Real-time vehicles velocity monitoring and crossroads evaluation using rule-based RESTful maps API service

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Abstract. The vehicle velocity monitoring system is an important part of the transportation system. This system is used to conduct monitoring and evaluations so that the quality of the land transportation system can be improved. At present, there are many vehicle velocity monitoring systems. Unfortunately, most of these devices still have to be operated manually, some other devices may have been automated, but it still involves many devices that must be installed, so it is causing problems in installation, maintenance, and repair in the event of damage. In this research, we propose a rule-based cloud system, which monitors the average speed of vehicles passing on the roads that can be used to evaluate the traffic controller at crossroads using the Maps API-Service that accessed via RESTful web services. Longitude and latitude coordinates of the road are inputted into the Maps API-Service than results in distance and travel time data. This data is then developed into other information using the formula and rule-based method to measure the vehicle’s velocity and traffic controller performance. The result of this research produces a cloud-based information system that can measure vehicle velocity and performance of crossroads traffic controllers in real-time and automatically.

1. Introduction
Nowadays the land transportation world faces increasingly complex problems, the increasing number of vehicles on the highway raises many problems, ranging from traffic congestion, transportation safety, and security, public transport route arrangements, etc. All of which greatly affect the sustainability of the transportation system [1][2]. The problem that is quite influential on land transportation is traffic congestion, which then causes various forms of losses, from waste of fuel and energy, waste of foreign exchange, disruption of business and economic interests, waste of time, stress noise, air pollution and various other impacts caused either directly or indirectly [3]. So that now the problem has become a
global problem that requires serious handling [4]. The fundamental measurement tool to solve the problem is a monitoring and evaluation system. So Land transportation requires a system that can monitor the average velocity of passing vehicles on the road for many purposes. At present there are many ways to monitor the speed of vehicles passing on roads, unfortunately, most of these monitoring systems require many devices that must be installed, ranging from loopwire, sensors, radar, cameras and many other devices [5], so that it raises a lot of effort that must be spent, from installation, maintenance to repairs if damage occurs.

There are many types of map providers and traveling API-services such as Google, Geography, Bing Maps Geocode, MapQuest, Rand McNally, etc.[6][7]. Each map and traveling API-Service have different characteristics. At most places in the world, Google Maps-based API-Service had the best information regarding estimated arrival time and the condition of traffic congestion, so in this research, the authors used Google Distance Matrix API-Service which accessed via the RESTful webservice to get an initial data [8]. Then the preliminary data processed using a formula developed from the principle of load-balancing and a rule-based system to obtain information on the average speed of vehicles passing and evaluation of the crossroads. The advantage of this system is that it does not require special equipment that must be installed on the road. It does not require physical operation and maintenance on-site, but the average velocity of the vehicle passing and road intersection can still be evaluated and monitored online, real-time and approached like a real condition.

2. Related work

In previous similar research, measurements and evaluations of many highways using sensor tools such as loop wire, radar, infrared, sonar, and others are used to detect and measure an object [9]. In another research, there are also use fiber optic sensors, the working principle is by detecting vehicle vibrations passing through two optical fiber-based interferometric sensors [10]. Besides that in other research use computer vision-based cameras to recognize objects. Data from these sensors are processed by a method such as CNN, R-CNN and so on to produce the information needed to measure road speed and performance [11][12]. However, all of that method requires device installation that is quite complicated and requires a lot of effort, so another alternative measurement system that’s easier, practical and effective is needed.

The proposed method based on several previous research, which consist of research on the implementation of cloud computing [13], RESTful Webservice and Maps-API services [14], the relationship and integration between speed, time and distance [15], research that implements the analogy of the water flows algorithm in the roads traffic congestion [16], research on linear equations and comparison [17], adaptive load-balancing and cloud computing [18], and solving problems related to cloud computing using rule-based methods [19], so that the combination of these ideas results in a new method that can be used to do vehicles speed measurement and evaluation of the intersection in real-time, online, easy and practical.

Cloud computing is widely used in a system based on software as a service. In many previous studies cloud computing was implemented in big data analytics and the implementation of RESTful web services in various fields including smart city and transportation [13][19]. RESTful (Representational State Transfer) web services are a data communication protocol and integration between different systems that can be widely used by utilizing HTTP/Web protocols, many of the advantages offered by RESTful-based integration architectures, including resource-oriented architectures, such as caching systems and the principle of loose coupling between parts in an integrated system [20], the principle of loose coupling integration also provides many conveniences to update components, redirects and implement alternatives so that the RESTful web service is very suitable for integrating and communicating data on systems that heterogeneous with cloud-based [21].

Google distance matrix API-Service is a Google API based on RESTful web service provided by Google, from this service, we can get distance information from two-point in the roads, the duration of time it takes for the vehicle to pass from the starting point to the destination point in real-time and estimate the average duration of the vehicle that passes on the road based on historical data [5].

2
The following is an example of the output from the Google distance matrix API-Service:

```
{
  'distance': {'text': '2.5 km', 'value': 2520 },
  'duration': {'text': '8 mins', 'value': 450},
  'duration_in_traffic': {'text': '7 mins', 'value': 410}
}
```

In previous research on the implementation of water flow algorithm in road traffic engineering optimization analogizes that vehicle traffic on the road is like water flowing in a pipe or water channel media, therefore water flows modeling can be applied to solve problems related to road traffic [16].

In research that examines the relationship between velocity, distance and time have a basic concept and show the relationship as shown in formula 1 [15].

\[ v = \frac{d}{t} \]  

(1)

where \( v \) is a vehicle velocity, \( d \) is a distance, \( t \) is a time durations. While in research on linear equations and comparisons, to state the relationship between two elements that influence each other in a linear condition can be formulated as in formula 2 [17].

\[ \frac{a}{m} = \frac{b}{n} \]  

(2)

where \( a \) and \( b \) are elements that have a linear relationship with \( m \) and \( n \) as the dividing factors that influence. In research on load-balancing discusses how a resource can be divided properly to get maximum performance from a system [18]. The principle of load sharing is to take an average value that can be formulated by the formula:

\[ \bar{a} = \frac{\sum_{i=1}^{n} x_i}{n} \]  

(3)

where \( \bar{a} \) is the average value of \( x_1..x_n \), \( n \) is the number of entities.

Research about congestion prediction can be concluded, the average speed of vehicle passing on the road has a relationship with the level of traffic jam indicator. To measure the level of congestion must refer to the Highway Capacity Manual (HCM) [22]. This research use congestion prediction in normal condition and non-rainy day, so that has a traffic jam indicator scale 0-100 compared to the speed scale of 0-120 km/hours. Comparison between the level of traffic jam indicator and the vehicle speed is shown in formula 4 [23]:

\[ j = \frac{100}{120} \cdot v \]  

(4)

Where \( j \) is a traffic jam indicator, \( v \) is a velocity of vehicles now, \( v_a \) is an averages vehicle velocity.

A Rule-based method is used to store and manipulate knowledge and rules that are predetermined to solve a problem automatically. In previous research, rule-based methods are widely implemented in various research topics such as IoT, sensors, monitoring, and measurement [19]. Besides, in the field of transportation rule-based systems are applied to intelligent traffic control systems and traffic management [24].

3. Method

3.1. Method explanation

The proposed method idea in this research based on a combination of several previous research. The use of cloud computing that accesses Maps-API through RESTful web services makes it easy to obtain distance and duration data from one place to another places in the road, so the velocity can be calculated using the simple formula that explained in this research. Then data processed using the analogy of flowing water and the principle of load-balancing, the crossroads evaluation formula built by the analogy
of the load-balancing system. This formula is embedded in a rule-based system to produce an online and real-time velocity measuring and crossroads evaluation system.

3.2. System infrastructure
Apache webserver runs PHP-7.2. This PHP7.2 module runs Yii2 Framework in which there are PHP scripts that serve to manage interconnections with Python Script and generate interfaces with users. HTML, CSS, Javascript code generated by PHP Script is sent by Apache Webserver to the web browser to be displayed as an interface to the user. The system design proposed in this research can be seen in Figure 1.

![System design](image)

*Figure 1. System design*

In this research, the authors took the example of a crossroad scenario with 8 directions of vehicle traffic, as in figure 2.

![Intersection scenario](image)

*Figure 2. Intersection scenario*

In figure 2, it can be seen that each road has 4 intersection points with other roads, more clearly can be seen in the crossroads table (Table 1).

![Crossroads table](image)

*Table 1. Crossroads table.*

| Number | Road   | Cross 1 | Cross 2 | Cross 3 | Cross 4 |
|--------|--------|---------|---------|---------|---------|
| 1      | a1a2   | d1d2    | b1d2    | c1b2    | c1c2    |
| 2      | b1b2   | c1c2    | a1c2    | d1a2    | d1d2    |
| 3      | c1c2   | b1a2    | d1a2    | b1d2    | b1b2    |
| 4      | d1d2   | b1b2    | c1b2    | a1c2    | a1a2    |
3.3. Vehicle speed ratio and traffic light effectiveness coefficient (traffic light fitness value)

Calculation of the traffic light or traffic controller effectiveness value starts by determining the ideal target velocity value of each road section. The calculation of this ideal target is influenced by the ratio of the maximum capacity of each road section. Then the process continues with the calculation of deviation value between the vehicle’s velocity read on the system with the ideal velocity. The average deviations value on each of these roads shows the performance of the traffic controller in dividing the traffic load of the road so that the performance of the crossroads traffic controller can be evaluated.

The traffic controller is intended to regulate traffic on each road segment so that the road can be utilized optimally. On each road with the same capacity, it has the same ideal target velocity level, namely the average speed of the vehicle on all road segments measured by its effectiveness coefficient, so that the difference in average vehicle speed of each road with an ideal velocity arranged in one cycle of scheduling traffic light indicates the performance of the system. So that, as in the formula to calculate the average value (shown in formula 3), the ideal velocity of each road segment is the same with the average speed of vehicles passing on all roads, so it can be formulated as in equation 5.

\[ v_t = \overline{v} = \frac{\sum_{x=1}^{n} v_x}{n} \tag{5} \]

Where \( v_t \) is a target velocity (ideal vehicle velocity), \( v \) is an average vehicle velocity, \( v_x \) is a velocity of road \( x \), \( n \) is a number of roads.

For roads that have different capacities, the maximum speed of the vehicle that is allowed to pass through on the road is used as a proportional linear comparison in determining the ideal target velocity in load balancing system, so the formula can be adopted from linear equations and comparison (as formula 2). Implementation in calculating target velocity proportionally, on roads that have different maximum speed rules, can be written as in formula 6.

\[ \frac{v_{tx}}{\sum_{a=1}^{n} v_a} = \frac{v_{max_x}}{\sum_{a=1}^{n} v_{max_a}} \tag{6} \]

Where \( v_{tx} \) is a target velocity (ideal vehicle velocity) for road \( x \), \( v_a \) is a real-time velocity of road \( a \), \( v_{max_x} \) is a maximum velocity allowed on road \( x \), \( v_{max_a} \) is a maximum velocity allowed on road \( a \), \( n \) is a number of roads. so the \( V_{tx} \) value can be determined by equation 7.

\[ v_{tx} = \frac{v_{max_x} \sum_{a=1}^{n} v_a}{\sum_{a=1}^{n} v_{max_a}} \tag{7} \]

Where \( v_{tx} \) is a target velocity (ideal vehicle velocity) for road \( x \), \( v_a \) is a real-time velocity of road \( a \), \( v_{max_x} \) is a maximum velocity allowed on road \( x \), \( v_{max_a} \) is a maximum velocity allowed on road \( a \), \( n \) is a number of roads.

The success rate coefficient of a traffic light in regulating traffic can be measured from the deviation value of the difference in the speed of the road with an ideal speed (vt), so that this shows the effectiveness coefficient of traffic regulation for \( n \) road segments. Formulas can be formulated as in equation 8.
$$e_x = |v_x - t_x| = \sqrt{(v_x - v_{tx})^2}$$  \hspace{1cm} (8)

Where $e_x$ is a traffic light effectiveness coefficient of road, $v_{tx}$ is a target ideal velocity of the road $x$, $v_x$ is a real-time velocity of the road $x$.

It can also be written as equation 9.

$$e_x = \sqrt{(v_x - \frac{V_{max_x} \sum_{a=1}^{n} v_a}{\sum_{a=1}^{n} V_{max_a}})^2}$$  \hspace{1cm} (9)

Where $e_x$ is a traffic light effectiveness coefficient of road $x$, $v_x$ is a real-time velocity of road $x$, $v_a$ is a real-time velocity of the road $a$, $V_{max_x}$ is a maximum velocity allowed on road $x$, $V_{max_a}$ is a maximum velocity allowed on road $a$, $n$ is a number of roads.

Therefore, to see the effective coefficient of overall traffic arrangement of one cycle that consists $n$ roads can be represented by averages value of the effective coefficient of each road section, as shown in formula 10.

$$E = \bar{e} = \frac{\sum_{x=1}^{n} e_x}{n}$$  \hspace{1cm} (10)

$E$ is an overall effectiveness coefficient, $\bar{e}$ is an average effectiveness coefficient, $e_x$ is an effective coefficient of road $x$, $n$ is a number of roads. The overall effectiveness coefficient can also be written as in formula 9.

$$E = \bar{e} = \frac{\sum_{x=1}^{n} \left( v_x - \frac{V_{max_x} \sum_{a=1}^{n} v_a}{\sum_{a=1}^{n} V_{max_a}} \right)^2}{n}$$  \hspace{1cm} (11)

Where $E$ is an overall effectiveness coefficient, $\bar{e}$ is an average of effectiveness coefficient, $v_x$ is a real-time velocity of roads $x$, $v_a$ is a real-time velocity of road $a$, $V_{max_x}$ is a maximum velocity allowed on road $x$, $V_{max_a}$ is a maximum velocity allowed on road $a$, $n$ is a number of roads.

If the traffic light system has managed each road segment in such a way that each road section has the same velocity value as the ideal target (divided proportionally), then the Overall Effectiveness coefficient ($E$) value will reach 0, meaning there is no difference in velocity with the ideal velocity target ($v_t$) on each road, thus the ideal target of the load-balancing traffic light system has been achieved.

3.4. Rule-based system of traffic analysis

The flow of the proposed system starts from the longitude and latitude coordinate input of the road segment to be analyzed, then these coordinates are used as Maps-API Service inputs that are accessed using the RESTful web services. Maps-API Service generates duration and time data which is then processed to be a vehicle velocity value (as shown in formula 1). Then the process is continued with the classification process of congestion using classification rules, which are then analyzed the road section using the formula method of crossroads evaluation to generate the final result. The explanation can be seen in figure 3.
4. Result and discussion
The proposed method in this research is implemented into a cloud computing information system that conducts vehicle velocity monitoring and crossroads evaluation on major roads located in the city of Semarang, Indonesia. The first sample data were taken on May 14th, 2019, then the result is compared and tested by data in real field studies. Measurement in the field study is done by reading the GPS and speedometer using a vehicle passing on the road. We mark the coordinates of the points on the google map that are used as the starting point and destination point of the road analyzed as shown in figure 4.

![Figure 4. Coordinate the point of the road](image-url)
The resulting graph that records the speed of vehicles passing by using Google Distance Matrix API-Service can be seen in figure 5.

![Figure 5. average vehicle velocity](image)

Comparison between system result and field study on a1a2 road section (Majapahit street) shown in system result and real conditions comparison in table 2. This data is taken at times representing different levels of congestion which are indicated on the value of the traffic jam scale (in a heavy traffic jam (1), moderate traffic jam (2) and normal velocity traffic (3)).

**Table 2. System results and real conditions comparison.**

| Number | Time  | Velocity read by the system (km/h) | Velocity in Real Conditions (km/h) | Deviation (km/h) | Traffic jam |
|--------|-------|-----------------------------------|-----------------------------------|-----------------|-------------|
| 1      | 04.45 | 43.00                             | 50.00                             | 7.00            | 3           |
| 2      | 04.55 | 44.07                             | 50.00                             | 5.93            | 3           |
| 3      | 06.00 | 35.30                             | 36.00                             | 0.70            | 2           |
| 4      | 06.07 | 32.40                             | 34.00                             | 1.60            | 2           |
| 5      | 07.00 | 28.30                             | 25.00                             | 3.30            | 2           |
| 6      | 07.05 | 31.60                             | 35.00                             | 3.40            | 2           |
| 7      | 07.10 | 25.60                             | 30.00                             | 4.40            | 2           |
| 8      | 16.45 | 17.60                             | 18.00                             | 0.40            | 1           |
| 9      | 16.50 | 15.16                             | 15.00                             | 0.16            | 1           |
| 10     | 17.15 | 10.50                             | 15.00                             | 4.50            | 1           |
| 11     | 20.50 | 32.70                             | 35.00                             | 2.30            | 2           |
| 12     | 21.00 | 31.10                             | 32.00                             | 0.90            | 2           |
| 13     | 21.15 | 31.60                             | 31.00                             | 0.60            | 2           |
| 14     | 22.15 | 34.60                             | 35.00                             | 0.40            | 2           |
| Average|       | 29.54                             | 31.50                             | 2.54            |             |
There is a difference between the data reported by the information system and real data from field conditions, which shows an average difference of 2.54 km/hours. While in figure 6, shows a graph of the traffic jam indicator of a1-a2, and the opposite (crossroads) using the rule-based method as described in section 3.4.

![Traffic jam indicator](image)

**Figure 6.** Traffic jam indicator

The rule-based traffic jam scale graph can be seen in figure 7.

![Rule-based traffic jam scale](image)

**Figure 7.** Rule-based traffic jam scale

Survey data shows that this road has the highest density level in the morning at 07.00 - 08.00 GMT+7 which is an average of 9037 vehicles per hour (LV = 2255, HV = 210, MC = 6572), in the range of 12.00-01.00 GMT+7 an average of 7977 vehicle hours (LV = 2277, HV = 308, MC = 5392) and evening at 16.00-17.00 GMT+7 an average of 9345 vehicles per hour (LV = 2704, HV = 236, MC = 6406) [25]. LV is Light Vehicles, HV is Heavy Vehicles, and MC is Motorcycle. This data has similarities with the graph shown in Figure 7, the graph shows in the morning (at 07.20 - 08.20 GMT+7), in the range of 10.35 - 11.10 GMT+7, in the range of 14.05-14.40 GMT+7 and evening (at 15.50 – 17.35 GMT+7) has heavy traffic jam (scale 1).
In the second field study data was taken on August 27th, 2019, the purpose is to test the overall traffic light/controller effectiveness. In the traffic light/traffic controller evaluation, using the proposed formula (formula 11), the system reports a result as shown in figure 8. A comparison between system reports and real conditions can be seen in the table of the vehicle’s velocity between system and real condition (table 3).

![Overall Effectiveness of Traffic Controller (deviation in km/h)](image)

**Figure 8.** Overall Effectiveness (E) coefficient of a traffic controller

On the effectiveness coefficient of traffic controller graph (shown in figure 8) detect some imbalanced traffic density (ideal value E = 0), this is because in real conditions through direct observation, the traffic that passes on each road section has a difference vehicles velocity, that cannot be balanced by the traffic controller system.

**Table 3. Vehicles velocity between system and real condition.**

| time | a1a2 sys | b1b2 sys | c1c2 sys | d1d2 sys | a1c2 sys | b1d2 sys | c1b2 sys | d1a2 sys |
|------|----------|----------|----------|----------|----------|----------|----------|----------|
| 5:00 | 47.32    | 40.00    | 40.21    | 45.00    | 32.62    | 35.00    | 33.19    | 36.00    |
| 5:10 | 46.21    | 45.00    | 42.01    | 45.00    | 33.90    | 38.00    | 34.64    | 38.00    |
| 5:20 | 30.75    | 34.00    | 25.76    | 25.00    | 23.38    | 25.00    | 24.66    | 25.00    |
| 5:30 | 28.13    | 30.00    | 23.89    | 20.00    | 22.98    | 25.00    | 24.78    | 25.00    |
| 5:40 | 26.55    | 25.00    | 28.06    | 30.00    | 14.40    | 16.00    | 22.76    | 20.00    |
| 5:50 | 21.19    | 25.00    | 28.67    | 30.00    | 18.12    | 20.00    | 23.61    | 20.00    |
| 6:00 | 25.23    | 25.00    | 28.93    | 31.00    | 21.33    | 24.00    | 20.41    | 22.00    |
| 6:10 | 23.69    | 25.00    | 28.80    | 32.00    | 19.37    | 20.00    | 19.98    | 22.00    |
| 6:20 | 30.60    | 30.00    | 28.80    | 32.00    | 22.08    | 24.00    | 22.23    | 24.00    |
| 6:30 | 21.20    | 25.00    | 28.80    | 30.00    | 22.23    | 24.00    | 20.87    | 22.00    |
| 21:45 | 27.54    | 30.00    | 25.46    | 28.00    | 20.55    | 23.00    | 21.97    | 24.00    |

**Average**

|         | sys  | real | deviation |
|---------|------|------|-----------|
| a1a2    | 30.72| 30.90| 0.18      |
| b1b2    | 30.06| 31.80| 1.74      |

So the averages of vehicle velocity in system report and the real condition are shown in table 4.

**Table 4.** Average comparison in each road segment.
In Table 4, it shows that average deviation in overall road segment between system reports and the real condition is 1.58 km/hours. This shows better results compared to one road segment field studies conducted on May 14th, 2019.

**Table 5. Crossroads analysis and comparison between system and real report.**

| Result Source | Road | Cross 1 | Cross 2 | Cross 3 | Cross 4 | Average | Effectiveness |
|---------------|------|---------|---------|---------|---------|---------|--------------|
|               | a1a2 | d1d2    | b1d2    | c1b2    | c1c2    | avg     | e            |
| System        | 30.721| 24.823  | 26.111  | 23.901  | 22.873  | 25.6858 | 5.0352       |
| Real          | 30.9 | 25.6    | 29.3    | 26.1    | 25      | 27.38   | 3.52         |
|               | b1b2 | c1c2    | a1c2    | d1a2    | d1d2    | avg     | e            |
| System        | 30.059| 22.873  | 21.918  | 26.047  | 24.823  | 25.144  | 4.915        |
| Real          | 31.8 | 25      | 22.3    | 28.1    | 25.6    | 26.56   | 5.24         |
|               | c1c2 | a1a2    | d1a2    | b1d2    | b1b2    | avg     | e            |
| System        | 22.873| 30.721  | 26.047  | 26.111  | 30.059  | 27.1622 | 4.2892       |
| Real          | 25   | 30.9    | 2.053   | 29.3    | 31.8    | 23.8106 | 1.1894       |
|               | d1d2 | b1b2    | c1b2    | a1c2    | a1a2    | avg     | e            |
| System        | 24.823| 30.059  | 23.901  | 21.918  | 30.721  | 26.2844 | 1.4614       |
| Real          | 25.6 | 31.8    | 26.1    | 22.3    | 30.9    | 27.34   | 1.74         |
|               | a1c2 | d1d2    | c1b2    | d1a2    | b1b2    | avg     | e            |
| System        | 21.918| 24.823  | 23.901  | 26.047  | 30.059  | 25.3496 | 3.4316       |
| Real          | 22.3 | 25.6    | 26.1    | 28.1    | 31.8    | 26.78   | 4.48         |
|               | b1d2 | c1c2    | d1a2    | c1b2    | a1a2    | avg     | e            |
| System        | 26.111| 22.873  | 26.047  | 23.901  | 30.721  | 25.9306 | 0.1804       |
| Real          | 29.3 | 25      | 28.1    | 26.1    | 30.9    | 27.88   | 1.42         |
|               | c1b2 | a1a2    | b1d2    | a1c2    | d1d2    | avg     | e            |
| System        | 23.901| 30.721  | 26.111  | 21.918  | 24.823  | 25.4948 | 1.5938       |
| Real          | 26.1 | 30.9    | 29.3    | 22.3    | 25.6    | 26.84   | 0.74         |
|               | d1a2 | b1b2    | a1c2    | b1d2    | c1c2    | avg     | e            |
| System        | 26.047| 30.059  | 21.918  | 26.111  | 22.873  | 25.4016 | 0.6454       |
| Real          | 28.1 | 31.8    | 22.3    | 29.3    | 25      | 27.3    | 0.8          |

Average velocity: 25.81 km/hours, Average deviation: 1.58 km/hours.
In Crossroads analysis and comparison between system and real report (table 5) shows the velocity level of each road compared to the intersection. The velocity data is compared also between data produced by the system and the field survey result. Then each of the data is calculated its average value to produce the value of overall effectiveness (E). The result shows a little difference between the effectiveness level calculation reported by the system and the field survey results data, the system reports \( E = 2.69 \text{ km/h} \) average speed difference between crossroads road segments, whereas in field studies shows \( E = 2.39 \text{ km/h} \), there is a difference of 0.3 km/h.

In previous studies, the use of velocity sensors in the form of optical fiber interferometric mounted on the road to detect speed provides good performance, with an error rate of 1.53 km/h to 3 km/h in 100 km/h. Unfortunately, it cannot detect accurately if many vehicles are passing together, and weather conditions such as rain and others that make vibrations cause the sensor to be inaccurate. so the average speed of the vehicle cannot be predicted accurately [10]. The results of reading with a camera produce the number of vehicles passing per unit of time, by detecting objects that pass to predict velocity level, the more vehicles that pass certainly affect the performance and the level of accuracy. The ability of the method using the camera is only able to detect 43% of motorcycles that pass, and 92% for vehicles other than motorcycles, so the accuracy of the average vehicle velocity that passes has not been predicted precisely [10]. While the method proposed in this research provides a better certainly level of accuracy. In a place where more vehicle drivers are smartphones user, it can provide a better level of accuracy. In the first field study, a deviation between system report and real study show 2.54 km/h in 31.50 km/h, so accuracy value shows 1 - (2.54/31.50) or 92%, and the second field study show the deviation 1.58 km/h in 27.39 km/h or about 94.2%.

5. Conclusion
A Rule-based system based on online cloud methods that get raw data from the RESTful Map API-Service can be used as a vehicle velocity measurement tool and evaluate the performance of a crossroads traffic controller without the need for devices to be installed at the road location to be analyzed. This method provides a lot of added value when compared to many measurement methods that use multiple sensors and cameras. The measurement accuracy level of the proposed system is about 92% - 94.2%, so this measurement result is close to the real conditions and can solve the problem of the need for an effective and efficient measurement system for land transportation.

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