

Point Clipping Algorithm on Employee Presence Application for Geolocation of Employee Position

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Abstract

In organizations, companies, or agencies such as the Office of Communication and Information Technology, presence has become one of the critical things in assessing the performance of workers/employees. There are several ways to do attendance, where one of them can facilitate the present process with digital tools/machines such as smartphones that utilize the GPS feature to run APIs such as Google Geolocation on Android. Also, a system is needed that can manage the results of the present process, such as web-based applications that can also be accessed through either a computer or smartphone. Therefore, the need to build a presence application both in the presence and in management that can help agencies such as Office of Communication and Information (Diskominfo) to handle internal processes, especially in the management of its employees. In this study, the application in the construction of its application is used Point Clipping algorithm as a tool for the present process that can take advantage of the GPS feature. Based on the results of the tests carried out obtained the value of accuracy. The entry and return attendance process starts at the location area with an average of each side of the area, around 11.21 meters at the entry point and 18.05 meters at the present home outside the office. Where the location limit outside the specified office is around 15 meters. The time test is obtained the time delay value in the attendance process with an average of each side of the area of about 9.6 seconds at the incoming attendance and 8.3 seconds at the home attendance.

1. Introduction

The development of mobile device technology has now reached a very rapid level were based on the We were Social survey in January 2018, the use of mobile devices is more widely used than desktops/PCs, with around 72% of all computer device owners in Indonesia using mobile devices. The application of mobile devices with the Android operating system can facilitate the transfer of interactive and practical information where and whenever [1]. One mobile device technology that utilizes spatial/space data as its main supporting factor is Location-Based Service (LBS) [2].

LBS technology based on cellular networks, determining the position of mobile communication equipment is determined based on the relative position of the equipment to the location of BTS (Base Transceiver Station) [3]. One form of Location-Based Service currently available is Google Geo Location on the Android platform [4], where geolocation refers to the identification of the user's geographical location or computing device through various data collection mechanisms. When GPS signals are not connected, geolocation applications can use information from cell towers to carry out approximate position tracking, a method that is not as accurate as GPS, but this system has developed in recent years [5].

In its implementation, this feature can be implemented/applied to the process and management of employee presence in agencies such as the Office of Communication and Information (Diskominfo). Presence can be said to be an attendance data collection [6] that is part of the reporting activities in an institution. Presence is structured and arranged so that it is easy to find and use when needed by interested parties [7][8].

In the application of presence, in previous studies, there were various methods for carrying out the present process such as the LockGPS Method, Geofence, Cell Id & MAC Address, or by using algorithms such as Euclidean and Ellipsoidal Distance. Whereas, in this study, an algorithm is needed that can provide a boundary in an area. Clipping is a method for activating or deactivating an operation selectively in a defined area/area. Therefore, Point Clipping Algorithm is used to determine which points are in the area/window. Then, compare the points/points with the minimum and maximum coordinate points of the area/window [9].

This is necessary for the present process, and the use of Location-Based Service on the smartphone to determine the location of the area (latitude and longitude) that is obtained through Google Geolocation. The location of the employee area and the office/service area boundary are compared or calculated with the Point Clipping algorithm to determine whether the employee can attend or not.

2. Related Works

In the previous study, Riki showed that the use of global positioning system (GPS) could be used as a position detector [10][11][12]. Ronny and Nanu stated that attendance could be done by the Lock GPS method, which can lock the signal to calculate the user's position [13]. Rizky explained that attendance could be done at each access area that is different according to the access area determined by the central location of the office [14]. Furthermore, in Kharis's research, it was stated that presence could be done automatically by tracking the user's position continuously [15]. Adriana and Yulianto explained that presence could be done by tracking users with specific time intervals in each location area/room that will be calculated between the user's position and location [16]. Aziz's research shows that attendance can be done using the Cell Id & Mac Address method, where Cell Id determines the location area and the Mac Address to mark the user's position when the user is in the location area [17]. Then, in the study of Benfano and Echo, it was suggested that attendance systems that use GPS features could be integrated with other applications such as the payroll system, and the Human Resources Information System [18]. Also, Anwar [19] stated that attendance using GPS is used as authentication for access to applications.

However, in previous studies, the Point Clipping algorithm has never been used as a geolocation controller. So that in this study will apply geolocation with the location APIs method on the application of Android-based user presence, to make attendance and monitoring with the geolocation feature based on the Point Clipping algorithm. So that employees can only do attendance at the office/service and web-based admin presence application that manages employee attendance, so that agency management is more careful and fast in its management.

3. Research Method

Research on employee application development is carried out through several stages. The research steps will be explained in the form of data collection, Point Clipping algorithm analysis, software development, and conclusions. The following Figure 1 is the plot of the research method.



Figure 1. Research Method

3.1 Data Collection

a. Discussion

Obtained application requirements such as service data management, inputting or managing types of attendance data and monitoring employee data, attendance data information in the form of table recap data attendance and attendance data diagrams employee, type/role accounts, forms of workday off and regulatory mechanisms for attendance according to needs that have been discussed by Diskominfo in Tasikmalaya Regency.

b. Observation

Obtained data such as employee data, location coordinates, and working time from Diskominfo Tasikmalaya Regency.

c. Literature Review

Study the theories in the application of Geolocation/GPS in Applications that are tailored to the Point Clipping algorithm of the journal.

3.2 Analysis of Point Clipping Algorithms

a. Determine the coordinates of the minimum and maximum latitude and longitude boundaries of the location of the office.

Google maps are used to retrieve latitude and longitude as an office boundary. Showing latitude and longitude places/locations can be done by left-clicking or right-clicking → What is Here?

b. Determine latitude and longitude user/employee coordinates

To take latitude and longitude user coordinates, it is done on the Android mobile by using the Location-Based Service feature that takes the current position coordinate data from Google Play Service location APIs.

c. Compare the coordinates of the user and office using the Point Clipping algorithm.

In determining the location of a user, the system distinguishes the area of the office and outside the office. The office area is the entire area within the office, while the area outside the office is an area outside the office. The general formula for Point Clipping algorithm can be seen in the Equation 1 and Figure 2.

$$\begin{aligned} X_{min} &\leq X \leq X_{max} \dots \\ Y_{min} &\leq Y \leq Y_{max} \dots \end{aligned} \quad (1)$$

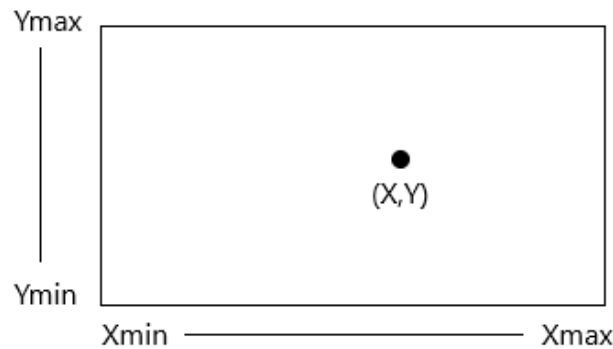


Figure 2. Point Clipping Algorithm

Where X_{min} is the minimum value of latitude in the office area, X_{max} is the maximum latitude area of the office, Y_{min} is the minimum value of longitude in the office area, Y_{max} is the maximum longitude value of the office area, and X and Y are latitude and longitude users. If latitude and longitude users are outside the area of the office, they cannot attend or go home, whereas if the user is in the area of the office, then attendance or return and monitoring are accepted to proceed to the next validation.

- d. The process of identifying attendance and user/employee monitoring.

After conducting location validation, there are rules of time at the time of attendance, which, if past the time of entry, will be considered late. This, too, is the same as going home; if the user returns home early, it is considered a quick return. Whereas when doing both attendance and other absences, if it exceeds the time limit absent, the user is considered absenteeism without information (TK). If the presence is successful, then it will automatically carry out monitoring, which checks the user's location every hour, but the minutes are randomized. When the user has returned, the monitoring is stopped.

3.3 Software Development

The software development method used in this present application research is by using the Rapid Method proposed by James Martin (1991) [20][21].

- a. Requirements Planning

Analyze needs by discussing/consulting directly with employees and agreeing to the needs, scope, boundaries, and requirements of the application/system of presence. Employee data and completeness were obtained in the construction of the Presence application, and it was found that there was no application for employee presence and management in the Tasikmalaya District Diskominfo.

In this study, a web-based presence application was created for admin & super admin and Android for users & executives.

- 1) The web

This web application to manage service data, accounts, attendance, and preset settings and dashboard. The access rights for each account role are:

- a) Super admin

Super admin can manage offices, manage all account roles, create, change, and view user attendance data for each/all offices. Besides that, view attendance recaps for each/all offices, change and view settings data such as latitude and longitude, hours of entry, return, rest, and attendance limit for each service, adding and viewing holiday data for each service and viewing daily & monthly attendance diagram data for each/all offices.

- b) Admin

Admin can get a user account, create, change, and view user attendance data, view attendance recap, view settings data and choose workdays in settings, add and view holiday data and view daily & monthly attendance diagram data by Admin service. Admin can also provide absences without information (TK) for users who have not been absent when the time has passed the time limit for attendance.

- 2) Android

This android application is a tool for attendance, attendance, and view attendance data and displays a daily attendance data diagram of each/all offices. The access rights for each account role are as follows:

a) User

Before accessing the android application, the user account must be created first by a super admin or admin. This application uses the Location Based Service feature that takes latitude coordinates and longitude users to attend or go home. To determine the location of the office area, this application uses the Point Clipping algorithm to determine the location of the work area boundaries when presenting and monitoring. Also, attendance is identified to determine attendance successfully or not according to the time specified.

Users can also view attendance data themselves, and can change their account data such as passwords, names, e-mail, and cellphone numbers.

b) Executives

The Executive or EIS is an account that is dedicated to being used being executives in local apparatus such as heads of offices, heads of regional secretariats, heads of regional technical agencies, etc. Executives can only see daily user attendance data diagrams of each/all offices.

b. User Design

At this stage, there is an evaluation of employees regarding the application design presence that will later be used to develop models and prototype application presence that represents all parts of the application (input, process, output). Stages are carried out continuously so that employees can understand, modify, and ultimately approve the attendance application model according to their needs.

System design using the Unified Modeling Language (UML) because the application is object-oriented (OOP) so that the model uses an object-oriented model. As for Use Case diagrams can be seen in Figure 3, and class diagrams can be seen in Figure 4.

c. Construction

The process of making attendance applications with coding, unit integration, and system/application testing based on the design/design and requirements specified in the previous stage. This stage also allows employees to continue to participate and can still suggest changes or improvements to the present application being developed.

d. Cutover

At this stage, application presence is implemented as well as testing, data conversion, switching to a new system and training of users/employees so that the application can be released and placed in the new system quickly.

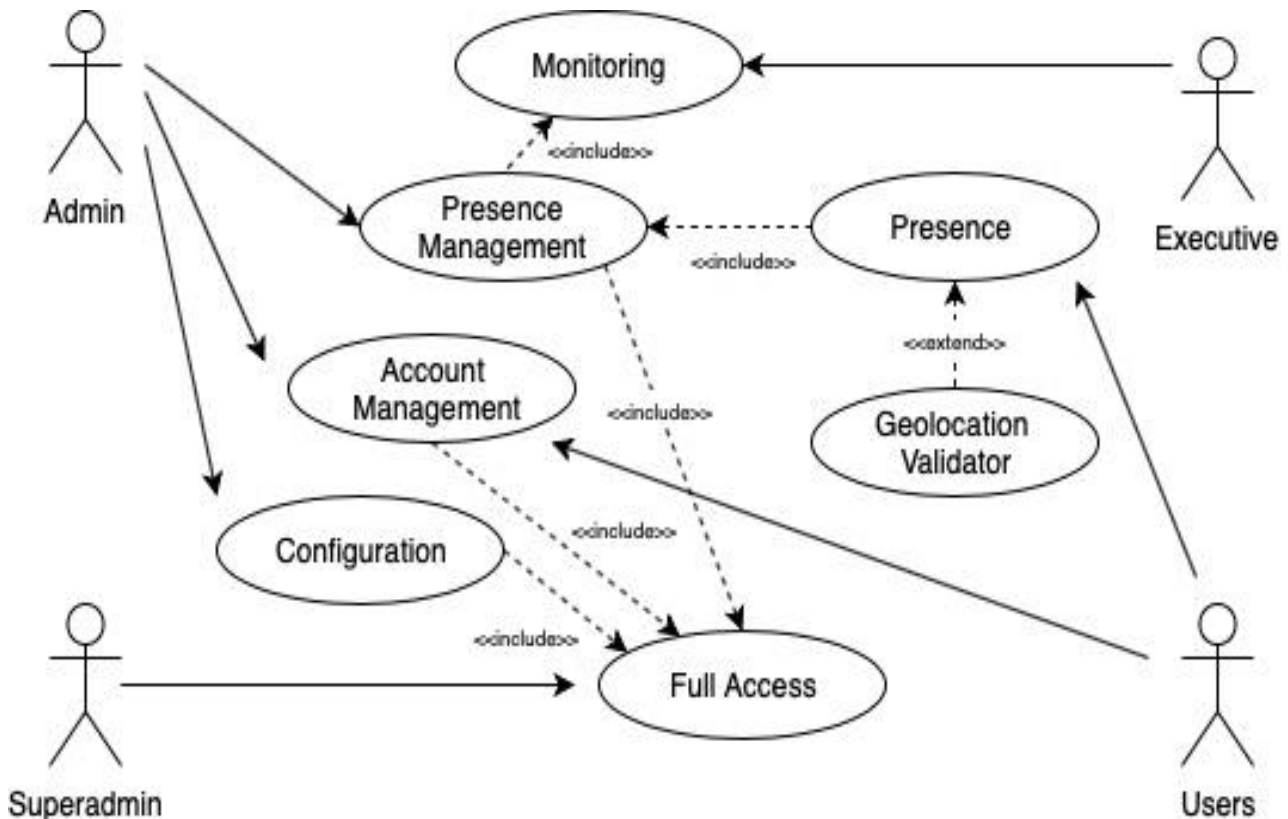


Figure 3. Use Case Diagram

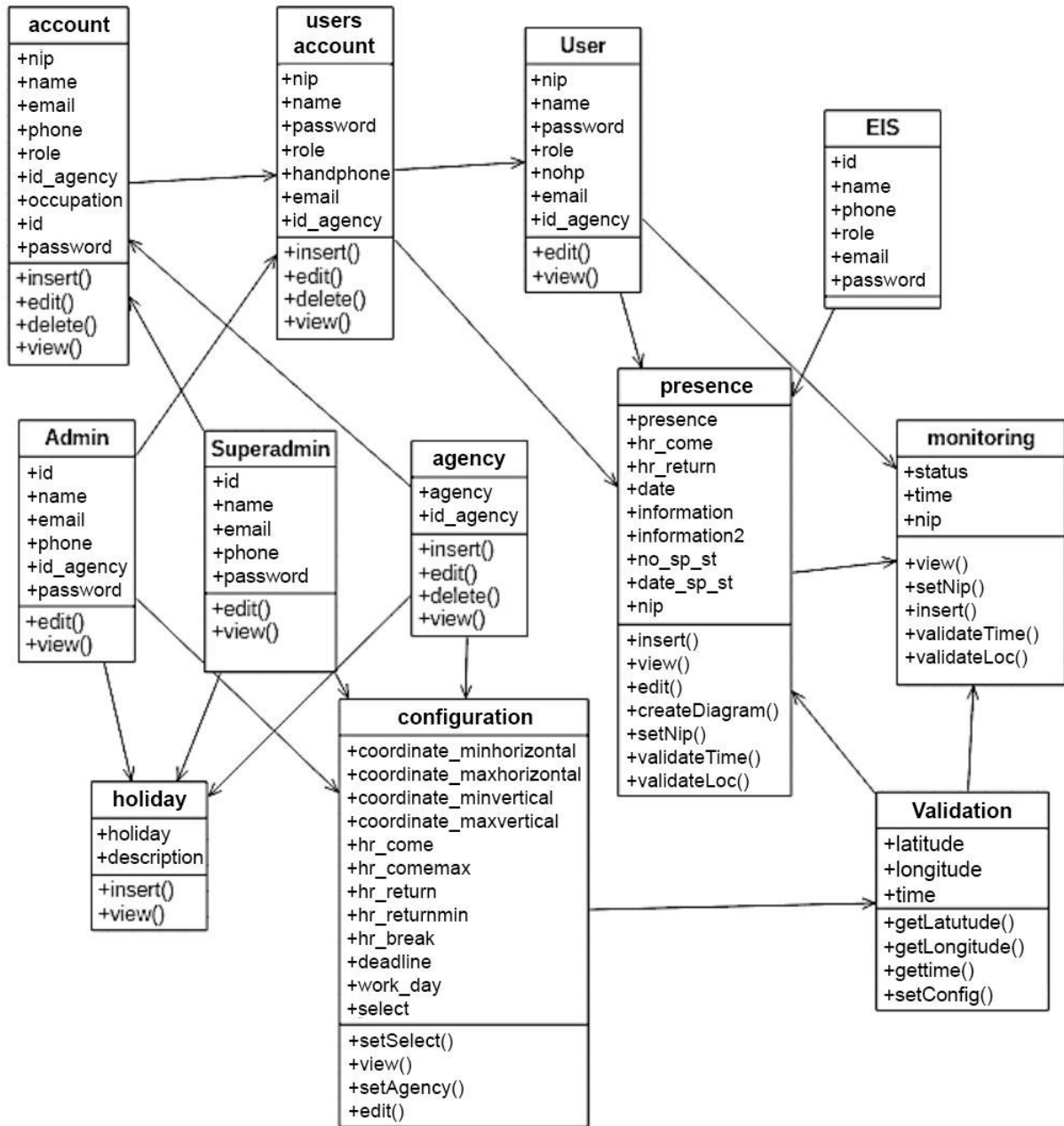


Figure 4. Class Diagram

4. Results and Discussion

4.1 Application Results

This application is built with Web and Android-based, where the Web uses the PHP programming language and Javascript and MySQL database, while Android uses the Java programming language with Tools for developing Android Studio applications with the Google Play Service location APIs method for GPS usage and Point Clipping algorithms applied for the application attendance mechanism.

a. The web

1) Dashboard

The Web Dashboard page contains a circle diagram that represents daily user attendance data, where each slice describes the proportion of each type of attendance. This page also has a bar diagram that represents monthly user attendance data where each bar represents each type of attendance. The results of the web dashboard page can be seen in Figure 5.

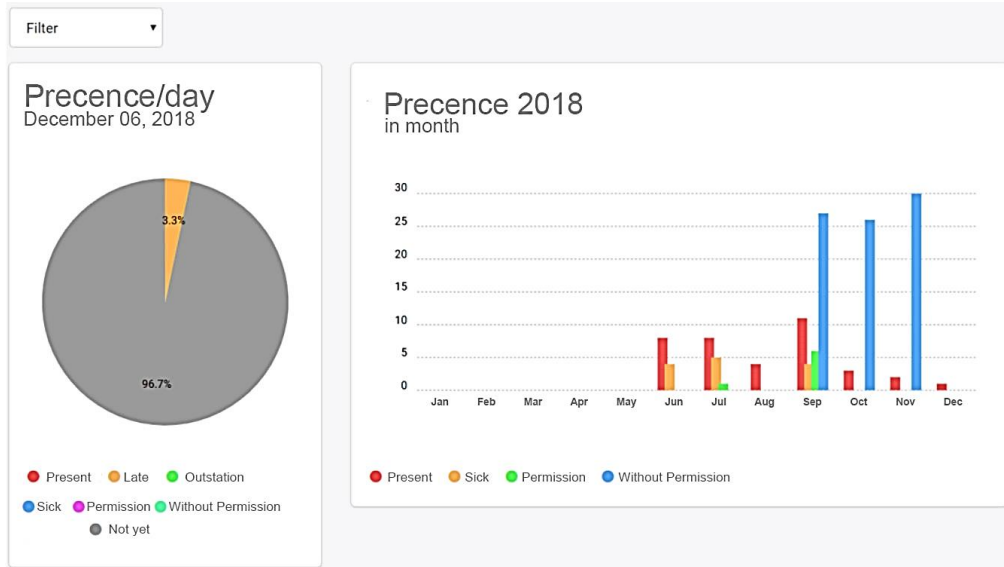


Figure 5. Web Dashboard Page

There are seven types of attendance information starting from being present, late, outside service, illness, permission, without information, and not yet absent.

2) Service

The Service Web page has official data input forms and service data tables. In service tables, the data can be changed or deleted. The results of the service web page can be seen in Figure 6. Figure 6 contains a list of official organizations that have been input to the application that has been built.

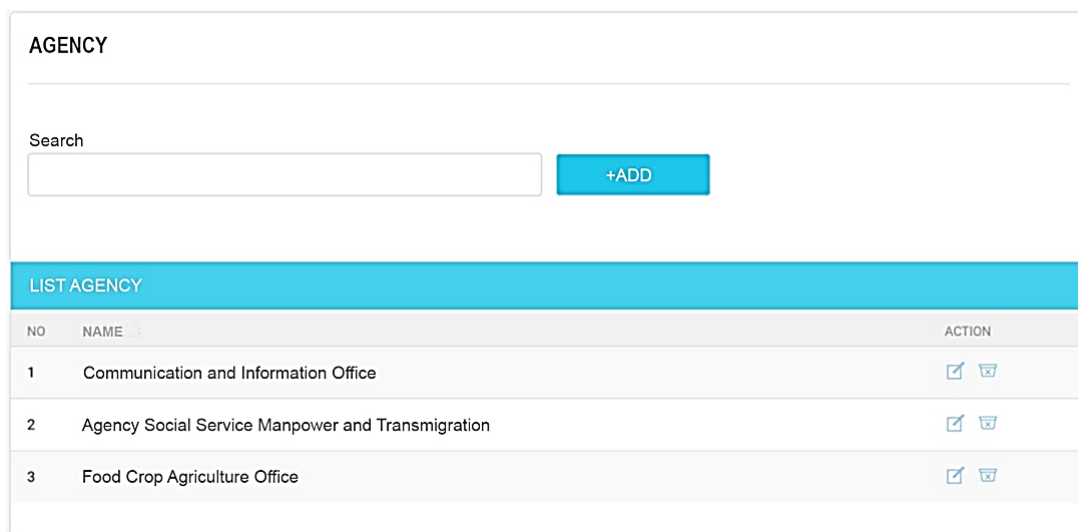


Figure 6. Web Services Page

3) Presence

Presence Web pages display user attendance data, which can be viewed per day and per person. Daily, user attendance data tables are sorted by day/date. The day/date can be entered on the date form, while per person, the user attendance data table is sorted by person/employee and based on month and year. People/employees can be inputted into the employee form and month form to determine the month and year of their absentee data, and for the per-person portion, the absentee data can be made into a PDF file. At the presence can also see the monitoring of the attendance, which represents checking the user's position at a particular time when the user is the present/presence. Also, data on absences can be added and changed. The results of the web presence page can be seen in Figure 7.

NO	NIP	NAME	ATT	WORK HOUR	CHECK IN	CHECK OUT	TOTAL ATT	INFORMATION	MONITORING	ACTION
1	195911271985032002	Nia Kurniati	Present	07:00 - 15:00	07:27:00	14:28:00	7 hours 01 minute		Detail	
2	196008041994031002	Rasep	Present	07:00 - 15:00	08:15:00	13:35:00	5 hours 20 minute	late (rain)	Detail	
3	196111121986032008	Teni Anjungsari	Permission	07:00 - 15:00				leave		
4	196306041991111002	Nanang	Present	07:00 - 15:00	08:15:00	13:15:00	5 hours	late (traffic jam) go home early	Detail	
5	196309261991031002	Abdul Naseh	Present	07:00 - 15:00	07:19:00	14:23:00	7 hours 04 minute		Detail	

Figure 7. Web Presence Page

4) Recap

Presence Web Recap page there is a table of user attendance recap data sorted by month and year in which month and year can be inputted on the month form, and there is a PDF button to generate pdf files from the attendance table recap data. In this recap table, data is represented by the number of each aspect of attendance as well as the type of attendance of the user. The results of the web recap page can be seen in Figure 8.

NO	NAME	NIP	PRESENCE					SUM OF DAY	%	PRESENCE		
			H	S	I	TK	TOTAL			DL	T	PC
1	Abdul Naseh	196309261991031002	2	0	0	0	2	21	8.49 %	0	1	0
2	Ade Nirwana	197707052007011018	0	1	0	0	1	21	0.00 %	0	0	0
3	Ahmad Susana Aheng	196104071990031005	0	0	1	0	1	21	0.00 %	0	0	0
4	Ai Ida Farida	197901052009012004	1	0	0	0	1	21	4.76 %	1	0	0
5	Ami Yulistiana	197607072008012030	1	0	0	0	1	21	3.65 %	0	0	1
6	Ani Budiani	198607032014102001	1	0	0	0	1	21	3.19 %	0	1	1
7	David Ismail Marzuki	197910042006041004	0	0	0	1	1	21	0.00 %	0	0	0
8	Desi Rian Dwi Putri	199212062016092001	0	0	0	0	0	21	0.00 %	0	0	0
9	Doni Antoni	198502142011011003	0	0	0	0	0	21	0.00 %	0	0	0
10	Eka Prasetya Esabara	198206102000121001	0	0	0	0	0	21	0.00 %	0	0	0

Figure 8. Web Recap Page

The results of employee attendance recap can provide complete present information, total days, percentage of attendance of employees.

5) Settings

The Web Settings page for Super admin has attendance setting data for each service where the data can be changed in the settings form. The setting data contains the minimum & maximum latitude and longitude coordinates as the official office area boundary according to the Point Clipping algorithm and attendance times such as hours of entry, hours of return, hours of rest, and attendance limits. As for the admin can only choose the number of working days by its provisions. Also, arrangements can add data on work holidays. The results of the super admin web settings page can be seen in [Figure 9](#).

The screenshot displays the 'PRESENCE CONFIGURATION' and 'WORKING HOURS' settings. At the top, there are two tabs: '5 Day' and '6 Day', with '6 Day' selected. Below the tabs is the 'PRESENCE CONFIGURATION' section, which includes a 'COORDINATE' subsection with four input fields: 'MIN LATITUDE' (108,127375), 'MAX LATITUDE' (108,127426), 'MIN LONGITUDE' (-7,34894), and 'MAX LONGITUDE' (-7,348771). The 'WORKING HOURS' section contains six input fields: 'CHECK-IN' (07:00), 'TOLERANCE LATE' (07:45), 'CLOCK OUT' (15:00), 'TOLERANCE LATE' (14:15), 'RECESS' (12:00), and 'ATTENDANCE LIMIT' (09:00). A blue 'SAVE' button is located at the bottom left of the form.

Figure 9. Super Admin Web Settings Page

b. Android

1) Presence

The Android Presence page has presence button, pain, permission, service, history, password, and info buttons and displays the date and time. Doing attendance click the presence button, which later will have location and time verification. Location verification is done by taking the coordinates of the user's location data and adjusting to the boundaries of the location of the official office. If the user's location is inside the office, then verification of the location is successful, whereas if the user's location is outside the office, verification fails. Time verification determines the time of attendance, which adjusts the current time with the time of entry, the maximum time of entry, and the time limit absent. If the user does attend more than the time limit, then attendance is canceled and will be considered without information (TK), while if it does not exceed the time limit absent, then the user can be either on time or late. Also, other buttons to access the submenu according to the button. Moreover, it can do presence home that has the same mechanism with presence, which adjusts the current time with the time clock curfew and a minimum return home unless there is no time limit verification absent. The results of the Android presence pages can be seen in [Figure 10](#).

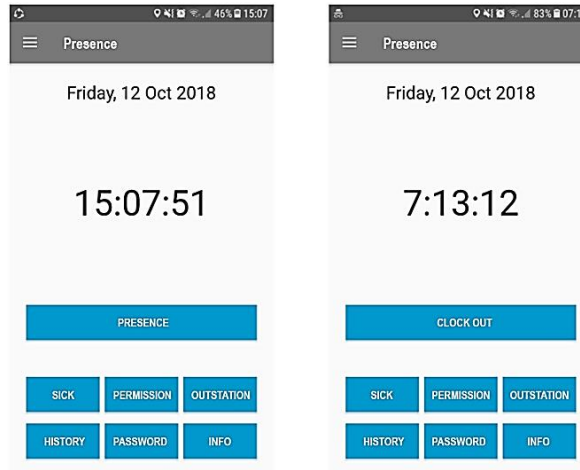


Figure 10. Android Presence Pages

2) Dashboard

The Android Dashboard page is devoted to Executive accounts, which have a circle diagram that represents daily user attendance data, where each slice describes the proportion of each type of attendance. This page also has a drop-down/spinner form to select attendance data per service/all departments. The results of the Android dashboard page can be seen in Figure 11.

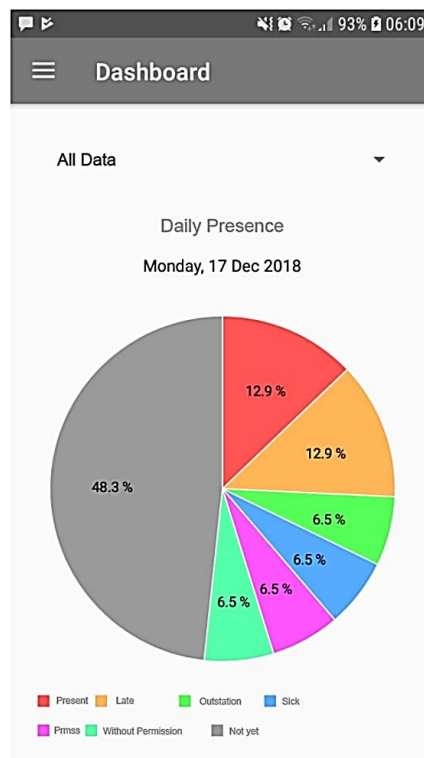


Figure 11. Android Dashboard Page

The dashboard page on Android there are seven types of attendance information starting from being present, late, outside service, illness, permission, without information, and not yet absent.

4.2 Cutover

a. Time Testing

User coordinates are taken through the Location Based Service from Android from the location APIs. In this experiment, access times were calculated in the incoming and returning attendance process and monitoring. Time testing results are shown in Table 1 and Table 2.

Table 1. Test-1 Presence Time

Number	front of the office		back office	
	Entry (second)	Return (second)	Entry (second)	Return (second)
1	5.7	8.3	9,8	10,9
2	13	8.8	14,5	7,8
3	5	4	15,1	11,5
4	9	9.3	9,6	12
5	11.7	4.3	6,1	5,5
Average	8.9	6.9	11	9.5

Table 2. Test-2 Presence Time

Number	Right side		Left side	
	Entry (second)	Return (second)	Entry (second)	Return (second)
1	11.8	9.3	7.2	11
2	9.5	10.2	7.7	4.7
3	12.5	9.7	7.5	6.3
4	9.3	6.8	10.7	6
5	8	7.7	8.3	11.8
Average	10.2	8.7	8.3	8

In [Table 1](#), based on the results of the testing of the time the average time obtained at the time of entry and return from the front of the office is 8.9 seconds and 6.9 seconds, behind the office when entering and returning home is 11 seconds and 9.5 seconds. In [Table 2](#), test results obtained the right side of the office when entering and returning, is 10.2 seconds and 8.7 seconds and the left side of the office when entering and returning are 8.3 seconds and 8 seconds. This time delay occurs because the coordinate retrieval process in location APIs has wrong connections/signals or other conditions such as weather, environment, etc.

b. Accuracy Testing

The coordinates of the office location area are used as a marker that the user/employee is in the work area or other words, and the employee has successfully entered/returned home. This experiment measures the accuracy of the position of employees successfully performing presence with the boundary of the location of the area is about 15 meters from outside the office each corner. The results of location accuracy testing are shown in [Table 3](#) and [Table 4](#).

Table 3. Test-1 Presence Location Accuracy

Number	front of the office		back office	
	Entry (m)	Return (m)	Entry (m)	Return (m)
1	13.4	18.2	11.4	19.3
2	9	18.5	8.6	17.4
3	13.8	15.4	8.2	19.6
4	11.4	18.8	11.5	19.9
5	9.8	15.8	13.6	16
Average	11.48	17.34	10.66	18.44

Table 4. Test-2 Presence Location Accuracy

Number	front of the office		back office	
	Entry (m)	Return (m)	Entry (m)	Return (m)
1	9.7	18.8	12.5	19.8
2	11.1	19.3	12.2	16
3	9.3	19	12.3	17
4	12.2	17.3	10.4	16.8
5	12	17.8	11.8	20.3
Average	10.86	18.44	11.84	17.98

From the results of testing the accuracy, the accuracy of the average distance from the front of the office when entering and returning is 11.48 meters and 17.34 meters outside the office. Behind the office when the entry and return attendance is 10.66 meters and 18.44 meters outside the office, the right side of the office at the presence enter and go home, which is 10.86 meters and 18.44 meters outside the office and the left side of the office when the attendance comes and goes, which is 11.84 meters and 17.98 meters outside the office. In this test there are less accurate results, this is because the user's position is close to the boundary of the office location that can affect the process of identifying the user's location to compare it with the condition of the Point Clipping algorithm.

5. Conclusion

Based on the results of the tests carried out in Table 1, Table 2, Table 3, Table 4, the accuracy of the presence and entry process at the location area is obtained, with an average of each side of the area of about 11.21 meters at the presence and 18.05 meters at the attendance going home outside the office. The boundary of the specified location outside the office is around 15 meters. Testing the time obtained value of time delay in the presence process with an average of each side of the area around 9.6 seconds at check-in and 8.3 seconds at check-out.

This research still needs a more in-depth discussion about displays geographical boundary points on a Google Maps that represent the boundaries of the location of the office in the presence settings to improve the location accuracy of the presence. Speed up the communication process between applications and services in retrieving user coordinate data from Google location APIs so that this process can run in real-time.

References

- [1] B. Permana, E. Wahyu Hidayat, and A. Rahmatulloh, "Aplikasi Ensiklopedia Pakaian Adat Dunia Berbasis Android," *Jurnal Informatika: Jurnal Pengembangan IT*, Vol. 3, No. 2, 2018. <http://dx.doi.org/10.30591/jpit.v3i2.773>
- [2] B. Meng and K. Choi, "Tourists' intention to use location-based services (LBS)," *International Journal of Contemporary Hospitality Management*, p. IJCHM-09-2018-0734, Jun. 2019. <https://doi.org/10.1108/IJCHM-09-2018-0734>
- [3] J. Zhou, W. Deng, and L. Li, "Study on LBS-based Positioning Technique of Pipeline Robot," in *Proceedings of the 2019 International Conference on Wireless Communication, Network and Multimedia Engineering (WCNME 2019)*, Vol. 89, No. Wcnme, Pp. 54–56, 2019. <https://dx.doi.org/10.2991/wcnme-19.2019.13>
- [4] A. Pinandito, A. P. Kharisma, and R. S. Perdana, "Framework design for map-based navigation in google android platform," *Journal of Telecommunication, Electronic and Computer Engineering*, Vol. 10, No. 1–8, Pp. 35–40, 2018.
- [5] K. Aziz, S. Tarapih, S. H. Ismail, and S. Atalla, "Smart real-time healthcare monitoring and tracking system using GSM/GPS technologies," in *2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC)*, Pp. 1–7, 2016. <https://doi.org/10.1109/ICBDSC.2016.7460394>
- [6] D. Scott, R. Crossin, R. Ogeil, K. Smith, and D. I. Lubman, "Exploring harms experienced by children aged 7 to 11 using ambulance attendance data: A 6-year comparison with adolescents aged 12–17," *International Journal of Environmental Research and Public Health*, Vol. 15, No. 7, Pp. 1–13, 2018. <https://doi.org/10.3390/ijerph15071385>
- [7] A. Rahmatulloh, R. Gunawan, and I. Darmawan, "Web Services to Overcome Interoperability in Fingerprint-based Attendance System," in *Proceedings of the 2018 International Conference on Industrial Enterprise and System Engineering (IcoIESE 2018)*, Vol. 2, Pp. 277–282, 2019. <https://dx.doi.org/10.2991/icoiese-18.2019.49>
- [8] B. S. Eko and K. Bobi, "Perancangan Sistem Absensi Kehadiran Perkuliahan dengan Menggunakan Radio Frequency Identification (RFID)," *Jurnal CoreIT*, Vol. 1, No. 2, Desember 2015, 2015. <https://doi.org/10.1186/1756-3305-3-27>
- [9] P. Kumar, F. Patel, and R. Kanna, "An Efficient Line Clipping Algorithm for Circular Windows Using Vector Calculus and Parallelization," *International Journal of Computer Graphics & Animation*, 2018. <http://dx.doi.org/10.5121/ijcga.2018.8201>
- [10] B. Renfro, J. Rosenquest, A. Terry, and N. Boeker, "An analysis of global positioning system (GPS) standard positioning system (SPS) performance for 2015," *Space and Geophysics Laboratory. Applied Research Laboratories. The University of Texas at Austin*, 2017.
- [11] R. A. Fauji, A. Rahmatulloh, and A. P. Aldya, "Implementation Of Global Positioning System As A Location Monitoring Media For Final Project Guidelines On Android-Based Applications," *Jurnal Transformatika*, Vol. 16, No. 2, Pp. 169–174, 2019. <http://dx.doi.org/10.26623/transformatika.v16i2.1071>
- [12] Rianto, Febryanata, and A. Rahmatulloh, "Implementasi Formula Haversine dan Komunikasi Data Real-time Menggunakan WebSocket di Sistem Pengawasan Warga Negara Asing," *KLK - KUMPULAN JURNAL ILMU KOMPUTER*, Vol. 06, No. 02, Pp. 143–151, 2019. <http://dx.doi.org/10.20527/klk.v6i2.210>
- [13] A. R. Makhfuddin and N. Prabowo, "Aplikasi Absensi Menggunakan Metode Lock GPS dengan Android di PLN APP Malang Basecamp Mojokerto," *MAJAPAHIT TECHNO: Jurnal Ilmiah dan Teknologi*, Vol. 5, No. 2, 2015.
- [14] R. N. Rosso, "Sistem Presensi Menggunakan Global Positioning System Berbasis Android," 2017.
- [15] K. Rosyadi, "Otomatisasi Presensi Menggunakan Global Positioning System (GPS)," 2015.
- [16] A. Faggidae and Y. T. Polly, "Sistem Presensi Dosen Menggunakan IMEI dan GPS Smartphone dengan Data Terenkripsi," *Jurnal Nasional Teknik Elektro dan Teknologi Informasi (JNTETI)*, Vol. 5, No. 3, Pp. 1–8, Sep. 2016. <http://dx.doi.org/10.22146/jnteti.v5i3.249>
- [17] E. Suprih Wihidayat, A. Rahmanto, and A. Doewes, "Mobile Positioning Menggunakan Network Identity Sebagai Sistem Absensi Berbasis Mobile Studi Kasus: Universitas Sebelas Maret," *Jurnal Teknologi & Informasi ITSmart*, Vol. 4, No. 2, Pp. 57, Sep. 2016. <http://dx.doi.org/10.20961/its.v4i2.1762>
- [18] B. Soewito and E. W. M. Simanjuntak, "Efficiency Optimization Of Attendance System With GPS and Biometric Method Using Mobile Devices," *CommIT (Communication and Information Technology) Journal*, Vol. 8, No. 1, P. 5, May 2014 <https://doi.org/10.21512/commit.v8i1.589>
- [19] R. Tullah, F. A. T. Tobing, and A. Hadi, "Sistem Aplikasi Android untuk Sales Dengan Local Based Service (LBS) Berbasis Client - Server (Studi Kasus di PT . Conbloc Internusa)," *Sisfotek Global*, Vol. 5, No. 2, 2015
- [20] D. S. Putra and A. Fauzjiah, "Perancangan Aplikasi Presensi Dosen Realtime Dengan Metode Rapid Application Development (RAD) Menggunakan Fingerprint Berbasis Web," Vol. 03, No. 02, Pp. 167–171, 2018. <http://dx.doi.org/10.30591/jpit.v3i2.836>
- [21] K. Francis, J. Nunez, C. Lloyd, and C. Torres, "Exploration of Rapid Application Development," *Systems and Software Engineering Publication*, Vol. 3, No. 1, 2019 .

