Real Time Global Positioning System (GPS) Tracking Implementation Using Android and Web Based System

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Abstract— **One of the main problems in current Global Positioning System (GPS) is the slow duration on updating the position. Moreover, current system uses two separated devices for a single purpose which consumes more power. This research develops a GPS tracking system which provides real time current position information by using High Speed Downlink Packet Access (HSDPA) and Enhance Data for Global System for Mobile Communication Evolution (EDGE) technology, and uses a single device to obtain and send its location. The system was designed to send and track data by which the stability, the level of system response, and the availability of the system were continually measured. The experiment result showed that the mean interval for updating data under HSDPA connection was better than EDGE. By using HSDPA, it was observed that the fastest interval recorded in the database was 1 second. Additionally, the tracking operation could be done between Android devices and web based system simultaneously, by which the receiver could also be used as the coordinate sender and the sender could also be used as the coordinate receiver.**

***Index Terms*— GPS, HSDPA, EDGE, Android based, mobile network.**

I. Introduction

Global Positioning System (GPS) is a satellite based navigation system made up of a network of 24 satellites placed into orbit[1-5]. Nowadays GPS has been used in many applications that demand the information of the position, speed, or acceleration. GPS is now often embedded in mobile phone, computer, or separated GPS module for vehicle. The use of GPS is important for the vehicle and it is used to control as well as to obtain the position of moving vehicle, especially for the company of transportation fleet. GPS is used to obtain the whole information supporting the corporate development to serve its customers.

In the previous GPS tracking, we noticed that there was a problem in updating position interval which was too slow. Additionally, the power consumption was also a problem in the previous GPS tracking research [6-8]. The system used two separated devices for a single purpose, namely a GPS Bluetooth Receiver as the coordinate receiver, and a mobile phone as coordinate sender to the server [9].

In this research, we proposed an implementation of GPS tracking providing the information of the latest position which was updated continuously in real-time by using *High Speed Downlink Packet Access* (HSDPA) and *Enhance Data for GSM Evolution* (EDGE) technology. A single device was used to receive its coordinate and send it directly to the server. In this way, the use of the GPS Bluetooth Receiver might be eliminated. Next, the position somewhat was shown on Google Maps to be tracked in real-time mode where the position address was directly shown to users. The system will be easily used for both monitoring and tracking by using either web service or Android. To track the position history, we also provided a feature of history tracking in the system which recorded the location, time, and speed of the device. The system can be applied to private vehicle security system or to monitor transportation fleet.

II. Experimental Setup

In this system, there are 3 main parts: the sender, the server, and the tracker as shown in figure 1. The position sender was getting the position from satellites and sent the coordinates to the server. On the server side, these coordinates were saved in MySQL database tables [10-11]. On the tracker side, the data were obtained from the server and would be shown on Google Maps. The block diagram of the system can be seen in figure 2.

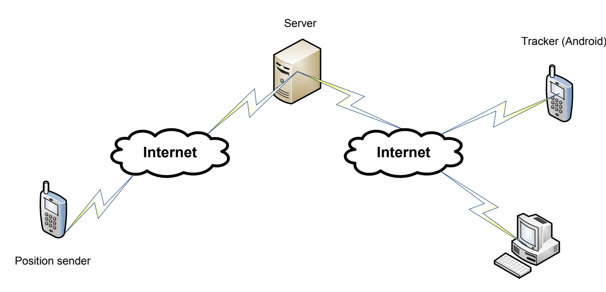

Figure 1: Illustration of the system

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There were five experimental setups done in this research and the whole experiments were done in Syahdan and Kijang Campus of Bina Nusantara University. In the first experiment, a single sender was used. EDGE network was used on the device to connect the server. The interval of position update to the server was set to be every 5 seconds. After the device locked its coordinate, the author took it along to walk surrounding Syahdan Campus, starting from the first standing point and back to the same point. Then on the same device, the connection was switched to HSDPA, and the similar steps were repeated. The objective of this preliminary experiment was to compare the stability of EDGE and HSDPA network against the device movement.

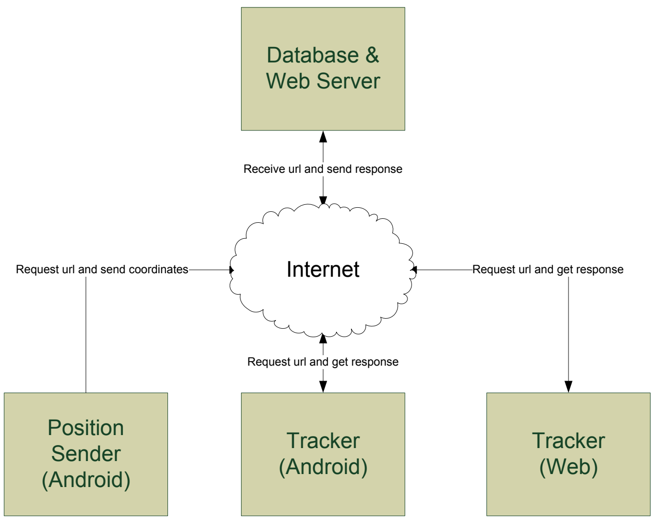

Figure 2. Diagram block of the system

In the second experiment, the author applied HSDPA connection on the device and decreased the updating interval from 5 seconds to 3 seconds, and later to 1 second. The objective of this experiment was to know how responsive the system is to the interval decrement.

In the third experiment, by switching both EDGE and HSDPA network on a single Android tracker respectively, we observed how big is the difference of the duration to obtain data from the server and load it on *Penerima_App* (a receiver application created by the author to do tracking).

In the fourth experiment under HSDPA connection, two Android devices were used to track each other simultaneously. In the same time, they were also tracked on a PC browser. The objective of this experiment was to examine whether there is an obstacle during simultaneous tracking operation.

In the last experiment under HSDPA connection, the author took along a single sender to travel from Kijang Campus to Syahdan Campus. In this experiment, the additional attribute namely "Device Speed" in km/s was added to the system. The objective of this experiment was to estimate the moving speed of the device by applying Haversine formula.

III. Results and Discussion

The result for the first experiment was shown in figure 3 and 4. The first experiment showed that the smallest mean interval deviation was obtained when HSDPA was used. The data shows that the mean interval was 5,303 seconds with the deviation of 6.07%. However, for EDGE, the mean interval was greater that it was 9.4 seconds with the deviation of 88%.

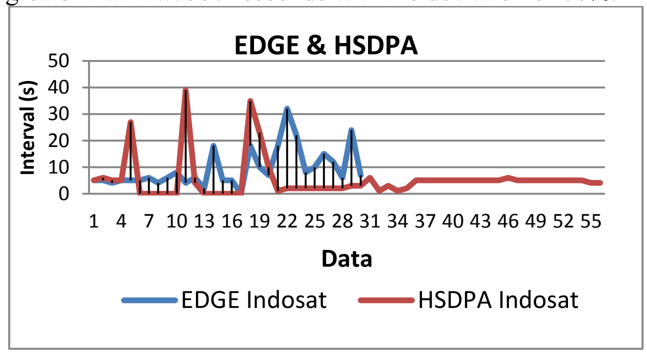

Figure 3: Interval against n-th Data Relationship.

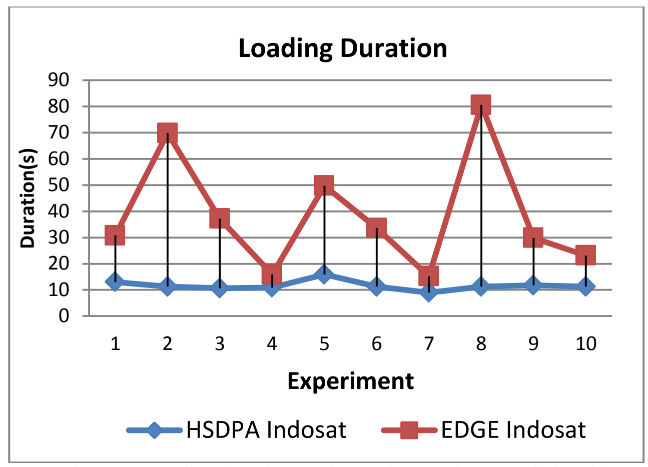

Figure 4: Loading duration against n-th Experiment Relationship.

By using the standard deviation formula, the error could be written as [12]:

$$\delta mean = \frac{mean_{set} - mean_{obtained}}{mean_{set}} \times 100\%$$

By substituting value using mean interval, we could get the mean interval deviation as:

$$\delta mean = \frac{5 - 9{,}4}{5} \times 100\% \quad ; \quad \delta mean = -88\%$$

By using the same formula, the deviation for the other experiment was:

Table 1: Standard Deviation for EDGE and HSDPA

Provider/Network	Mean Interval (s)	Absolute Deviation (%)
Indosat/EDGE	9.4	88
Indosat/HSDPA	5.303571	6.071428571

Table 2 and table 3 showed the data of the second experiment. In the second experiment, the calculated mean interval was 3.3 seconds, which approximated the intended 3 seconds interval. Similar thing also happened for the decrement to 1 second. The system still responded the data and recorded the position, but it got the mean interval of 2.1 seconds, whereas the intended interval should be 1 second. The difference between the actual and intended interval might be affected by the connection of the internet which eventually caused delay of one to two seconds or more.

Table 2: Data of Second Experiment (3s Interval)

Id	Latitude	Longitude	Record time	Interval
1	-6.20013903	106.78588101	2013-03-13 17:39:29	-
2	-6.20012784	106.78587389	2013-03-13 17:39:37	0:00:08
3	-6.20006898	106.78591903	2013-03-13 17:39:39	0:00:02
4	-6.20005623	106.78592713	2013-03-13 17:39:41	0:00:02
5	-6.20002211	106.78590762	2013-03-13 17:39:43	0:00:02
6	-6.20001638	106.78591888	2013-03-13 17:39:45	0:00:02
7	-6.19999631	106.78589997	2013-03-13 17:39:49	0:00:04
8	-6.19997899	106.78587889	2013-03-13 17:39:51	0:00:02
9	-6.19993818	106.78586378	2013-03-13 17:39:56	0:00:05
10	-6.19991222	106.78588288	2013-03-13 17:39:59	0:00:03
11	-6.19992	106.78590041	2013-03-13 17:40:01	0:00:02
12	-6.19994922	106.78590634	2013-03-13 17:40:04	0:00:03
13	-6.1999814	106.78590507	2013-03-13 17:40:07	0:00:03
14	-6.20000851	106.78590109	2013-03-13 17:40:09	0:00:02
15	-6.20003594	106.7858975	2013-03-13 17:40:12	0:00:03
16	-6.20008111	106.78591074	2013-03-13 17:40:19	0:00:07
17	-6.2001497	106.78587837	2013-03-13 17:40:23	0:00:04
Mean Interval				3,375

Table 3: Data of Second Experiment (1s Interval)

Id	Latitude	Longitude	Record time	Interval
1	-6.20016831	106.78592208	2013-03-13 17:51:55	-
2	-6.20014031	106.78589526	2013-03-13 17:52:00	0:00:05
3	-6.20009534	106.78587587	2013-03-13 17:52:02	0:00:02
4	-6.20005981	106.78588372	2013-03-13 17:52:05	0:00:03
5	-6.20001646	106.78588667	2013-03-13 17:52:07	0:00:02
6	-6.19996392	106.78587196	2013-03-13 17:52:09	0:00:02
7	-6.19993342	106.78587971	2013-03-13 17:52:11	0:00:02
8	-6.19990073	106.78588783	2013-03-13 17:52:13	0:00:02
9	-6.19988517	106.78590392	2013-03-13 17:52:16	0:00:03
10	-6.19991598	106.78592217	2013-03-13 17:52:17	0:00:01
11	-6.19994832	106.78592933	2013-03-13 17:52:19	0:00:02
12	-6.19997856	106.78592594	2013-03-13 17:52:20	0:00:01
13	-6.19999309	106.78592524	2013-03-13 17:52:22	0:00:02
14	-6.20002295	106.78592706	2013-03-13 17:52:24	0:00:02
15	-6.20005038	106.78590874	2013-03-13 17:52:26	0:00:02
16	-6.20007737	106.78589679	2013-03-13 17:52:28	0:00:02
17	-6.20010975	106.7858991	2013-03-13 17:52:32	0:00:04
18	-6.20010975	106.7858991	2013-03-13 17:52:32	0:00:00
Mean Interval				2,17647

In the third experiment, the duration to load the data were shown in Figure 4. When using HSDPA, the mean duration was 11.617 seconds, with the fastest of 8.956 seconds and the slowest of 15.891 seconds. The mean duration for EDGE network was 38.585 seconds with the fastest of 15.215 seconds and the slowest of 80.584 seconds, as illustrated on figure 4. The graph also showed that along n experiments, HSDPA connection tended to be more constant than EDGE.

In the fourth experiment, both devices succeeded in tracking each other, as shown in table 4. Success in this context was determined by success in sending or receiving between devices in the same time without the need to wait each other to take turn, as well as no error happened. The table also showed that PC browser had successfully tracked device 1 or device 2 simultaneously without any obstacle.

Table 4: Tracking Data between Device1, Device 2 and PC.

	Track Device 1	Track Device 2
Device 1	-	Success
Device 2	Success	-
PC	Success	Success

In the fifth experiment, the estimation of device movement speed was shown in the table *positionlog* (a table created by the author to record the coordinates). The speed calculation was done by using the help of Haversine formula [13] used to calculate the nearest distance of two points, in which the distance was divided by the time difference of old coordinate with the new coordinate. The first 5 data from 36 data of the experiment are shown in table 5:

Table 5: Additional Speed Data in km/h (First 5 Data)

Id	Latitude	Longitude	Record time	Device speed
1	-6.19429213	106.78733682	2013-03-14 07:13:54	0.0313273
2	-6.19439205	106.78746294	2013-03-14 07:13:57	21.3932
3	-6.19445241	106.78748011	2013-03-14 07:14:00	8.36994
4	-6.19464136	106.78755339	2013-03-14 07:14:03	27.0215
5	-6.19475818	106.78758842	2013-03-14 07:14:06	16.2657

IV. Conclusion

Based on this research, it can be concluded that the mean interval for updating data under HSDPA connection was better than under EDGE as it had much lower deviation, 6.07% compared to 88%. The data showed that when the interval was set to 1 second, the system still responded the data and recorded the position, whereas it showed that the fastest interval recorded in the database was 1 second, but with the mean interval of 2.1 seconds. Moreover, tracking operation could be done between Android devices and web based system simultaneously. The receiver could also be used as the coordinate sender and the sender could also be used as the coordinate receiver, vice versa. In this experiment, Haversine formula was used to provide speed information in km/h for the tracking purpose.

For the future development, due to the increasing number of smart phone users, this application is not only used as vehicle tracking, but also applied for human tracking. By the help of Indoor Wireless Positioning, the system can be developed as the integration of indoor and outdoor tracking. Moreover, the system can be developed on multi platforms, not only on Android.

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