The Development of Mobile and Server Application for Traffic Data Collection Based on Location-Based Services (LBS)

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Abstract. Traffic data includes various data such as the number of vehicles, vehicle velocity, or travel time that might lead to meaningful information for the traffic engineers. This research aims to collect the traffic data based on the Location Based Services (LBS) by utilizing the Global Positioning System (GPS) in a smartphone. The drivers bring the smartphone and collecting the traffic data while driving the vehicle. It is done in real-time by running the mobile application in background service. The data includes the date, timestamp, latitude, longitude, device ID, and vehicle velocity. These data are temporarily stored in the internal smartphone database, then synchronized to the database in the server application. According to the result, the large number of online taxi drivers and a longer time to collect the data should be considered to cover a wide area.

1. Introduction
Traffic data collection aims to obtain a real-world traffic situation. It includes various data, such as the number of vehicles, vehicle velocity, or travel time. The engineer might use the data to analyze traffic congestion or traffic engineering. The number of vehicles that are passing through a particular road segment over a certain period is an example of data processing results that can be performed. The result might lead to meaningful information that can be used by traffic engineers.

This research aims to propose an alternative to collect traffic data based on the vehicle location or position by utilizing the most common device, which is a mobile phone. Current mobile phones usually equipped with a feature called Global Positioning System (GPS). This research utilizes the GPS module in a mobile phone to obtain the current position of a driver who drives a vehicle. By obtaining the current location and velocity of the vehicle, we expect to obtain data that can be used to yield the travel time. Previously, research by Wu predicted travel time by utilizing support vector regression \[1\]. Furthermore, this data can also be used to yield traffic congestion information. As discussed by Dias \[2\], they found the relationship between congestion and traffic accidents.

Previous research \[3\] discussed the traffic data collection by designing a GPS device which embedded in a taxi vehicle. This research is done for a year. The research obtained the traffic data, which are used to yield the shortest route and estimated time based on traffic congestion conditions.
Another research discusses the classification of traffic congestion levels in the urban area by providing real-time location data every 30 seconds by using the tracking application [4]. The location data will be analyzed by using Kalman Filter to predict the level of traffic congestion in the urban area. Kalman filter also used by [5] to reduce noise in GPS data.

A different approach is used by the Medan city government while compiling the masterplan of a road network [6]. This masterplan is used to develop a transportation system among areas in Medan city. The government collected the traffic data by organizing the research form and gather the data from the institutes which have any relation with the transportation system and spatial planning. Those data are analyzed to obtain the weight of origin and destination matrix in the road network, which is the traffic weight in every road segment in a road network.

This paper consists of four sections. The introduction section discusses the background, the aim of this research, and previous studies. The next section discusses the research method to obtain the traffic data by using a mobile application, and transmission to the server application. The third section discusses the result of this research and then followed by the conclusion.

2. Research Method
2.1. General Architecture

As this research gathers the data based on Location-Based Services (LBS), we utilize smartphones that have a GPS feature. This research utilizes the existing feature in smartphones to collect driver positions and record them to the database. The mobile application records several data such as date, timestamp, latitude, longitude, device ID, and vehicle velocity in every vehicle position changes. The velocity will be recorded as a meter per second. According to Stipanic [7], the traffic congestion index in a road segment can be calculated using the vehicle velocity in that road segment.

The data updating occurs every two seconds. The mobile application has a background service feature to keep the data processing runs in the background without any interaction from the smartphone owner. The application also keeps running while the user opens another application. The background service feature allows the application to record the data in real-time. As shown in Figure 1, it stores all the collected data from the GPS satellite to the internal database. This research uses an internal database in the mobile application as temporary storage before it sends all the recorded data to the server. Saving the data to the internal storage aims to avoid data transmission failures due to loss of data communication because the mobile application and the web server are connected through the internet.

Figure 1 illustrates that the webserver listens to the request from the mobile application. The mobile application will synchronize its data to the server whenever the smartphone has an internet connection. The web server has a particular service called Application Program Interface (API) to handle the request from the mobile application. Besides the date, timestamp, latitude, longitude, device ID, and vehicle velocity, this research will yield other data, namely road segment name for available coordinates. Because the GPS satellite does not provide this kind of data, then we perform a new process to obtain it. As the smartphone has limited resources, we decide to perform the process on the server-side. In order to yield the road segment name, we will convert the latitude and longitude by using the geocoding method. This research uses Google Maps API to perform the geocoding process. We use the following API code to obtain the road segment name:

https://maps.googleapis.com/maps/api/geocode/json?latlng=lat,lng&key=api_key&sensor=false

Google Maps API will return requests in JSON format. Next, we decode the JSON to obtain the road name and store it to the traffic dataset.
2.2. Application Testing

We test the mobile application to collect traffic data by installing it into 15 online taxi drivers’ smartphones. Although other devices such as Personal Navigation Devices (PND), Personal Digital Assistant (PDA), or portable computer can access LBS as well [8], we decide to use a smartphone because it is the compulsory device for the online taxi drivers. We choose the online taxi drivers because they drive the car around the city more often. Therefore, the coverage area will be wider. The taxi drivers agreed and knew that the application would track their location. Therefore, they agree to keep the mobile application running while they are driving. We collect the traffic data in Medan city for one month.

3. Result and Discussion

The traffic data collection involved mobile and server applications. Generally, the mobile application will gather the data, then transmit it to the server. The mobile application is developed for Android OS (Version 6.0.1 or Marshmallow) and only requires a smartphone with GPS features. The server application is developed with PHP and hosted in Apache2 Web Server. We utilized MySQL version 10.1.10 to store the traffic dataset.

This research collects the data by using 15 online taxi drivers. The mobile application gathers the data while the drivers take guests to their destination. We collected the data for one month in Medan city. We collect the date, timestamp, latitude, longitude, device id, and the car velocity. This research obtains 50,000 locations, include the data where the velocity field shows zero values. From our observation, the zero values are caused where the drivers stopped or did
Table 1. The example of traffic data obtained from the smartphone

| Date          | Timestamp     | Logitude   | Latitude    | Devide ID         | Velocity |
|---------------|---------------|------------|-------------|-------------------|----------|
| May 19, 2017  | 7:42:26 AM    | 98.659953  | 3.5673131   | 860153037496280   | 5.37     |
| May 19, 2017  | 7:42:28 AM    | 98.659883  | 3.5673608   | 860153037496280   | 5.1      |
| May 19, 2017  | 7:42:32 AM    | 98.659579  | 3.5673312   | 860153037496280   | 7.3      |
| May 19, 2017  | 7:42:40 AM    | 98.659078  | 3.5673371   | 860153037496280   | 7.07     |
| May 19, 2017  | 7:42:44 AM    | 98.658822  | 3.5673334   | 860153037496280   | 7.25     |
| May 19, 2017  | 7:42:46 AM    | 98.658679  | 3.5673474   | 860153037496280   | 7.81     |
| May 19, 2017  | 7:42:50 AM    | 98.658379  | 3.5673605   | 860153037496280   | 8.06     |
| May 19, 2017  | 7:42:54 AM    | 98.658136  | 3.5673598   | 860153037496280   | 6.78     |
| May 19, 2017  | 7:42:56 AM    | 98.658023  | 3.5673587   | 860153037496280   | 6.3      |
| May 19, 2017  | 7:43:00 AM    | 98.6578    | 3.567369    | 860153037496280   | 5.15     |

Table 2. The example of geocoding result

| Logitude      | Latitude    | Road Name                                                                 |
|---------------|-------------|---------------------------------------------------------------------------|
| 98.659953     | 3.5673131   | Jl. DR. Mansyur No. 22, Merdeka, Medan Baru, Kota Medan, Sumatera Utara 20153, Indonesia |
| 98.659883     | 3.5673608   | Jl. DR. Mansyur No. 22, Merdeka, Medan Baru, Kota Medan, Sumatera Utara 20153, Indonesia |
| 98.659579     | 3.5673312   | Jl. DR. Mansyur No. 30, Merdeka, Medan Baru, Kota Medan, Sumatera Utara 20153, Indonesia |
| 98.659078     | 3.5673371   | Jl. DR. Mansyur No. 58, Merdeka, Medan Baru, Kota Medan, Sumatera Utara 20153, Indonesia |
| 98.658822     | 3.5673334   | Jl. DR. Mansyur No. 60A, Merdeka, Medan Baru, Kota Medan, Sumatera Utara 20153, Indonesia |

not drive their car. For example, while the drivers were dropping the guest, waiting for the guest, having lunch, or taking a rest. These data should be eliminated because they do not reflect the traffic. We obtain 20,000 locations after eliminating the record, which contains zero values in the velocity field.

Table 1 shows an example of the data that was obtained by the mobile application. The mobile application stored them in the internal database instead of directly transmit them to the webserver. Storing the data to the internal database avoids the possibility of losing the data while transmitting them. The mobile application will transmit the data if the internet connection is available. It transmits the data to the webserver through the API. The server application will perform the geocoding process to obtain the road name by using Google Maps API, which returns the data in JSON format. The server application will combine the data from the mobile application and the geocoding result. Table 2 shows the result after the geocoding process. Next, the server application stores all the data to the traffic dataset.
According to the result, the data are scattered in various areas. Based on our observation, this occurs because the taxi drivers cannot determine the guest’s origin, destination, and time. Besides, this causes the time gap in a similar road segment.

4. Conclusion
The smartphone can be used to obtain traffic data based on Location-Based Services (LBS). The mobile application has the ability to utilize the GPS feature in a smartphone to collect the traffic data. In order to avoid losing data while transmitting them, the data should be temporarily kept in the internal database. The mobile application will synchronize the data with the server application through the Internet. In the server application, we perform the new process, which called geocoding, to convert latitude and longitude to road name by utilizing Google Maps API. According to the result, we conclude that the mobile and server applications can be utilized as the system to gather and process the traffic data. In order to collect real-time traffic data, we can rely on online taxi drivers. However, we should consider a large number of online taxi drivers and a longer time to collect the data in order to cover a wide area.

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