Mobile Technologies of Formulation Haversine Application and Location Based Service

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Abstract. This study aims to perform the nearest laundry kiosks search from the current location of the user's device. By calculating the distance between two points of location, so the nearest location searching can be done. It requires the latitude and longitude of each point location to do the calculations. This is a Research and Development study which used a Prototype model as the method for application development. In performing distance and search calculations, the Haversine Formula was used. Meanwhile, to get the latest location of the user device and to determine the location of the laundry kiosks, Location Based Service on Android mobile device was used. The function of this application is to assist laundry business managers in managing their business such as transaction management, managing laundry kiosks, operators or laundry employees, laundry service and laundry packages service, expenses, transaction reports, financial reports and online order services. This application is Android-based called Londree

Keywords: Haversine Formulation, Location Based Service, Londree.

1 Introduction

Laundry kids is a service business undertaken by an institution or individual. The services provided can be based on weights in kilograms or clothing units. Laundry kiosk is one of the many businesses we encounter in major cities of Indonesia such as Jakarta, Surabaya, Bandung, Yogyakarta. To run a laundry business, it is necessary to pay attention to several issues such as quality and service, for example, recording transactions, reports, and expenditures. Many laundry kiosks manage the recording transactions, reports and expenditures manually. In addition, customers who want to wash their clothes sometimes have to deliver clothes to the laundry kiosks although some laundry kiosks provide picking and delivering service.

Based on the above problems the authors created a Londree application as the solution. Londree is an android based application to help manage laundry business. With this application, laundry business owners will operate their business easier particularly in doing bookkeeping transactions to see the report based on an individual transaction period. In addition, Londree also serves as a relationship between customers with laundry business manager. Customers do not have to go to the laundry kiosks to deliver clothes, but

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customers can order online through the application. When doing online order, the system will search and display the laundry list nearest from the current user position. This search method uses the Haversine Formula and Location Based Service.

The Haversine formula is used to calculate the distance between two points on the surface of the earth using latitude and longitude as the input variables. The Haversine formula is an essential equation in navigation, giving sizeable circular spacing between two points on the surface of the globe (earth) with longitude and latitude. The use of this formula assumes to ignore the ellipsoidal effect, entirely accurate for most calculations, also ignores the height of the low hills and valleys on the earth's surface.

Location Based Service is a location-based service or common term that is often used to describe the technology used to locate the device used by the user. This service uses Google's Global Positioning Service and Call-based Location technology.

2. Method

Research and Development method is used by doing analysis process and design application as follows; (1) data collection, (2) data analysis, (3) design, (4) development, (5) implementation, (6) testing. Furthermore, all the data collected were analyzed by SWOT analysis method and Functional and Non-Functional Requirement and then used to develop an application of Android-based mobile app to facilitate the process of laundry business management and service of picking and delivering.

The design method used in this research is Unified Modeling Language which is a visual modeling method. This visual modeling is object-oriented design system. There is four diagram in Unified Modeling Language: 1) Use Case Diagram to explain the functionality of the system to be created, 2) Activity Diagram to describe the system workflow, 3) Sequence Diagram, and 4) Class Diagram.

3 Results

Zainal Arifin's, Muhammad Rivani Ibrahim and Heliza Rahmania Hatta, entitled Nearest Tourism Site Searching Using Haversine Method, concluded that the Haversine method could be used to find the closest distance from recreational sites with the use of locations in the city of Samarinda. By using 13 tourism site data which was then divided into three recreation destinations, obtained the position of the traveler who had the shortest distance to the area of outdoor recreation. The three targets of relaxation are Pinang Seribu Waterfall, followed by Tanah Merah Waterfall and Waterfall Lubang Muda [1].

In the study conducted by Vinayak Hegde, Aswathi T S and Sidharth R, entitled Student Residential Distance Calculation using Haversine Formulation and Visualization through google map for Admission Analysis concluded that Analysis based on histogram did not provide accurate results. Instead, it showed results in terms of frequency. The distance-based analysis was presented as a description number of how far these two locations were. The Haversine formula, on the other hand, calculates the exact orthodromic distance between the two sites. Grouping the same position into one group make it easy to concentrate more on a particular area, or we can focus more [2].

In the research conducted by Ginanjar Wiro Sasmito and Fuad Hadassah, entitled Implementasi Location Based Service. Implementation of Location-Based Service Route for Tourism Destinations in Tegal, it was reported that the Location-Based Service implementation for Tegal tourism destinations was in the form of an application of Android-based Tegal Tour. By leveraging Global Positioning System and internet app Tegal Tour

displayed user position using Google Maps Application Programming Interface version 2 and presented some information about tourism object in Tegal city and regency [3].

Android is an operating system for mobile based devices Linux that includes the operating system, middleware, and alkali. Android provides an open platform for developers to create applications they. Initially, Google Inc. buy Android Inc. who is a newcomer new software that makes software for mobile/smartphone. Then to developing Android, the Open Handset Alliance was formed, a consortium of 34 hardware, software, and telecommunication companies, including Google, HTC, Intel, Motorola, Qualcomm, T-Mobile, and Nvidia [4][5][6].

The Haversine formula is used to calculate the distance between two points on the surface of the earth using latitude and longitude as an input variable. The Haversine formula is an important equation in navigation, giving a large circular spacing between two points on the surface of the ball (earth) with longitude and latitude. The use of this formula assumes to ignore the ellipsoidal effect, quite accurate for most calculations, also ignores the height of the low hills and valleys on the surface of the earth [7][2][8][9]. *Haversine* Formulation:

$\Delta lat = lat2 - lat1$
$\Delta long = long2 - long1$
$a = \sin2(\Delta lat/2) + \cos(lat1)\cos(lat2)\ \sin2(\Delta long/2)$
$c = 2\text{atan2}(\sqrt{a}, \sqrt{1-a})$
$D = R.c$

Information:
R = Earth radius ie. 6371000 (m)
Δlat = number of changes in latitude
Δlong = number of changes to longitude
a = axis of intersecting calculation
c = calculation of the crosses axis
D = distance (meter)
1 degree = 0.0174533 radians

Integration of mobile technology Global Positioning System and internet enabling the development of interactive location-based mobile applications. By utilizing the internet and application can know the location of the user at that time. Location Based Service is an information service that can be accessed by mobile devices through the network and able to display the geographical position of the existence of the mobile device. Location Based Service can serve as a service to identify the location of a person or a particular object, such as finding the location of the nearest gas station or another place. Location Based Service services are implemented on an Android Platform [3][10].

Supporting Software research: (1) Java Development Kit, Android using Java as the programming language then it takes Java Development Kit to enable Java libraries. (2) Android Sofware Development Kit, Android Sofware Development Kit is the Application Programming Interface tool needed to start developing applications on the Android platform using the Java Programming language. Android is a subset that includes the operating system, middleware¸ and critical applications released by Google. Indirectly Software Development Kit and Application Programming Interface is a tool for a developer to develop their Android Applications [11][12].

System testing is the process of system execution software to determine whether the software system is suitable for system specifications and running in accordance with the desired environment. Testing for validation in research using black-box testing. Used to test the software in terms of functional specifications without testing the design and program code. The trial is intended to know whether the functions, inputs, and outputs of software according to the required specification. Black box testing is done by making a test case that is trying all the services of using the software to meet the required specifications. Case tests made to perform black box testing should be made with cases correct and wrong example, suppose for case login process then test case that created are: (1) If the user enters the username and password is correct. (2) If the user enters the username and password is wrong, for example, the username is correct, but the password wrong, or otherwise, or both are wrong [13][14][15].

Analysis and Design this research, using SWOT analysis. The results of the SWOT analysis of the Smart Immunization Application are shown in the following description. Strength (S), Internet availability and easy access. Very easy to access data through internet network.

Hardware and software for development needs. The availability of both the manager and laundry user. Bluetooth technology that allows Bluetooth printer devices to print a receipt for transactions via smartphone.Hosting and domains. Weakness (W), Lack of team in system development and maintenance. Related community support, especially laundry community. App management and marketing team. Capital (cost) development, maintenance, and marketing. Opportunities, The rapidly increasing number of smartphone users is predicted by 2018 to reach 100 million users. Ease of getting hosting services with various server packages as needed. National Laundry business revenue reached 8.4 Trillion. Net & Laundry Business Turnover Reaches Rp 60 Trillion. Threats, Dependency on supporting facilities such as electricity and internet. Bug and Error in the application. The existence of similar applications so that the competition in product marketing [16][17][18].

The results of data analysis using SWOT are as follows:

1) Creating an Android-based Londree app facilitate the laundry business management process such as recording transactions, expenses, reports transactions and financial statements and can facilitate laundry customers to do message/order online.
2) Using the haversine formula to do laundry search nearby.
3) Develop offline mode feature to be able to do offline transactions.
4) Using library crash reporting such as fabric.io or firebase crashlike.
5) Creating applications to facilitate management laundry business and messaging service between applications.
6) Using a comfortable interface design understood and applied.
7) Advertise apps through social media such as Facebook, Instagram and website www.londree.id to get users.
8) Create a marketing team to help marketing and app socialization to kiosks laundry.

Functional Needs Analysis The operational needs of the application to be built are as follows:

1) This application can display the login page. Users can register, log in with a predefined password.
2) The system provides authentication to be entered as owner, operator, and customer.

3) The system provides laundry kiosk management, operator/employee, member, service, and service package. Data management includes viewing, adding, modifying and deleting.
4) The system provides inbox data management of all laundry kiosks. Data management includes approving orders, rejecting orders, viewing directors in the activity folder.
5) The system is able to provide transaction data management of all laundry kiosks.
6) Data management includes adding, viewing, deleting, printing transaction memos, changing job status, retrieving and payment transactions.
7) The system is able to provide data management expenditures in the form of salaries of employees, operational, rental and Bisaya other than all laundry kiosks. Data management in the form of adding, viewing, modifying and deleting.
8) The system enables customers to order online and cancel orders.

Non-Functional Needs Analysis this research consist of:

1) Hardware Needs Analysis
   The hardware required in making this application, i.e.: (1) Macbook (Type: Macbook Pro MD102, Processor: Intel Core i7, 2.9 GHz, RAM 8 GB, Harddisk: 750 GB, VGA Intel(R) HD Graphics 4000. (2) Smartphone Device (Type Xiaomi Redmi 5A, RAM 2 GB, Internal Memory 16 GB, Screen Resolution: 720 x 1280, Android Version 7.0)
2) Software Needs Analysis
   Software that will be used to support the development of the system is Mozilla Android Studio as the IDE of making an Android application, Firefox or Google Chrome as a web browser. And also a smartphone with the Android operating system.

The londree application consists of 2 (two) parts, namely, Web Service becomes Backend. is the part that handles client requests namely Android and data processing from the database, android mobile applications as an interface that is Frontend is an application that interacts with users who feel input and output data. Londree Application design is illustrated in Figure 1.

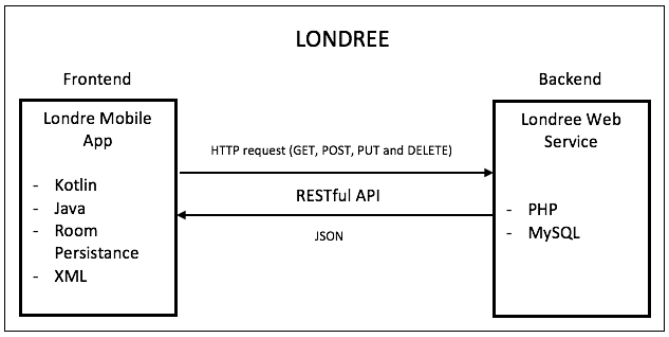

Figure 1. design of the londree application

In this system, there is 3 (three) division of user that is Owner, Employees, and Customers of Laundry. Londree serves as a palatial point of sales, so that helps the manager (owner and employee laundry) in do bookkeeping, reporting, recording transactions and serving as an application on demand that allows customers to make online messages pickup laundry in the wash that helps the message between.

This stage includes the activity of writing program code. Implementation is also the application of elements that have been in the form of programming to produce a goal based on the needs of making the system. Figure 2 illustrates the login page. There is a menu of options the user will log in as a manager or user. Managers here are the owner and operator. This stage calculates the distance and determines the nearest laundry kiosk from Building V Amikom by using Formula Haversine.

Table 1. Sample Location Data

Location	Latitude	Longitude
Amikom Campus	-7.759400	110.408856
Laundry A	-7.761224682669747	110.38039203733204
Laundry B	-7.757047186349504	110.39583653211594
Laundry C	-7.758141478462829	110.39198689162733

In the kiosk table, the latitude and longitude of listed laundry kiosks in the database were stored. When customers wanted to order online, then the phone from the customer sent latitude and longitude data from its location at that time. From the data, the calculation could be done and determined the nearest laundry. Latitude and Longitude Amikom Campus in the form of radians:

Latitude A = -7.759400 = -0.13542707797925
Longitude A = 110.408856 = 1.9269980605603

a. Laundry A
   Latitude B and Longitude *B* of Laundry A in the form of radians:
   Lat*B* = -7.761224682669747
   = -0.13545892469964
   Long*B* = 110.38039203733204
   = 1.9265012706936
   Δlat = *LatB* – *LatA*
   = (-0.13545892469964) – (-0.13542707797925)\
   = -0.000031846720391138
   Δlong = *LngB* – *LngA*
   = (1.9265012706936) – (1.9269980605603)
   = -0.00049678986672075
   a = sin2 (Δlat / 2) + cos (*LatA*) .cos (*LatB*) .sin2 (Δlong / 2)
   = 6.0828624139804e-8
   c = 2.atan2 (√a, √(1-a))
   = 0.00049326919779438
   d = Rc
   = 3142.618059148

b. Laundry B

Latitude B and Longitude B of Laundry B in the form of radians:

LatB = -7.757047186349504
= - 0.13538601363436
LngB = 110.39583653211594
= 1.9267708279789
Δlat = LatB – LatA
=(-0.13538601363436) – (-0.13542707797925)
= 0.000041064344887043
Δlong = LngB – LngA
= (1.9267708279789) – (1.9269980605603)
= -0.00022723258143476
a = sin2 (Δlat / 2) + cos (LatA) .cos (LatB) .sin2 (Δlong / 2)
= 1.3094995091079e-8
c = 2.atan2 (√a, √(1-a))
= 0.00022886673107499
d = Rc
= 1458.1099436788 m

c. Laundry C

Latitude B and *Longitude* B Laundry C in the form of radians:

LatB = -7.758141478462829
= -0.13540511263472
LngB =110.39198689162733
= 1.9267036390773
Δlat = *LatB* – *LatA*
= (-0.13540511263472) – (-0.13542707797925)
= 0.000021965344530916
Δlong = *LngB* – *LngA*
= (1.9267036390773) – (1.9269980605603)
= -0.00029442148297898
a = sin2 (Δlat / 2) + cos (*LatA*) .cos (*LatB*) .sin2 (Δlong / 2)
= 2.1396652060428e-8,
c = 2.atan2 (√a, √(1-a))
= 0.00029255189087089
d = Rc
= 1863.8480967384 m

From the above calculation, it can be seen that the nearest laundry with Building V Amikom is as follows:

1. Laundry B distance 1.4 km
2. Laundry C distance 1.8 km
3. Laundry A distance 3.1 km

A system test is a process for a program or application to find errors and all possible errors. The purpose of testing this system is to make sure all modules work correctly. This test is performed to show that the functions are working correctly, inputs received correctly,

and the resulting output is correct. This test is declared successful if the tasks that exist in the software work as expected.

Tabel 3. Black Box Testing Results

No	Testing Items	Results	Note
1	System authentication	The menu successfully displays according to each access privilege	Good
2	Laundry data kiosk management	Displays kiosk data/place of business	Good
3	Inbox data management	Displays inbox data	Good
4	Transaction data management	Successfully manage transaction data	Good
5	Viewing report data	Displays financial and transaction report data	Good
6	Expenditure management	Successfully manage laundry outlay data	Good
8	Managing service and packaging data service	Successfully manage service data and service packs	Good

System maintenance performed in this Londree Application includes program code maintenance, feature and server development. As long as the system operates, server maintenance is still played for several reasons, e.g., the system leaves an undetectable problem during the lifetime of the system.

4. Conclusion

Based on the results and discussion above, it can be concluded as follows: The londree application works for laundry business management such as transaction management, expense, laundry employee, transaction report and financial report and inter-message service.The Haversine formula works to calculate the distance between two point locations in a straight line using latitude and longitude inputs so that it can be used to perform nearby searches. *Place Based Service* works to get the latest location, latitude, and longitude on android smartphone devices.

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