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Implementation Floyd-Warshall Algorithm for the Shortest Path of Garage

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Abstract:-The high number of user vehicles means that the needs of the garage will be higher.The garage is very necessary especially when vehicles experience problems at a location unknown. Nowadays, we can use insurance for our vehicles but not everyone can have this solution. This is because there are several conditions that must be met before a person can have or become a policyholder. So when a problem occurs, the driver needs another alternative to overcome it. To overcome this, needed media information to help find the nearest garage location. Application usingFloyd-Warshall algorithm for the shortest path of the garage is one solution to solve this problem. This application based on Android, equipped GPS systems and Google Map to make it easy to find the nearest garage location from the user location.

Keywords:Garage, GPS, Floyd-Warshall, Android, Google Map API

I. INTRODUCTION

According to the catalog of the Central Bureau of Statistics Jakarta, the number of public transport operated by the company in 2015 based on its type, namely large buses as many as 2396 vehicles, buses were 3024 vehicles, small buses 13690 vehicles while public vehicles tricycle around 14043 vehicles, taxis as much as 24368 vehicles, as many as 44187 cars goods vehicles, buses as many as 5156 vehicles and as many as 3310 vehicles AKAP bus. On the other hand, the number of motorcycle vehicles reached 13084372 vehicles. From these data it can be concluded that the vehicles in the city is not a bit with different types and users[6].

The high number of vehicles cause the damage that will occur from the vehicle will be experienced by many drivers. Damages that may occur in vehicles such as leaking tires, breaking chains or engine off as well as the need for engine maintenance and repair. This causes the driver to require service to the nearest garage if the vehicle has problems. Limited knowledge about the location when the vehicle is damage especially for the driver from out of town causing the driver difficulty to find the nearest location of the garage, very difficult to obtain information fast and accurate, in addition, the driver can not estimate how far to walk or push the vehicle until the driver finds the nearest location of garage. Usually, the driver will ask the people around the area to get the nearest garage information, but the way it is ineffective and takes a long time and difficult to get accurate information.

Actually, we can use insurance for our vehicles. By having vehicle insurance, when an incident occurs, such as a strike on a trip, you can contact the insurer to take your car to a partner's garage and you will get a replacement car during the repair process. This definitely makes it easier for you to stay active and drive.Although the government also appealed to the public to have and take advantage of the benefits of insurance, not everyone can have this protection product. This is because there are several conditions that must be met before a person can have or become a policyholder. So when a problem occurs, the driver needs another alternative to overcome it.To overcome this, needed media information to help find the nearest garage location.

On the other hand, Technological advances are something that can not be avoided in this life, because the advancement of technology will go according to the progress of science. At first, the technology developed slowly. But along with the advancement of the level of culture and human civilization, the development of technology is growing rapidly.The more advanced the culture, the more developed the technology because the technology is the development of advanced culture by leaps and bounds[1].

In Indonesia, Android user statistics in 2014 dominate the circulation of smartphones in the country with a market share of 59.91%.This became one of the causes of developers in Indonesia to switch to develop android applications that have dominated the smartphone market.Applications offered have the main function to meet the needs of users, including satisfying the desires of users, making it easier for users to get up to date information andto find the location of the user's desired destination.

With the development of the field of information and communication technology and the increasingly dominating the android based smartphone devices expected to assist drivers in finding the location of the garage when they are having problems in traveling. To find the nearest garage

needs the technology of Global Positioning System (GPS) and Google Map API as a virtual map provider that runs on an operating system based on Android and displays the route on the position of the driver to the garage location technology using Location Based Services(LBS). By obtaining more accurate information, the driver can easily determine the shortest path to the location of the garage.

Moreover, to know where the nearest garage, distance measurement methods are needed. The method used is Floyd-Warshall algorithm. This algorithm can compare the possible trajectories of the graph for each side of all the nodes so as to facilitate the search for the shortest path to the location of the garage.

The Decision Support System (DSS) is interactive, computer-based systems and subsystems intended to help decision makers in using communication technologies, data, documents, knowledge and/or models to complete decision process tasks, explain in [8].

From the above, it is necessary to develop an application that determining the shortest path of garage based on Android in kecamatan Kembangan, Jakarta Barat using Floyd-Warshall algorithm.

II. METHOD

A. Floyd-Warshall Algori thm

In general the Floyd-Warshall algorithm is a variant of the dynamic programming, a method which perform troubleshooting by viewing the solution that would be obtained as an inter-related decisions. This means that the solutions formed from the solution coming from the previous stage and there is more than one possible solution.

The input of Floyd-Warshall algorithm is a matrix graph and output circuit is the shortest path from all points. In an effort to find the shortest path algorithm iterations Warshall start from the starting point and then extend the path by evaluating point by point until it reaches the destination point with the amount of weight to a minimum[4].

Floyd-Warshall algorithm compares all possible trajectories on the graph for each line of all points. Suppose that there exists a graph G with vertices V, each numbered from 1 to n (for n pieces). Suppose that there is also a function shortest Path (i, j, k), which restores the possibility of a shortest path from i to j by utilizing only the node 1 to k as an intermediary point. The ultimate purpose of use of this function is to find the shortest path from each vertex i to vertex j by an intermediary node 1 to k + 1.

There are two possibilities occur:

- The shortest path is actually just came from the nodes that are between 1 and k.
- There are some lines from the vertices i to k + 1, and also from k + 1 to j

Note that the shortest path from i to j which is just past the nodes 1 to k defined in function shortestPath (i, j, k) and it is clear that if there is a solution from i to k + 1 to j, then the length of the solution had been a the number of shortest paths from i to k + 1 (which passes simpulsimpul 1 to k), and the shortest path from k + 1 to j (also using simpulsimpul from 1 to k). Therefore, the formula for the function shortestPath (i, j, k) can be written as a notation as follows :

Basis-0

```
shortestPath (i, j, 0) = edgeCost
(i, j);
```

Rekurens

```
shortestPath (i, j, k) = min
(shortestPath (i, j, k-1) , shortestPath
(i, k, k-1) + shortestPath (k, j, k-1));
```

Figure 2.1:- Shortest Path Function

This formula is the core of Floyd-Warshall algorithm, this algorithm works by calculating shortestPath (i, j, 1) for all pairs (i, j), then the results will be used to calculate shortestPath (i, j, 2) for all couples (i, j), and so on. This process will continue until k = n and we have found the shortest path for all pairs (i, j) using the vertices intermediary.

B. Calculation Method of Floyd-Warshall Algorithm

Let W_0 is a Initial graph relations matrix.
W * is a matrix circuit at least.
Wij * = the shortest path from point vi to point vj.
The steps of Floyd-Warshall algorithm as follows:
1. $W=W_0$
(2.1)
2. For k=1 to n,
For i=1 to n,
For j=1 to n,
Do : If $Wi,j>Wi,k+Wk,j$ then
Swap Wi,j with $Wi,k + Wk,j$
3. $W^*=W$
(2.2)
Information:
W = matrix
W_0 = Initial graph relations matrix
iteration k = 1 to n
i = start point of vi
j = endpoint on vj
W* = results after comparison matrix

C. *The Flowchart of Floyd-Warshall algorithm*

Flowchart is a chart that shows the flow in the program or system procedures logically. Flow charts are used primarily for communication aids and for documentation[10].

The flowchart Floyd-Warshall algorithm can be seen in Figure 2.2 below:

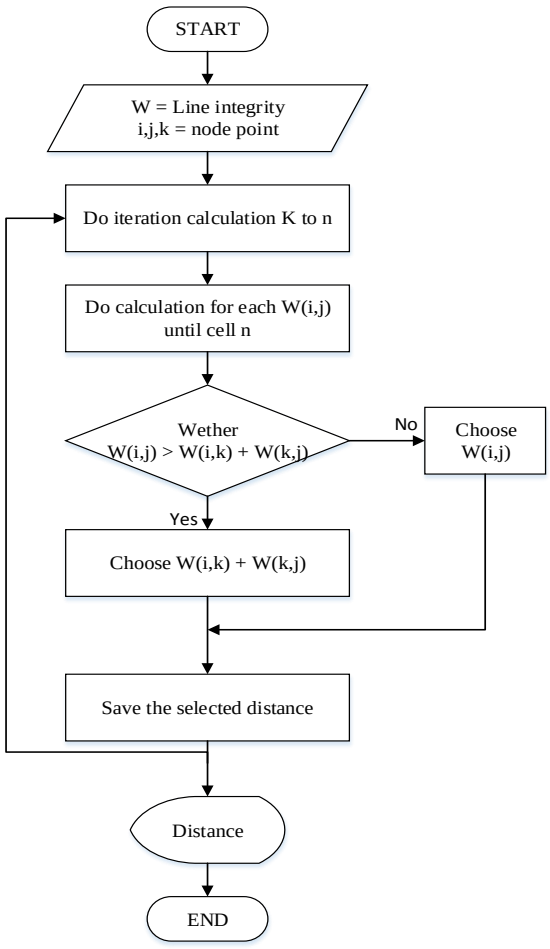

Figure 2.2:- Flowchart of Floyd-WarshallAlgorithm

The process of determining the minimum floyd-warshall algorithm can be written as follows:

- In the 1st iteration, each matrix cell is checked whether the distance between two starting points is greater than the sum of the distance from the origin to the destination point (destination point = 1st iteration) with the distance of the origin point (origin point = 1st iteration)) to the destination point. In other words, W [i, j]> W [i, k] + W [k, j].
- If so, the distance between two starting points is replaced by the sum of the distance from the origin to the destination point (destination point = 1st iteration) with the origin point distance (origin point = 1st iteration) to the destination point (W [i, k] + W [k, j]).
- If not, then the distance used is the distance between the two starting points (W [i, j]).
- The iteration process is done up to the last iteration (number of iterations = total number of points). Figure 3.4 shows the flowchart flow of minimum value determination on the floyd-warshall algorithm[2].

A. Implementation of Floyd-Warshall Algorithm

Floyd -Warshall algorithm here to compare all the possible trajectories of the graph for each side of all of the nodes. This can occur because of the approximate decision (choosing the shortest path) at any stage between two vertices, until the estimate is known as the optimum value.

One example is from somewhere that was at the point D where we had to pass through at least one point, a point between B, C, and E, the network model shown in Figure 2.3 below :

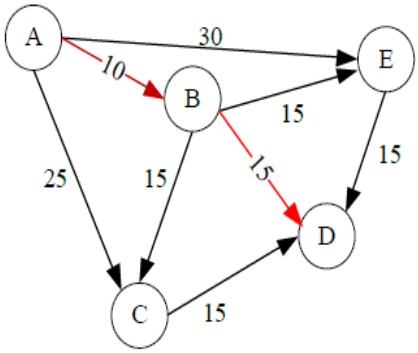

Figure 2.3:- Path Implementation Sample On Node

If we used a Floyd-Warshall algorithm then there are working stages of the algorithm, that is:

Looking for any node that can be passed to get to the destination or D

Summing up the value of edge on the edge node by node to be traversed from the initial node to the destination node.

A-E-D = 30+15 km
A-B-E-D = 10+15+15 km
A-B-D = 10+15 km
A-B-C-D = 10+15+15 km
A-C-D = 25+15 km

Finding the smallest value of the sum of edge on the nodes that can be traversed. Of the sum over the smallest value that is obtained on line edge ABD with a total of 25 km.[8]

D. V-Model

The application development phase will use V-Model. V-Model is an extension of the Waterfall model. The V-Model illustrates the relationship between quality assurance actions against actions related to communication, modeling, and preliminary construction activities.

The V-Model moves from the left side. Once the finished code is generated it will move up the right side of the V, basically performing a series of tests (quality assurance actions) that validate each model created as it moves down from the left side. The stages of the V-Model are Requirements modeling, Architectural design, Component design, Code generation, Unit testing, Integration testing, System testing, and Acceptance testing[9].

V-Model process model can be seen in Figure 2.4 below:

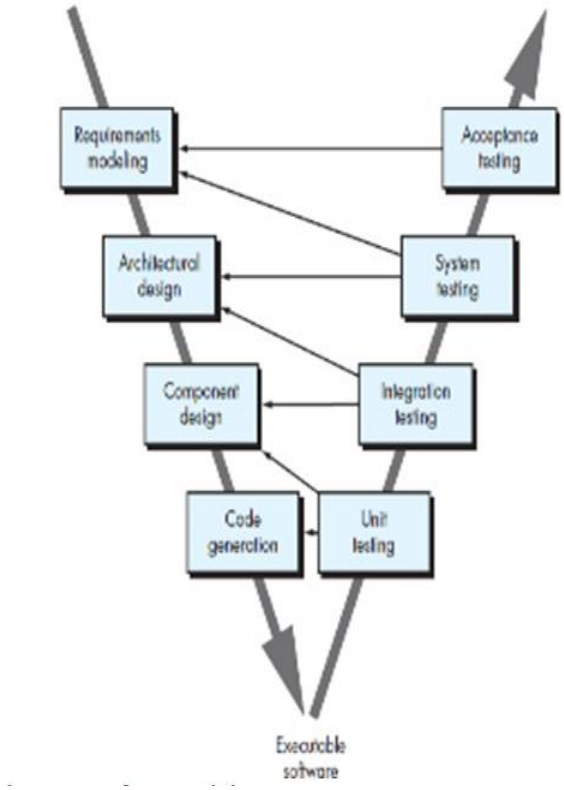

Fig 2.4:- V Model

The stage of V-Model:

- Requirements modeling: Analyze and collect all user needs.
- Architectural design : Can also called high-level design, where the system architecture is determined during this phase. This phase provides an overview of solutions, platforms, systems, products and services / processes.
- Component design : Can also called low-level design where the system is divided into sections in order to facilitate the developers to write code. This phase is where the actual software components are designed.
- Code generation : In this stage programming is done for each module that has been formed.
- Unit Testing : Unit testing will be performed on the code generation of the component design, which in this phase tests each part of the system separately.
- Integration Testing : Integration testing will be done on each component design where the component design will become a system architecture. In this phase test several parts of the system simultaneously to ensure the system can work and work together.
- System Testing : In this phase test the entire system that has been built in accordance with the needs of users.
- Acceptance Testing : Determining whether the built system meets the demand and satisfies the user or not.

➢ *Global Positioning System (GPS)*

GPS is a satellite navigation system and positioning its owned and managed by the United States. The system is designed to give one's position and a lot of people on an ongoing basis without depending on time and weather. Currently GPS has been widely used around the world in various fields of application that demands information about the position, velocity, acceleration or time carefully. GPS can provide positioning information with an accuracy varies from a few millimeters up to tens of meters. With GPS we can know our geographical position (latitude, longitude, and height above sea level), so wherever we are on this earth, we can know our exact position[11].

➢ *Location Based Services (LBS)*

LBS technology is one part of the implementation of mobile Geographical Information System (GIS) were more likely to show the city directory, vehicle navigation, search addresses and social networking than functionality in GIS. The technology used to locate the location device used.

LBS are two main elements:

- Location Manager (API Maps) Provide tool or a source for the LBS, Application Programming Interface (API). Maps provide facilities for menampilakan, manipulate maps or maps with these types of features such as satellite view, street, or a combination thereof. This package is com.google.android.map.
- Location Provider (API Location) Provide a location search technology used by the device. API Location corresponding data and Global Positioning System (GPS) and real-time location data. API Location is the android package that is in the package android.location. By Location Manager, we can determine our current location, track movement or displacement, as well as proximity to a specific location by detecting the displacement[3].
- *Google MAP Application Programming Interface (API)*

  An API is a documentation which shall be composed of the interface, functions, classes, structures and so on to build a device. With the API, then allows the programmer to unload a software to then be developed or integrated with other software. An API can be regarded as an application interface with other applications that allows programmers to use the system function.[5]

- *Black Box Testing*

  Black-box testing, also called behavioral testing, focuses on the functional requirements of the software. That is, black-box testing techniques enable you to

derive sets of input conditions that will fully exercise all functional requirements for a program. Black-box testing is not an alternative to white-box techniques. Rather, it is a complementary approach that is likely to uncover a different class of errors than whitebox methods.

Black-box testing attempts to find errors in the following categories:

1. incorrect or missing functions
2. interface errors
3. errors in data structures or external database access
4. behavior or performance errors
5. initialization and termination errors

Unlike white-box testing, which is performed early in the testing process, blackbox testing tends to be applied during later stages of testing. Because black-box testing purposely disregards control structure, attention is focused on the information domain[9].

III. RESULT

A. Android Implementation

- Homepage Display

On the Home page in the header, there is the page name and button for the help menu and the about menu. In this main menu, there is a page that displays the maps of all the garage around the user and the starting point of the user's location. There is a choice of motorcycle garage or car garage. There is a column to define the category of garage and column to determine the desired radius. At the bottom, there is a column of garage information and buttons to see the route.

Homepage Display can be seen in Figure 3.1 below:

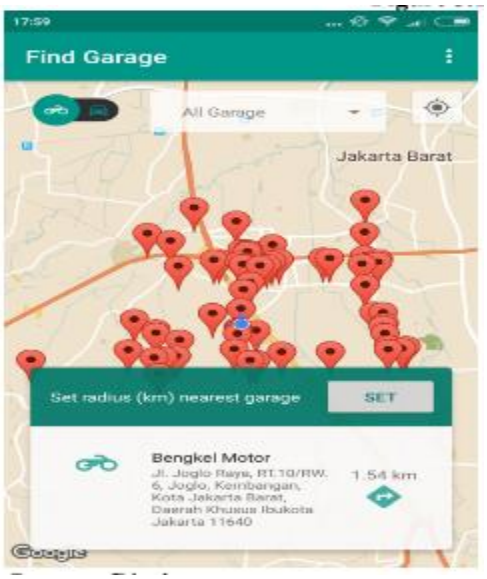

Figure 3.1:- Homepage Display

- Category Display

On the category page there are various types of garage options that users can choose based on categories.

Category Display can be seen in Figure 3.2 below:

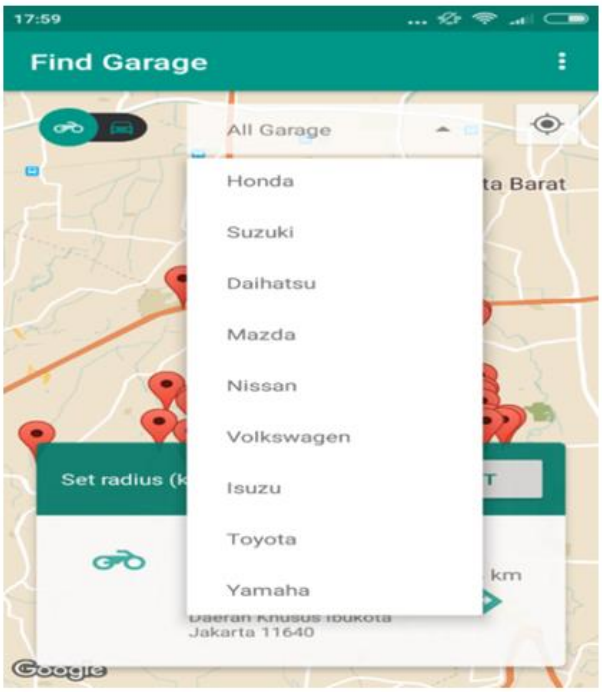

Figure 3.2:- Category Display

- Radius Display

On the radius page there is a column to determine the radius desired by the user.
Radius Display can be seen in Figure 3.3 below:

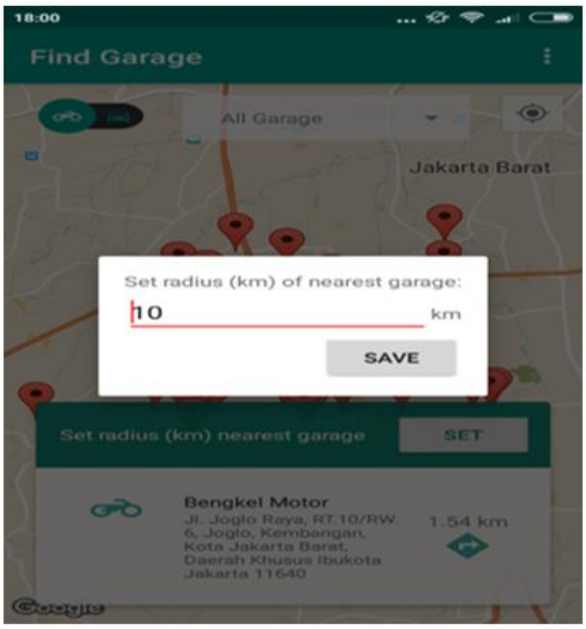

Figure 3.3:- Radius Display

- Motorcycle page Display

On the Motorcycle page, there is a page that displays the maps of all the motorcycle garage around the user and the starting point of the user's location in accordance with the category of garage and radius the user wants the application. At the bottom, there is a column of motorcycle garage information and buttons to see the selected motorcycle garage route.

Motorcycle Display can be seen in Figure 3.4 below:

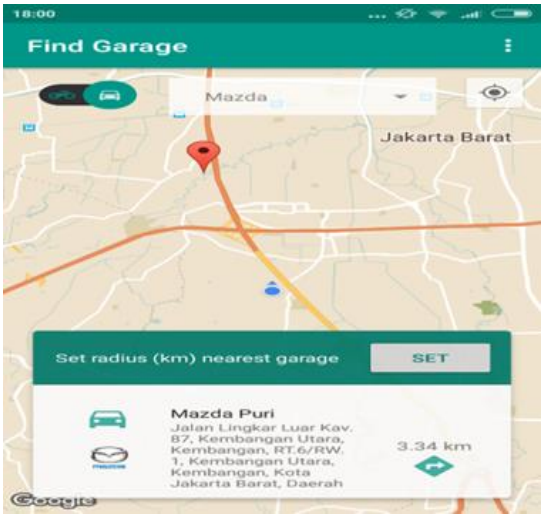

Figure 3.4:- Motorcycle Display

- Car page Display

On the car page, there is a page that displays the maps of all the car garage around the user and the starting point of the user's location in accordance with the category of garage and radius the user wants the application. At the bottom, there is a column of car garage information and buttons to see the selected car garage route.

Car Display can be seen in Figure 3.5 below:

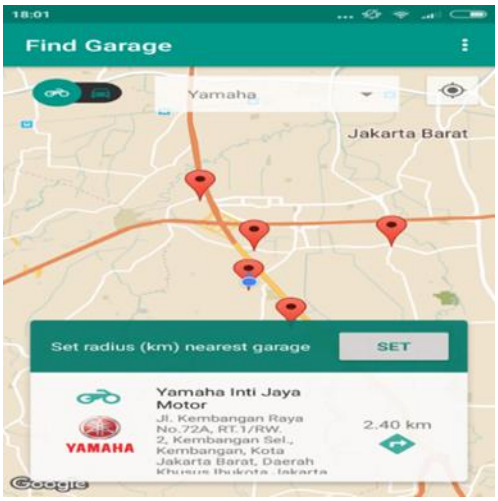

Figure 3.5 :- Car Display

- Route Display

On the route page there is information about the route path to the nearest garage selected by the user.

Route Display can be seen in Figure 3.6 below:

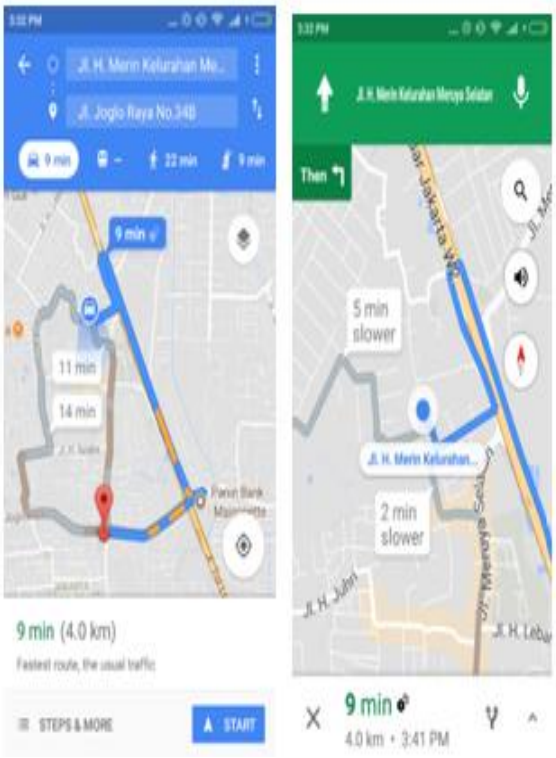

Figure 3.6:- Route Display

➢ *Analysis of Test Results*

Testing method is implemented to ascertain whether the system is developed as expected. The method used for this test is the Black-box testing method, which is a method that tests the software in terms of its functionality without testing the design and program code. Testing is intended to know the functions, input and output of the application is in accordance with the required specifications.

The results of Black-box testing can be seen in Table 3.1 below:

Table 3.1 Test Result

No	Trials	Expected results	Test Result
1	Login Home page	Display the Home page	corresponding
2	Choose garage category	The selected garage category is as desired	corresponding
3	Setting the radius	Go to the radius page and the radius data will be saved for calculation	corresponding
4	Display the nearest motorcycle garage	Displays the nearest motorcycle garage according to the category and the selected radius	corresponding
5	Display the nearest car garage	Displays the nearest car garage according to the category and the selected radius	corresponding
6	Display the route of garage	Displays the selected garage route	corresponding
7	Login Help	Display the Help page	corresponding
8	Login About	Display the About page	corresponding

After the black-box testing on all functions in the application determining the shortest path of garage using Floyd-Warshall Algorithm based Android, it can be concluded:

- At the time of developing the application, used android smartphone to find errors and other functions, so the application can run well on android.
- Functions of the application run well such as, take JSON data on the server, display the map of the location of the nearest garage with the category and radius selected by the user, display the route map to the garage location of the user position and display route information.
- The application takes time to access the location of the garage and map data because it requires the internet connection.

IV. CONCLUSION

Based on the theory and discussion in the previous chapters that have been done, it can be concluded that has been developed the application determining the shortest path of the garage using Floyd-Warshall algorithm based android which can display the shortest distance of the nearest garage location from the user position with the selected and radius category by the user, displaying route and road information to the location of the garage. In this application, utilization of Google Map API as a virtual map provider has been successfully implemented. In determining the shortest path the nearest garage in the application has successfully applied the distance measurement method using the Floyd-Warshall algorithm dan for displaying the shortest path has been successfully able to determine the categorization and radius based on the selected of the user.

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