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The effect of distance Base Transceiver Station (BTS) on speed of vehicle safety response based on internet of things

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Abstract. In 2018 the Central of Statistics recorded cases of theft of motorized vehicles and embezzled cars from rentals totalling 2.752 cases, this was due to inadequate safety systems on the vehicle, and there were also several vehicles from vehicle rental services that had used GPS technology (Global Positioning System) which is integrated with the SMS gateway system (Short Message Service) to control the vehicle remotely, but in that system it has many disadvantages such as low speed of time response to turning off the vehicle and requires a large microcontroller memory because it has to store SMS messages and requires resetting in a certain period. The purpose of the study is to build a system in real-time by utilizing the latest technology, namely the Internet of Things so that vehicle owners can easily monitor and control their vehicles through the internet. The method of data analysis uses Anova two-way factor without replication. Data retrieval is done by varying the distance of the BTS and the type of provider to determine the accuracy and speed of response of the vehicle. The result of the study shows that Ublox neo 6M GPS can detect more accurately with Telkomsel Simpati providers with an average distance of 7,6184 meters and for the speed of response of vehicle control remotely Telkomsel Simpati provider with an average of 1,3334 seconds faster and stable.

1. Introduction

In 2018 the Central Statistics Agency noted 2,752 cases of motor vehicle theft or embezzlement of cars from rental or leasing services [1], this was due to inadequate safety systems on these vehicles, and there were also some vehicles from vehicle leasing services that have used GPS (Global Positioning System) technology which combined with the SMS gateway system (Short Message Service) to control the vehicle remotely, but in the system has many disadvantages including being unable to monitor vehicle position in realtime but must send an SMS message in advance to find out every current position, and also devices used such as the Arduino Mega 2560 Microcontroller even though it has more memory than Arduino Uno, it will still run out of memory because it stores too many SMS messages and must first reset the microcontroller u can be reused [2]. Besides, in previous studies, the vehicle position tracking system with GPS and GPRS technology based on the website was only able to monitor the position of the vehicle through the website but could not detect the speed and turn off the vehicle remotely [3].

To overcome these shortcomings, it is necessary to build a system in realtime by utilizing the latest technology, namely the Internet of Things. Information from the 6M NEO GPS sensor on the Wemos D1 microcontroller will be sent via wireless fidelity communication to the internet via Mobile Wi-Fi (MIFI) with the latest 4G LTE super-fast network. So that vehicle owners can easily monitor and control

their vehicles, the system can be accessed online through an internet address that is available with a web browser and can also be accessed through an android application that was created specifically for the system. With the hope that the system has been made, the number of vehicle theft cases can be reduced and also vehicle owners who have the system will feel that it has been facilitated in monitoring their vehicles.

2. Proposed system

The proposed of the system, it is necessary to build a system in real time by utilizing the latest technology, namely the Internet of Things. Information from the 6M NEO GPS sensor on the Wemos D1 microcontroller will be sent via wireless fidelity communication to the internet via Mobile Wi-Fi (MIFI) with the latest 4G LTE super-fast network. So that vehicle owners can easily monitor and control their vehicles, the system can be accessed online through an internet address that is available with a web browser and can also be accessed through an android application that was created specifically for the system. With the hope that the system has been made, the number of vehicle theft cases can be reduced and also vehicle owners who have the system will feel that it has been facilitated in monitoring their vehicles.

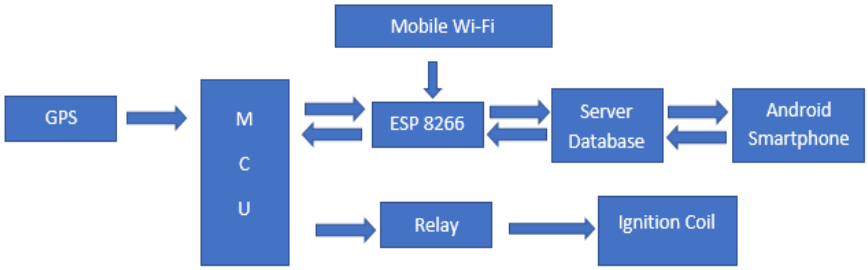

Figure 1. Diagram block.

3. Methodology

The steps taken in designing the design of the Vehicle Tracking system developed include Tracking Location, Calculating Latitude and Longitude data from GPS U-blox Neo 6M, time speed responsed with combined Mobile WIFI 4G LTE Network using Internet of things. The tracking system design is discussed in Figure 2.

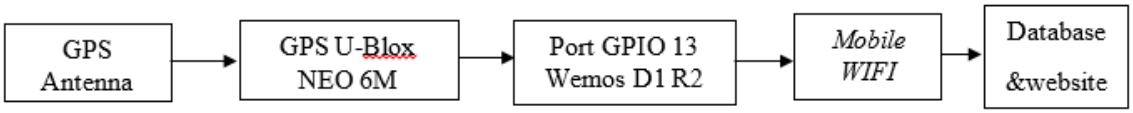

Figure 2. Vehicle tracking process flowchart.

3.1. Tracking location

Global Positioning System (GPS) is a system for determining the location on the surface of the earth with the help of synchronizing satellite signals. This system uses 24 satellites that send microwave signals to Earth. This signal is received by the receiver on the surface and is used to determine location, speed, direction, and time [4].

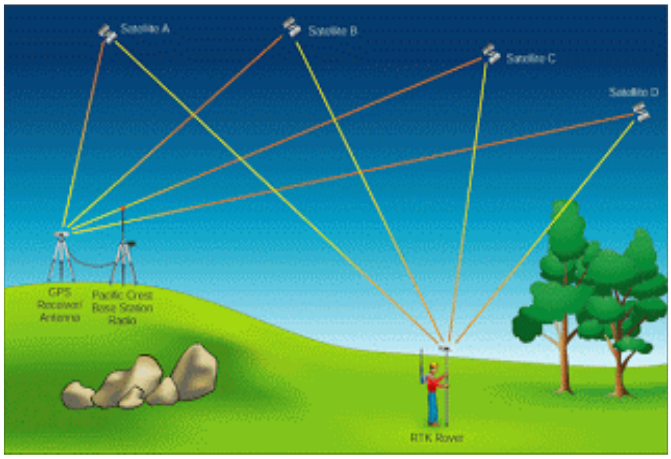

Figure 3. GPS sensor communication with satelite [4].

This GPS tracker which allows the user to track the position of the vehicle, in a Real-Time state. GPS Tracking utilizes a combination of 4G LTE network technology and GPS to determine the coordinates of an object, then translate it in the form of digital maps figure 3.

3.2. Calculate GPS data

To know the accuracy location, data from GPS U-Blox Neo 6M like Latitude and longitude will be show on website and comparing with Latitude and longitude from G-maps where you take a data, subtitute that data to movable-type.co.uk site to get difference of distance from point to point.

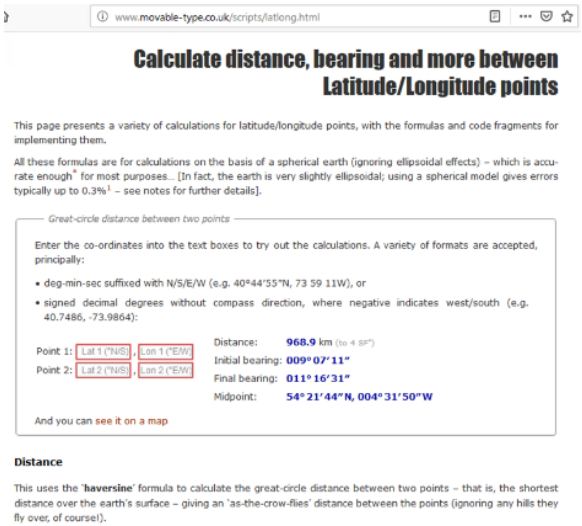

Figure 4. Calculating GPS data.

3.3. Time speed responsed

To know the time speed responsed is calculating time when push digital button on website and time changing on device LCD. Determined the difference time data from the website and device LCD in many BTS distance.

Figure 5. calculating time speed responsed.

3.4. Device training

The device training use Mobile Wi-Fi with running on 4G LTE network on Simpati and Smartfren provider, this device will be combined with Wemos D1 R2 (when got the information from GPS sensor) to sending the information about the vehicle location. to trial for this device and knew the best time speed responses with the difference 4G LTE netwok provider when sending the newest vehicle location dan controlling the firing system remotely through the website (siipeta.firebaseapp.com).

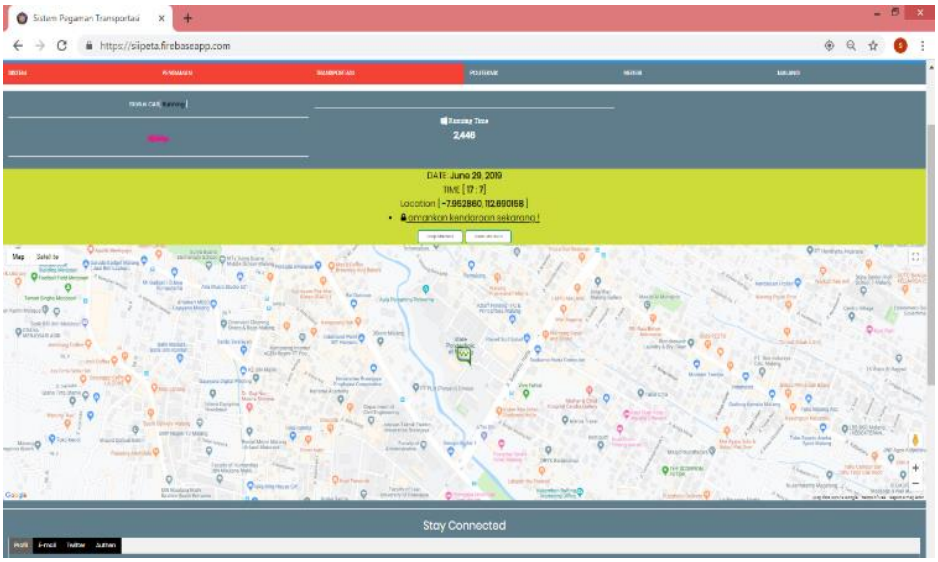

Figure 6. User interface website.

4. Result and discussion

In the test, the location or data collection point is drawn in a straight line from the BTS of each provider with each distance that has been varied by conducting experiments three times in 1 variable, so the total testing is carried out as many as 15 times testing for one provider. From these tests the following results were obtained:

4.1. Accuracy location

Table 1. Accuracy location with Smartfren provider.

PROVIDER SMARTFREN							
BTS Distance	**BTS Direction**	**GPS neo 6m**		**A-gps maps**		**Accuracy distance**	**Average distance**
		Latitude	**Longitude**	**Latitude**	**Longitude**		
500 m	East	-7.934221	112.617234	-7.934228	112.617277	0.00771km	0.009135
	North	-7.944157	112.619983	-7.944155	112.620026	0.004741 km	
	South	-7.948235	112.616533	-7.948130	112.616595	0.01353 km	
1 Km	East	-7.938864	112.672812	-7.938851	112.672871	0.000741 km	0.002151
	North	-7.937745	112.625752	-7.937755	112.625728	0.002867 km	
	South	-7.954362	112.620228	-7.954397	112.620237	0.004016 km	
5 Km	East	-7.952430	112.686935	-7.952464	112.686936	0.003782 km	0.012467
	North	-7.898812	112.627663	-7.898764	112.627657	0.005378 km	
	South	-7.989545	112.621797	-7.989295	112.621842	0.02824 km	
10 Km	East	-7.948878	112.731209	-7.948882	112.731245	0.003989 km	0.009331
	North	-7.876893	112.625275	-7.876942	112.625349	0.009804 km	
	South	-8.026468	112.616272	-8.026342	112.616293	0.01420 km	
15 Km	East	-7.952193	112.759828	-7.952183	112.759890	0.006918 km	0.037183
	North	-7.823492	112.644925	-7.823366	112.644808	0.01904 km	
	South	-8.065633	112.598865	-8.065657	112.598088	0.08559 km	
Average							0,01405

Table 2. Accuracy location with Simpati provider.

PROVIDER SIMPATI					
BTS Distance	**BTS Direction**	**GPS neo 6m**		**A-gps maps**	
		Latitude	**Longitude**	**Latitude**	**Longitude**
500 m	East	-7.952605	112.643555	-7.952555	112.643565
	North	-7.948510	112.639825	-7.948441	112.639820
	South	-7.955933	112.638340	-7.955940	112.638278
1 Km	East	-7.952833	112.648015	-7.952764	112.648052
	North	-7.944410	112.640885	-7.944373	112.640960
	South	-7.960967	112.636747	-7.960905	112.636800
5 Km	East	-7.952340	112.683828	-7.952357	112.683828
	North	-7.911122	112.657065	-7.911127	112.657092
	South	-7.991875	112.621095	-7.991899	112.621123
10 Km	East	-7.950378	112.730247	-7.950365	112.730206
	North	-7.871535	112.679083	-7.871369	112.679165
	South	-8.023745	112.617523	-8.023678	112.617561
15 Km	East	-7.952207	112.759870	-7.952162	112.759858
	North	-7.832737	112.697152	-7.832643	112.697181
	South	-8.079903	112.591398	-8.079940	112.591334

Table 3. Data analyze.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
BTS distance	**0.000316**	**4**	**7.91E-05**	**1.107657**	**0.461724**	**6.388233**
accuracy of place	**0.000266**	**1**	**0.000266**	**3.7178**	**0.126082**	**7.708647**
between providers						
Error	0.000286	4	7.14E-05			
Total	0.000868	9				

Based on the type influence test table above BTS distance and place accuracy above, it can be concluded that:

Because the F-count of 1.107657 with a significance value of 0.461724 is> 0.05, then accept the null hypothesis, meaning that there is no significant difference in the effect of the BTS distance for providers on the delivery of vehicle locations with a 6M neo GPS sensor, because the F-count of 3.7178 with a significance value of 0.126082 is> 0.05, then accept the null hypothesis, meaning that

there is no significant difference in the interaction between the types of Simpati and Smartfren provider interactions on the accuracy of the position of the vehicle.

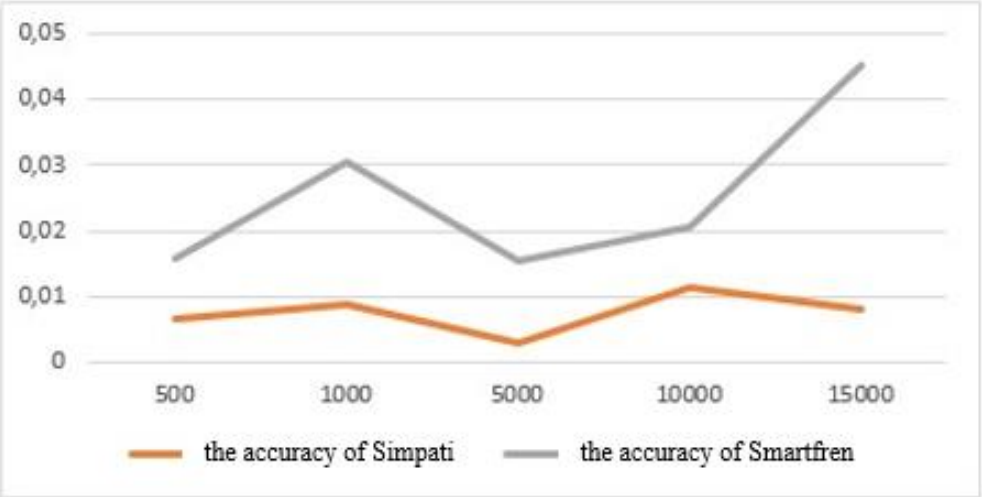

Figure 7. Difference acurracy location inter providers.

From the graph above, it can be concluded that the most accurate of the two types of signal provider 4G LTE (Telkomsel and Smartfren), namely Telkomsel, with the overall type of provider with a distance of 5000 meters from the signal source is to produce an average accuracy of vehicle location with measurement position which is 0.002998 km or 2.998 meters. and the farthest distance between the two points is Smartfren with a distance of 15 km produces an average accuracy of the position of the vehicle which is 0.037 km or 37 meters from the measurement position.

4.2. Time speed responsed

Table 4. Time speed responsed with Smartfren provider.

PROVIDER SMARTFREN					
BTS Distance	BTS Direction	Time on the LCD	Time on web pages	Difference in response time (seconds)	Average response time
500 m	East	07 : 13 : 54	07 : 13 : 55	1	1.333333
	North	15 : 40 : 27	15 : 40 : 26	1	
	South	15 : 35 : 52	15 : 35 : 50	2	
1 Km	East	07 : 33 : 12	07 : 33 : 14	2	1.6666667
	North	15 : 47 : 16	15 : 47 : 14	2	
	South	15 : 25 : 30	15 : 25 : 29	1	
5 Km	East	19 : 57 : 28	19 : 57 : 25	3	2.33333
	North	16 : 30 : 42	16 : 30 : 40	2	
	South	15 : 10 : 27	15 : 10 : 25	2	
10 Km	East	19 : 38 : 44	19 : 38 : 41	3	2.66667
	North	16 : 48 : 55	16 : 48 : 52	3	
	South	14 : 52 : 58	14 : 52 : 56	2	
15 Km	East	19 : 16 : 34	19 : 16 : 31	3	3.33333
	North	17 : 37 : 21	17 : 37 : 18	3	
	South	14 : 41 : 49	14 : 41 : 45	4	

Table 5. Time speed responsed with simpati provider.

PROVIDER SIMPATI					
BTS Distance	BTS Direction	Time on the LCD	Time on web pages	Difference in response time (seconds)	Average response time
500 m	East	21 : 45 : 41	21 : 45 : 40	1	1.333334
	North	16 : 16 : 07	16 : 16 : 05	2	
	South	18 : 37 : 50	18 : 37 : 49	1	
1 Km	East	16 : 31 : 16	16 : 31 : 14	2	2
	North	19 : 28 : 11	19 : 28 : 09	2	
	South	18 : 50 : 05	18 : 50 : 03	2	
5 Km	East	19 : 52 : 39	19 : 52 : 38	1	1.333334
	North	16 : 55 : 00	16 : 54 : 58	2	
	South	19 : 09 : 10	19 : 09 : 09	1	
10 Km	East	20 : 09 : 15	20 : 09 : 14	1	1.666667
	North	17 :27 :50	17 : 27 : 47	3	
	South	19 : 27 : 02	19 : 27 : 01	1	
15 Km	East	20 : 25 : 16	20 : 25 : 15	1	2
	North	18 : 36 : 13	18 : 36 : 10	3	
	South	20 : 00 : 48	20 : 00 : 46	2	

Table 6. Time speed responsed data analyze.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
BTS distance	**1.794441**	**4**	**0.44861**	**1.591134**	**0.331866**	**6.388232909**
accuracy of place between providers	**0.899997**	**1**	**0.899997**	**3.192115**	**0.148529**	**7.708647422**
Error	1.127775	4	0.281944			
Total	3.822213	9				

Based on the type influence test table above the BTS distance and tool response time above, it can be concluded that:

Because the F-count of 1.591134 with a significance value of 0.331866 is> 0.05, then accept the null hypothesis, meaning that there is no significant difference in the distance of the BTS provider to the response time of the device.

Because the F-count of 3.192115 with a significance value of 0.148529 is> 0.05, then accept the null hypothesis, meaning that there is no significant difference in effect between interactions between Simpati and Smartfren providers on the response time of the tool.

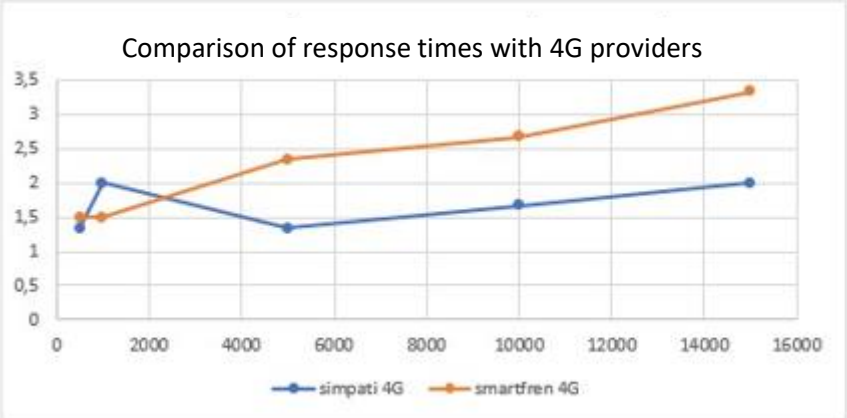

Figure 8. Comparing time speed responsed.

In the graph above the Simpati provider at 1000 meters from the BTS, experienced data transmission time due to the distance taken a measurement data in urban high rise buildings that affect the speed of

the provider in sending data from the device, the Simpati provider will experience an increase in the duration of turning off or turning on the vehicle when greater distance to the BTS.

Smartfren providers at a distance of 500-1000 meters from BTS have a vehicle safety response speed that is more stable despite being in the center of a high rise building due to Smartfren installing repeaters so Smarfren has better stability and speed than Simpati providers, but when moving away from BTS with distance 5000 - 1500 meters Smarfen has decreased the response speed which is much longer than the Simpati provider.

From the graph above, it can be concluded that the fastest of the two types of 4G LTE signals (Telkomsel and Smartfren), namely Telkomsel, with the overall type of provider with a distance of 500 meters from the signal source is to produce the average - fastest response time, namely 1, 333334 seconds and the slowest is Smartfren with a distance of 15 km resulting in an average response time of 3.333334 seconds.

5. Conclusion

Based on research that has been done it can be concluded that:

- The design of this tool uses a Neo 6M GPS sensor to detect the position of the vehicle and then the information is processed by the Wemos D1 R2 microcontroller to be sent to the Database via Mobile WIFI, data from the database data will be displayed to the web through an integrated HTML program.
- From the previous data it can be concluded that the U-Blox NEO 6M GPS can detect position accurately, has a shift point to the actual position with an average value of 0.0076184 kilometers or 7.6184 meters with Simpati 4G provider, meaning faster internet connection then it will be able to speed up the updating and sending of data from the NEO 6M GPS to the website and is still in the 8-10 meter absolute accuracy standard (SNI 19-6724-2002).
- Interaction between BTS distance and type of provider does not affect on deadly response time or activates the gasoline motor ignition system with a significance value of 0.148529 which means> 0.05. The fastest type of provider of the two 4G LTE providers (Telkomsel and Smartfren) namely Telkomsel with a distance of 500 meters from the signal source produces an average response time of 1.33334 seconds and the slowest is Smartfren with a distance of 15 kilometers produces an average response time of 3.3334 seconds.

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