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GOOGLE MAPS AND MAPBOX API PERFORMANCE ANALYSIS ON ANDROID-BASED LECTURE ATTENDANCE APPLICATION

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Abstract. Attendance is an inseparable component from lectures. The current manual attendance process still has its weaknesses, such as the loss or broken attendance sheets, the easiness to conduct fraud on the attendance sheets, and other cases. The attendance system using fingerprint devices are also not available in other locations yet, such as lectures that are done on the field or outdoor, where fingerprint devices are not available. Because of that, an online lecture attendance system that makes use of Android-based smartphones is developed in order to tackle the problem. This online lecture attendance system has the main feature of recording students' attendances in a radius of 300 m from the lecturer. This application is named Lecture Attendance System is developed using Rapid Application Development (RAD) model, because it is an effective method to minimize errors in the application. There are two testing performed to the application. The first testing was functional testing of the application. This testing was carried out in order to make sure that all functionalities and features are performing well. The second testing carried out is the distance accuracy testing, to compare between the Google Maps and MapBox API distances. From this testing, it was found that the error percentage using Google Maps is 9.250% and 12.128% for MapBox. From these results, they show that in calculating the distance, using Google Maps API has higher accuracy compared to the MapBox API.

Keywords: Attendance system, Google Maps, MapBox, Android

I INTRODUCTION

The education world has produced many new breakthrough and inventions, especially in the technology. Started off with computers, laptops up to smartphones that has sophisticated capabilities for a very portable device. Cellular phones were not only used to communicate via calls and sending short texts but also they have grown rapidly used for practically everything. One of the well-known operating systems used in smartphones is Android [1]. This research will produce an attendance application that can be used in the education world especially in lectures. This application will work on Android operating system by making use of the location based services. The system produced from this research will validate the students' attendance based on the distance of a student from the lecturer. Because of that, a maps API needed that provides a distance calculation function or commonly known as distance measure. Some APIs that provides this function is Google Maps that was developed by Google, Inc. [2] and MapBox that was developed by MapBox Inc. [3]. The analysis that will be conducted in this application is by identifying, measuring and comparing the accuracy of Google Maps API and MapBox API to determine which maps API that is more suitable to use in the Android-based attendance application.

II METHODOLOGY

The software development methodology used in this research is Rapid Application Development (RAD). According to [4], RAD is a software development model that emphasises on the speed of development, which is the short timeline. The RAD model is an adjustment from the linear sequential model. If the developer understood the criteria and the capacity of the software that is about to be built, then the developer can develop the application within very short time (60-90 d). This research uses CodeIgniter framework [5] to build the web service that will connect the Android application with the database. The development of the website project using this framework will lead to quicker development compared to building the

website manually [6]. CodeIgniter uses the Model View Controller (MVC) design pattern that differentiates between the logics and the interface, therefore the developmental process can be broken down. There are components that are specific to building the interface and there are components that are tasked to create the core program. The MVC pattern from CodeIgniter can be seen in Figure 1 [7].

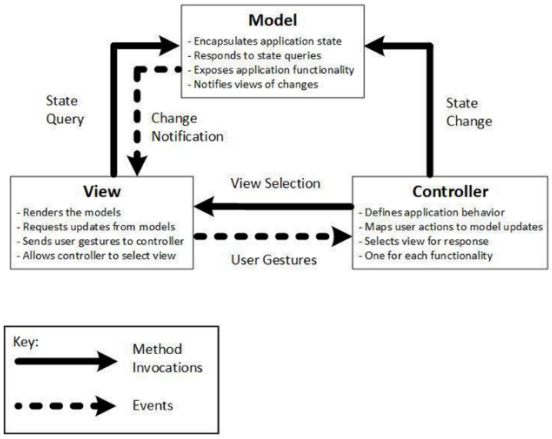

Figure 1 The MVC pattern of CodeIgniter.

This research will be carried out in several stages. The first stage started out by identifying and formulating the problem, followed by the literature study regarding the problem identified. Next, the development of the entire system using RAD model, started out with Data & Processing Modelling, Application Generation and Testing & Turnover. After the system is completed, then testing will be carried out with students as well as collecting distance data that will be used in the last stage, which is analysis of the distance measurement accuracy towards both APIs that will be compared. After the most accurate API is identified, then the chosen API will be implemented in the system. The flowchart of this research can be seen in Figure 2.

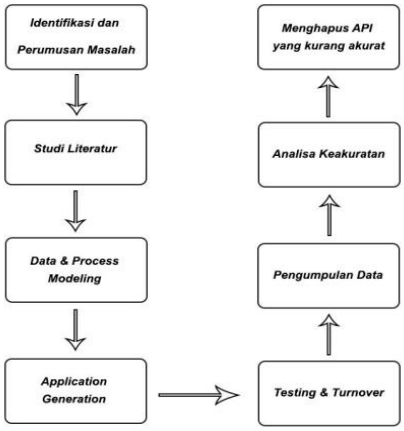

Figure 2 The flowchart of this research.

The programming language used for this research to build the system is Java for the Android-based application and PHP programming language for the web service. The communication scheme for the application's users in requesting and receiving data can be seen on Figure 3.

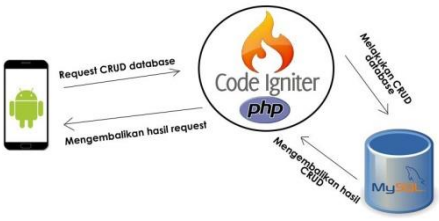

Figure 3 The communication scheme of application.

III RESULT AND DISCUSSION

The online lecture attendance application has two sides, they are; the server side, built with PHP programming language using the CodeIgniter framework and the client side that is an Android-based application that is developed using Java programming language. Both sides will interact and exchange data in the form of JavaScript Object Notation (JSON). There are several displays of this application, they are: the enter view, dashboard view (Active Attendance and Schedule List), and attendance configuration display, students' attendance display (MapBox and Google Maps), and the lecturers' attendance view (MapBox and Google Maps).

The enter display is the first display where users must use their accounts that have been registered on the Syiah Kuala University Online KRS. The initial display on the application will ask the user to input lecturer/student ID and password. If provided password is correct, the dashboard will be displayed. The dashboard is composed of two tabs, they are: active attendance and schedule list. On the schedule list, lecturers can click on the schedule to open the configuration page before the lecture attendance is opened. Meanwhile students can only see the available lecture schedules. The dashboard display can be seen in Figure 4. The attendance configuration display is a view that shows up when the lecturer clicks on one of the schedule that is available. The attendance components that can be configured are interval, schedule, lecturer's location, and many else. The configuration

display of the online attendance application is shown in Figure 5.

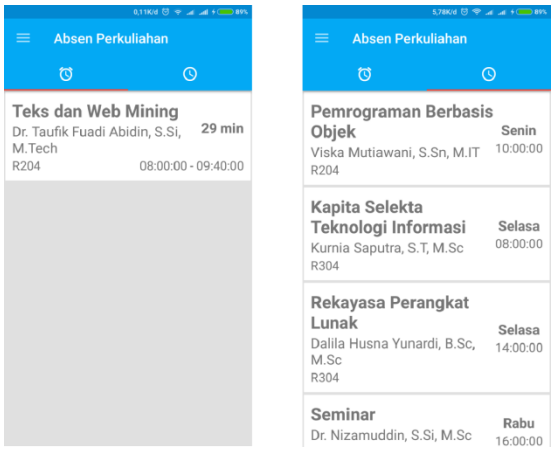

Figure 4 Dashboard display.

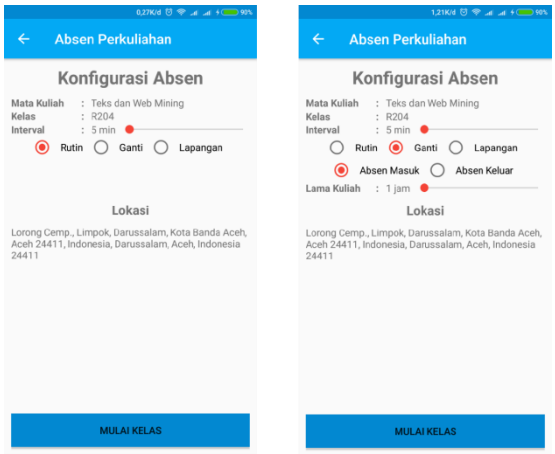

Figure 5 Configuration display.

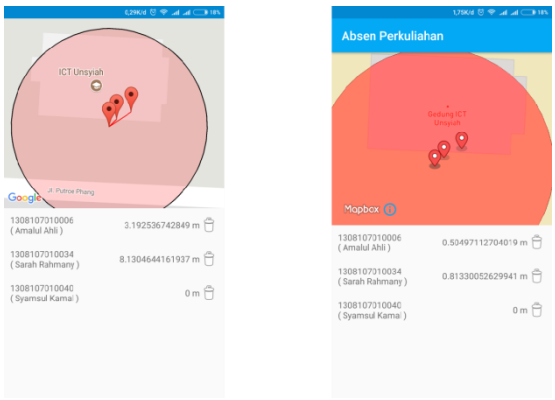

Figure 6 The display on the student side.

There are two different displays on the system; they are the lecture side and student side. The differences between these two displays are on the functionality and feature. On the lecturer side, the lecturer can see the list and the distance of a student, if that student is not present in class. Meanwhile from the student's side, the distance of the student and lecturer will be calculated then the student can state that he is present in the class by clicking a button. The display on the student side can be seen in Figure 6 and the display when a lecturer deletes a student's attendance can be seen in Figure 7.

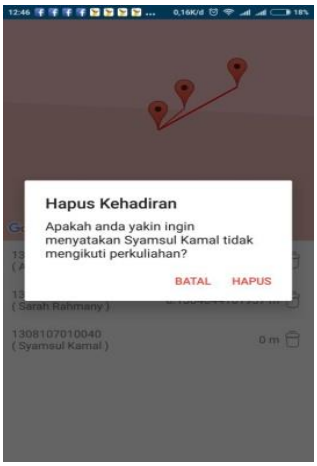

Figure 7 The delete display on the lecturer side.

Functional Testing

The functionality test performed on Online Attendance System is carried out three times. All three tests are carried out successfully. From the results it was found that this application has helped on recording attendance for lectures, either daily lectures or substitute lecture and field lectures.

Distance Testing using Google Maps and MapBox API

This test is conducted in several different places that are indoor and outdoor. The distance calculation is performed by opening up the attendance for three times with a varied number of students, so there were 20 distance calculations obtained from each APIs. The results of these tests can be seen on Table 1. In order to obtain the accuracy, a percentage error is calculated. This is a percentage is calculated based on the measured value and the real value. The measured values are considered more accurate if the error percentage is closer to 0. The formula used to calculate the percentage error is as follows:

$$\%_{error} = \left|\frac{\#_{testing\ distance} - \#_{real\ distance}}{\#_{real\ distance}}\right| \times 100\% \qquad (1)$$

With the formula (1), the error percentage on the distance calculation for each API can

be seen on Table 2 and Table 3. The error percentage results above shows that the average of the distance calculation distance calculation using Google Maps API is lower than MapBox API.

Tabel 1 The result of distance calculation

Location	Student	Google (m)	MapBox (m)	Manual (m)
Gedung ICT	Student 1	3.192	5.05	3.19
	Student 2	0	0	0
	Student 3	8.13	8.133	8.13
Stadion Mini Unsyiah	Student 1	4.771	4.773	4.7
	Student 2	4.856	4.858	5
	Student 3	2.426	2.427	2.4
	Student 4	5.439	5.441	3.62
	Student 5	3.883	3.884	3.85
	Student 6	6.9	6.902	4.77
	Student 7	3.287	3.746	3.3
Hutan Kota, Tibang, Banda Aceh	Student 1	2.597	2.598	2.51
	Student 2	3.084	3.085	3.8
	Student 3	3.509	3.87	3.59
	Student 4	4.367	4.368	3.82
	Student 5	2.809	2.81	2.75
	Student 6	3.369	3.371	3
	Student 7	1.81	1.81	2.11
	Student 8	4.369	4.367	4.36
	Student 9	2.649	2.65	2.6
	Student 10	4.973	4.975	4.8
	Student 11	5.828	5.83	5.5
	Student 12	0.773	0.773	1

Tabel 2 The error percentage on the distance calculation of Google Maps API

Location	Student	Testing Distance (m)	Real Distance (m)	Error Percentage (%)
Gedung ICT	Student 1	3.192	3.19	0.062
	Student 2	0	0	0
	Student 3	8.13	8.13	0
Stadion Mini Unsyiah	Student 1	4.771	4.7	1.51
	Student 2	4.856	5	2.88
	Student 3	2.426	2.4	1.08
	Student 4	5.439	3.62	50.24
	Student 5	3.883	3.85	0.85
	Student 6	6.9	4.77	44.65
	Student 7	3.287	3.3	0.39
Hutan Kota, Tibang, Banda Aceh	Student 1	2.597	2.51	3.46
	Student 2	3.084	3.8	18.84
	Student 3	3.509	3.59	2.25
	Student 4	4.367	3.82	14.32
	Student 5	2.809	2.75	2.14
	Student 6	3.369	3	12.3
	Student 7	1.81	2.11	14.21
	Student 8	4.369	4.36	0.21
	Student 9	2.649	2.6	1.88
	Student 10	4.973	4.8	3.6
	Student 11	5.828	5.5	5.96
	Student 12	0.773	1	22.7
Average				**9.25**

Tabel 3 The error percentage on the distance calculation of MapBox API

Location	Student	Testing Distance (m)	Real Distance (m)	Error Percentage (%)
Gedung ICT	Student 1	5.05	3.19	58.3
	Student 2	0	0	0
	Student 3	8.133	8.13	0.03
Stadion Mini Unsyiah	Student 1	4.773	4.7	1.55
	Student 2	4.858	5	2.84
	Student 3	2.427	2.4	1.125
	Student 4	5.441	3.62	50.3
	Student 5	3.884	3.85	0.88
	Student 6	6.902	4.77	44.69
	Student 7	3.746	3.3	13.51
Hutan Kota, Tibang, Banda Aceh	Student 1	2.598	2.51	3.51
	Student 2	3.085	3.8	18.82
	Student 3	3.87	3.59	7.79
	Student 4	4.368	3.82	2.182
	Student 5	2.81	2.75	2.182
	Student 6	3.371	3	12.37
	Student 7	1.81	2.11	14.22
	Student 8	4.367	4.36	0.16
	Student 9	2.65	2.6	0.02
	Student 10	4.975	4.8	3.64
	Student 11	5.83	5.5	6
	Student 12	0.773	1	22.7
Average				**12.128**

This shows that the distance calculation using Google Maps API is more accurate compared to the distance calculation using MapBox API, since the error percentage of Google Maps API is closer to 0, hence more accurate.

CONCLUSION

Based on the distance calculations conducted with Google Maps and MapBox API, the average error percentage for Google Maps API is 9.250% and 12.128% for MapBox API. Those results suggest that the distance calculation using Google Maps API is more accurate compared to using MapBox API.

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