in Bandung caused direct effect for misuse of waste operational vehicles. Various factors may affect the misuse of transporting waste, including the numbers of operational vehicles that operate on the field, the scheduling of the waste transporting in temporary waste disposal station, the route that carried vehicles as well as the amount waste vehicles rotations. This problem is analyzed and developed by applying GPS system of waste operational activity of Bandung Regional Sanitation Company. This research attempted to develop an application to solve the misuse factor of that vehicles. The information technology may apply to waste operational activity transport management is to integrate the Global Positioning System (GPS), Groupe Special Mobile (GSM) and Geografic Information System (GIS) web-based with graphic visual can offer an excellent solution to face a great challenge on waste operational.

**Key words:** Regional sanitation company, waste operational activity, transportation management, global positioning system, geografic information system

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### INTRODUCTION

The large population and the various activities of the big cities in Indonesia, caused the general problems in urban infrastructure service such as waste issue. Until now the waste management that is used. collect-transfer-dispose. However, it is estimated only 60% of waste in the big cities in Indonesia that can be transported to the final waste disposal station. The amount of waste that can be transported because it did not record/monitor systematically as it usual calculated based on the truck rotation to the final waste disposal station. Besides, there is unexpectedly the waste managed by non-government community and also the waste scattered and systematically dispose to the water (such as the rivers). Such paradigm of collect-transfer-dispose has consequent to the high cost of the waste operational management because most of the waste management cost is used for transportation about 50-60% of waste management total cost.

The Act Number 18/2008 Article 6 point states that the government's task is to carry out waste management

and provide infrastructure of waste management. Currently the waste in Bandung dispose to sarimukti final waste disposal station where is located in Cipatat sub district, West Bandung regency. The distance of this location is relatively far away from Bandung, it is about 50 km from Bandung downtown. That far away distance has consequent with the high operational cost for waste transportation which the most of the cost is used to buy the fuel for vehicles. Therefore, the supervision of the routes and transportation infrastructures have to monitor in order to get a good transportation system, so as to minimize environment effects and also the economic losses.

Based on that consideration, the Regional Sanitation Company of Bandung keep improve the transportation activity of the waste operational management which has paradigm collect-transfer-dispose can be applied optimally One of information technology that can be applied for that activity is to integrate The Global Positioning System (GPS), Groupe Spécial Mobile (GSM) and Geografic Information System (GIS) web-based with graphic visual can offer an excellent solution to face a great challenge on

waste operational. The integration of these technologies can monitor, control the tracking of operational vehicle location in real time, thus allowing interested parties can control and take action properly and appropriately. This conducted research has two objectives to be achieved, they are as follows.

The establishment of GPS Software in order to monitor the location of the waste operational vehicles thus the interested parties can monitor the movement of the transportation and take the appropriate decision if there is a problem during the vehicle trip. Produce the real time data, providing the monitoring data and information of waste operational vehicle as needed, appropriate and accurate

### **Literature review**

**Geographic information system:** Geographic Information System is a storage system, image storage, checking, merging, analysis, display and manipulate the data spatially which is described by the form of the earth (Prahasta, 2002).

Generally, the definition of Geographic Information System (GIS) included three main components. They are hardware, software and the appropriate procedures with the requirements. That components also describe that GIS used the data that is described spatially or geographically (Sunyoto, 2007).

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**Spatial data:** Every GIS software has been designed to overcome spatial data (it also called geographic data). Spatial data is signed by information about the location, the other features and the details with non-spatial characters. The example of spatial data from one weather station included as follows.

The latitude and longitude as a geographic reference. If the latitude and longitude of a weather station has been known, the relative position of other weather stations also can be assumed, along with its proximity to the hills and dangerous areas.

Details of the relationship such as street layout, lift and ski passes will allow meteorologists to access to a weather station. The non-spatial data, for example, details of the amount of snow, temperature, wind speed and direction.

**Map:** Map is a traditional method to storage, analyze and present spatial data. Map is the important basic of GIS as a data source, the structure of data storage and the tools

to analyze and signify of data. Generally, the map is differentiated by thematic map and topography map (Prahasta, 2002). Thematic map shows the data that related to a particular theme or topic such as soil, geology, geomorphology, land use, population or transportation. Topographic maps contain data sets that vary in different topics. Therefore, the use of land, relief and cultural features can be displayed all in the same topographic maps.

**Latitude and longitude:** The latitude and longitude are the imaginary lines on the earth surface that is drawn on the map, atlas or globe to help show the position of someplace. The location and position someplace referred by a cross point (coordinate) between latitude and longitude. The value latitude is stated first followed by the value of longitude.

Latitude are parallel lines on a globe that is parallel to the line of the equator. Latitude measured in estimates ( $^{\circ}$ ) on the Equator ( $0^{\circ}$ ) without angle. Longitude are semicircle line that is drawn around the globe from top to bottom upright to the latitude so that seems to connect the North and South pole. This also means that all lines of longitude meet each other at the North and South pole because each line begins and ends at both of them.

**Global Positioning System (GPS):** Global Positioning System (GPS) is a satellite-based navigation system and a tools to determine a position of 24 satellite constellation that orbit on the earth at an altitude of approximately 11,000 miles. There are various elements that support a GPS, they are as follows.

**Space segment:** Space segment is a part that consist of 24 satellites which work together to monitor the presence of GPS receiver.

**Control segment:** Control Segment is central for controlling and monitoring the existing of all satellites in order to ensure all working properly. All this informations is processed in MCS (Master Control Station).

**User segment:** User Segment consists of a receiver specifically designed to receive, to translate and to process the signals from the GPS satellites.

**How GPS work in determining position:** The basic principle of GPS located at a distance from the receiver to the satellites, the receiver must be at least seek 3 satellite positions to make an accurate positioning, this operation is called triangulation, briefly triangulation can be described as the three satellites would seek incision from

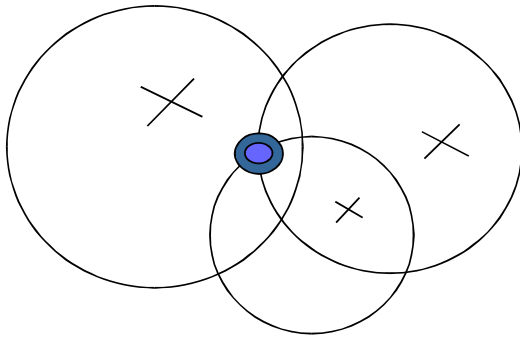


Fig. 1: Triangulation of GPS (Schmidt *et al.*, 2005)

three different positions, the accurate position would be found in the third incision of the satellite. Figure 1 described the three satellites would seek incision from three different positions, the accurate position would be found in the third incision of the satellite.

### MATERIALS AND METHODS

The research method which is used to build a GPS system application of Waste operational activity of regional sanitation company in Bandung is showed at Fig. 2 as follows. According to Fig. 2, the activity at collecting data step conducted by direct survey to the field. The result that want to be achieved in the field survey are as follows.

**Working from existing systems:** This step is conducted by examining the system in detail to find out how the system operates as follows:

- Data and information: collecting the information about the processing data of resulting activities, also making the classification all the types of data and mechanism concept of data flow
- The problems: collecting the information about the barriers that related to the plan of system development

**Analyzing results:** Conducting follow-up activities according to the data that has been obtained from the research that has been done. Analysis that are conducted as follows:

- Analyzing the running system procedure
- Analyzing the documents
- Analyzing the data and the information flows
- Analyzing the reliability system

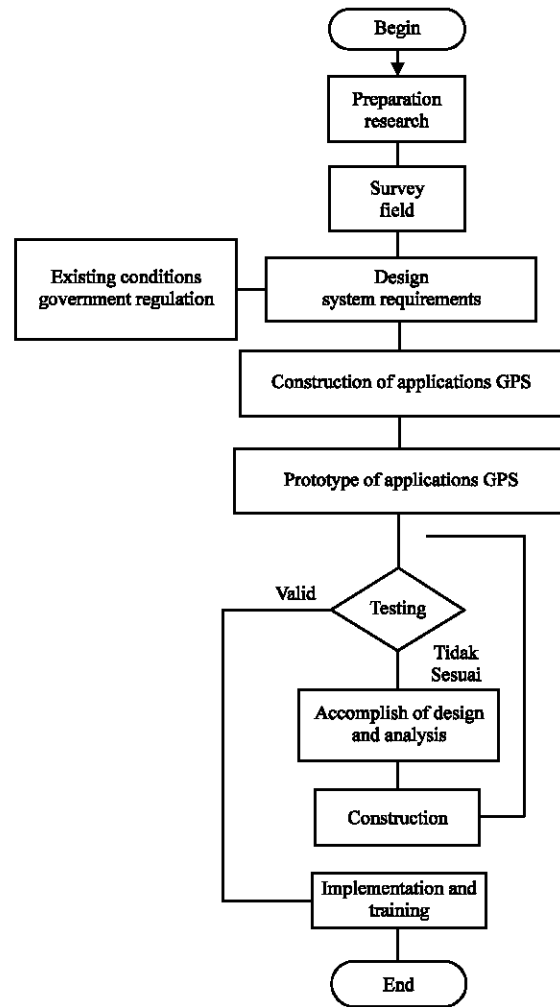


Fig. 2: Research method

### RESULTS AND DISCUSSION

#### Survey results and design system

**Analysis of current system:** The system that is running at Regional Sanitation Company in Bandung currently still use manual system. Start from the driver's data recording, temporary waste disposal station's data and also the operational vehicle's data are still made on the form. As well as that operational vehicles manually used a written form. It similar to the monitoring of operational vehicles that cannot be done because the limitation of the existing information system. Thus, the safety of the vehicles while in the field cannot be controlled directly. The lack of a strict monitoring to use company operational vehicle facilities caused the lack discipline at the workplace.

**The problems encountered:** There are some problems about the running system that have to be faced according to the resulting analysis that conducted at regional

Table 1: The data needs

Data type/the data of detail item	Data utility	
<b>Street</b>		
Street name	It contains the information about the street route	
Id-type		
Type		
Latitude degree		
Longitude degree		
<b>Vehicles</b>		
Vehicle registration number	It contains information about vehicle of the department operational	
Vehicle brand code		
Production year		
Machine number		
Driver code		
Road route		
<b>Vehicles brand</b>		
Vehicle brand code		It contains information about the vehicle type of the department operational
Vehicle brand name		
Vehicle type code		
<b>Driver</b>		
Driver code	It contains about the driver and who's responsible to vehicle operational	
Driver name		
Address		
Phone		
Driver status		
<b>Vehicle operation</b>		
Vehicle registration number	It contains about vehicle operational	
Driver name		
Operation date		
Start operation date		
Expiry operation date		
Time of the operation finished		
The weight of waste		
<b>Waste disposal station</b>		
Temporary waste disposal Station number		It contains about temporary waste disposal station
Street name		
Date of production		
Capacity		
Temporary waste disposal Station type		

There has not made a database that can store the details about company operational vehicles. Until now the company has not had a database that is used simultaneously to store the details about it. For now, they only conducted a data recording using Microsoft excel that become the responsibility of the supervision of inventory and operational division at Bandung Regional Sanitation Company.

**The data needs:** Table 1 shows the amount of the data needs that is used in GPS application system of waste operational activity

**GPS application system design of waste operational activity:**

The problems solution that may use by Regional Sanitation Company in Bandung for strict monitoring the used of inventory and vehicle operational are as follows.

Analyzing spatially by applying geographic information system. The used of geographic information system and its component made the spatial analysis can be conducted, because it conducted could give the optimal result, the deep analysis can be done by information system through the map, graphic, etc. Providing the map of Bandung to monitor manually the location each street in Bandung.

Making the database of company operational vehicles and also the database of the existing street in Bandung to determine the coordinate. The utilization of Global Positioning System can give the information about location accurately so the utilization of company operational vehicle can be analyzed the utilization in detail. Diagram context is an overview of system data flows which made generally from the user point of view. Figure 3 showed the diagram context of GPS application system of waste operational activities overall. The Fig. 3 above showed the entities user of the GPS, GPS application system utilization in Bandung is the operational officer of the regional sanitation company in Bandung and truck drivers. That entities can access the needed information adapted with the interest of each entities.

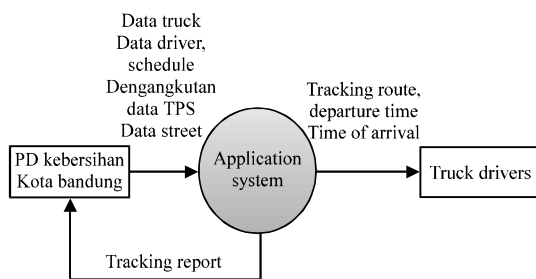


Fig. 3: The diagram context of GPS applications system of waste operational activities

Sanitation Company in Bandung as follows. The limitation of information system that owned by Bandung Regional Sanitation Company that is traditional information system in this case the monitoring conducted directly to the field that has been known ineffective and inefficient, both in the term of time and operational cost, so it resulting the lack of a strict monitoring to use company operational vehicle facilities.

**GPS application system of waste operational activities:**

GPS application system of waste operational of Bandung is an application that is used to monitor the vehicle positions GPS technology-based, GIS and track record/history of a vehicle fare to reach a certain position.

The benefits that can be gained make the vehicle's owner in this case the regional sanitation company of Bandung easier to track and monitor their vehicle position



Fig. 4: User authentication page

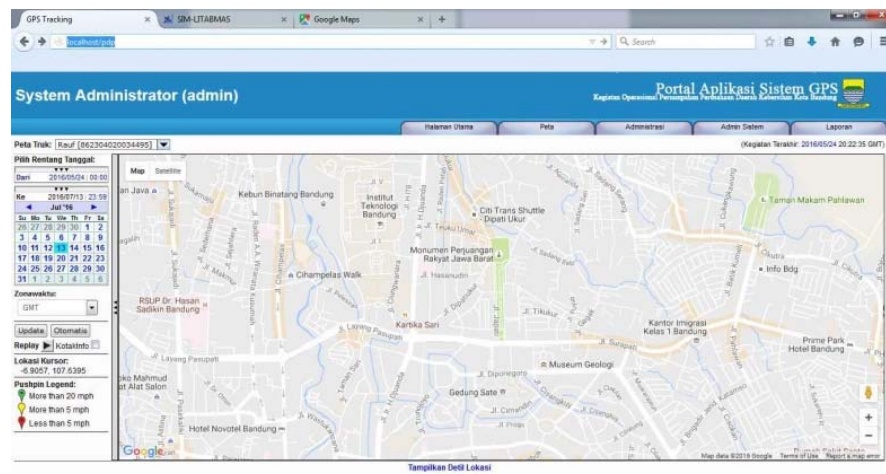


Fig. 5: Main menu of GPS application for admin level

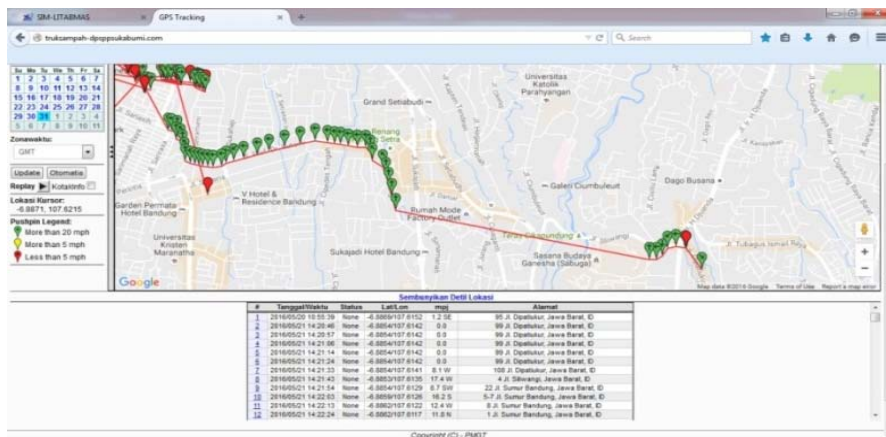


Fig. 6: The route history of the vehicle

if that vehicles driven by the others and to find the route also track record/history of the vehicle's position passed by to reach a certain position.

The GPS applications system of waste operations is a Web application that is connected to the internet and this application only requires a browser to be able to run. The procedures to use this application starts with the appearance of the opening screen to the Login on the page menu that consisting of "User Id" and "Password" as authentication (Fig. 4). Type Username and Password on the login form thus can enter this GPS application. Here is the Home display for user with admin level access (Fig. 5).

To find out the route history of the vehicles in a certain date conducted by selected the date of the trip and followed by selected the registration plate of vehicle. Figure 6 showed the route history of the vehicles that have been done in a certain date.

Besides monitoring the data of operational vehicles that are transporting the waste, this application has a facility to place a coordinate where the location of temporary waste disposal stations located. This facility is really important to find out whether the operational vehicles passed through or transported the waste to the temporary waste disposal stations located.

## CONCLUSION

According to the analysis result and discussion that has been described on this research, there are some conclusions that can be drawn as follows. This application that has been made could make speed up the searching process of operational vehicles and could find out who drive that vehicle without monitoring directly to the field. Provide an easy way to fill data form of vehicle operational and speed up the monitoring process of vehicle using so that it give the convenience to the operational division at Regional Sanitation Company in Bandung. Through this system, the operational division could monitor the vehicle usage in real-time and it also reduce misuse of operational vehicle. Based on the conclusion above can be drawn some suggestions as further indication that must be done for implementation of GPS application program of waste operational activities of regional sanitation company in Bandung, they are as follows.

## RECOMMENDATIONS

The thing that have to pay more attention from this software about the operational utilize of GPS application program of waste operational activities is the safety and responsibility of this software data. The authority's parties should consider several factors and considerations before granting the license to use this software to the user.

To keep the development of the rapid information system, GPS program application of Bandung waste operational activities can be developed into a sensor that equipped with RF sensor for the entry and exit of vehicles, added the weight tools in temporary waste disposal station and it connected to the software, the installation of CCTV and the software that can be accessed by another parties but it have to consider the level of their involvement and the level of the use of information.

The existence of human resource that has an Information Technology (IT) skill is needed to support the use of system and information technology especially in the necessary area. Thus, it good to reconsider about the mechanism to provide human resources in the field of IT to help the use of this GPS application.

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