

# The Shortest Path Search Application for Base Transceiver Station (BTS) Using A\* Algorithm

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## ABSTRACT

Looking for the shortest path to a place is very necessary, especially when there is damage that requires immediate repair. This paper shows the design and development of an application of the shortest path search for Base Transceiver Station (BTS) using the A\* algorithm. It has been designed an application that can help technicians in optimizing the distance to the base transceiver station (BTS) in case of damage and maintenance. In designing the Google Maps API (Application Programming Interface) system, the Global Positioning System (GPS), the Android SDK (Software Development Kit) has been used. A\* algorithm was also successfully implemented. The result shows that there is no difference between the results of the shortest path produced by the application or the results of manual calculation. The shortest route is 0-3-1-2 which is 24.1km. It was chosen from the starting position BTS 37 -BTS 2 -BTS 29.

**Keywords:** *Shortest Path, Application, BTS, A\* Algorithm*

## 1. INTRODUCTION

The number of Base Transceiver Station (BTS) continues to increase along with the increase in communication needs. To meet customer needs and provide the best service, GCI Science & Technology Co. Ltd Palembang collaboration with other companies working on several operator projects in Indonesia. One of them is a maintenance project for Base Transceiver Station (BTS) cellular telephone operators spread throughout the city of Palembang. So that the signal quality of the Base Transceiver Station (BTS) network is maintained, GCI Science & Technology Co, Ltd must always check and support the Base Transceiver Station (BTS). Therefore, an application is needed to find the shortest base transceiver station (BTS) that can run on the Android platform so that it can help technicians in optimizing the distance to the location of the Base Transceiver Station (BTS) in case of damage and maintenance.

Previous research related is A Poorva, R Gautam, and Rahul Kala [1] implemented A\* algorithm to plan the path for the movement of a team of robots from source to goal for accomplishing a task. The removal of

a group of robots in a chain in a mapped environment successfully carried out using the proposed algorithm.

Shrikant NA and Selvakumar AA. [2] proposed the A\* algorithm in autonomous robots-A to find the optimal path for robots to avoid collisions. A\* algorithm works by using a map, trying to find the track with the shortest route that has the lowest probability of collision with its surroundings.

M Zikky. [3] presented Navigation Mesh (NavMesh) pathfinding as the alternative of Artificial Intelligent for Ghosts Agent on the Pacman Game. NavMesh implemented the A\* algorithm and examined in the Unity 3D game engine.

P Mehta et all. [4] proposed A\* algorithms for pathfinding in computer games to avoid obstacles cleverly and seek the most efficient path between two endpoints. A\* algorithm provides an optimal solution to the pathfinding problem when compared to Dijkstra's algorithm and the Greedy Best-First-Search algorithm.

F Duchon et all. [5] design path planning of a mobile robot based on a grid map with functional and reliable reactive navigation and SLAM. A\* algorithm

modification carried out which focuses on computational time and path optimality.

G Elizebeth Mathew. [6] presented A\* algorithms for pathfinding in video games. It is solutions for pathfinding which results in a higher-quality path using less time and memory.

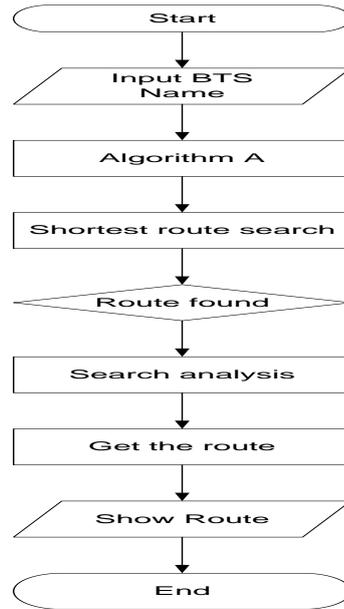
Overall, the authors propose the A\* algorithm to be used to find the path with the shortest route. A\* algorithm applied in various fields including robotics, games, computer games, etc. A\* algorithm provides an optimal solution to the pathfinding problem. However, no research applies the A star Algorithm to search for BTS.

In this study, we design an application of the shortest path search for Base Transceiver Station (BTS) using the A\* algorithm. In designing the Google Maps API (Application Programming Interface) system, the Global Positioning System (GPS), the Android SDK (Software Development Kit) used. We hope this can be a solution in optimizing the distance to the Base Transceiver Station (BTS) location if there are damage and maintenance.

**2. APPLICATION SYSTEM DESIGN**

The proposed system designed application for searching the shortest path of Base Transceiver Station (BTS) Location using A\* algorithm. It can help technicians in optimizing the distance to the Base Transceiver Station (BTS) location in case of damage and maintenance.

It found that currently, there is no Base Transceiver Station (BTS) route search application by using the A\* algorithm. A\* algorithm is widely used in robotics, computer games, etc. [2,4,5]. A\* algorithm used for pathfinding in-game AI, vehicle navigation systems but none of them targeted for Base Transceiver Station (BTS). Flowchart diagram system, as shown in Figure 1.



**Figure 1.** Flowchart Diagram

Google Maps API (application programming interface) is a computing interface commonly used by programmers to obtain geo-referenced information because Google Maps API provides a tool for quickly visualizing map data [7,8]. APIs (application programming interfaces) can simplify programming by only exposing objects or actions that developers need [7,8]—the API written for the Javascript programming of websites.

GPS is a navigation system based on the time and position known from satellites [9]. Nowadays, GPS receivers included in many commercial products, such as automobiles, smartphones, exercise watches, and GIS devices. GPS devices can work when there is an excellent connection to the satellite. GPS devices also use several types of location caching to speed up GPS detection. GPS devices can quickly determine what satellites are available when scanning GPS signals by remembering previous locations.

Currently, the Android SDK build tool y used because of its ability to debug, build, run and test Android applications and can work from the command line or IDE (i.e. Eclipse or Android Studio) [10]. Application designed using Android studio.

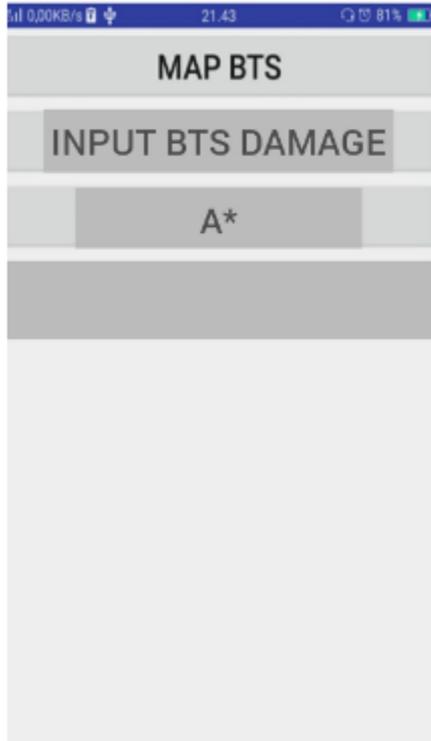
Algorithm A\* is a combination of heuristic search and search based on the shortest route applied to a metric or topology [5,11]. The formula for this algorithm:

$$f(n) = g(n) + h(n) \tag{1}$$

Where h(n) is heuristic distance and g(n) is the length of the path from the first state to the destination state. The advantages of this A\* algorithm are the distances can be modified, adapted and added to other distances [5].

### 3. RESULT AND DISCUSSION

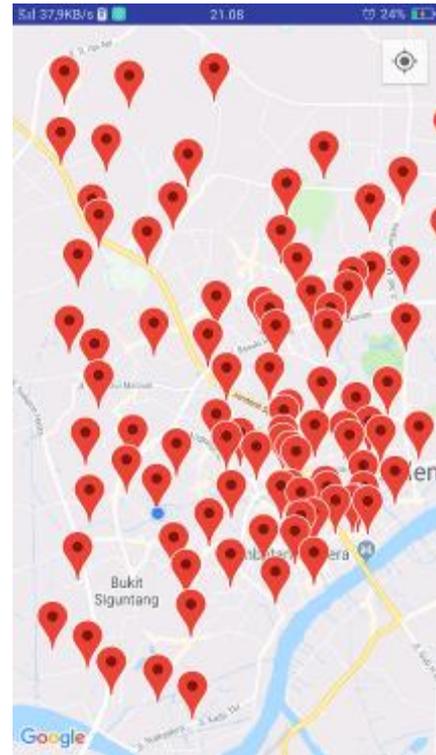
We implemented the proposed application system, screen display starting from the application of determining the shortest route to find the location of the Base Transceiver Station (BTS) in the city of Palembang as shown in Figure 2.



**Figure 2** Display start the application

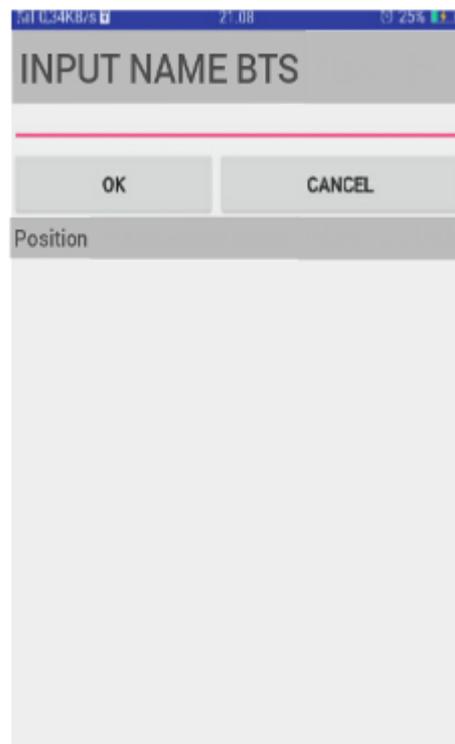
In figure 2, the Base Transceiver Station (BTS) folder menu is used for the search process for the shortest path to find the location of the Base Transceiver Station (BTS). The menu consists of a map of the Base Transceiver Station (BTS) in Palembang, the BTS damage input menu, and the A \* algorithm menu.

Figure 3 shows the location of the Base Transceiver Station (BTS), which is the destination, where 128 BTS are belonging to XL and three operators scattered throughout the city of Palembang.



**Figure 3.** Display the BTS folder menu

Base Transceiver Station (BTS) damage input menu display used to input Base Transceiver Station (BTS) names that need to be done for maintenance and repairs, as shown in Figure 4 and Figure 5.



**Figure 4.** Display the BTS damage input menu

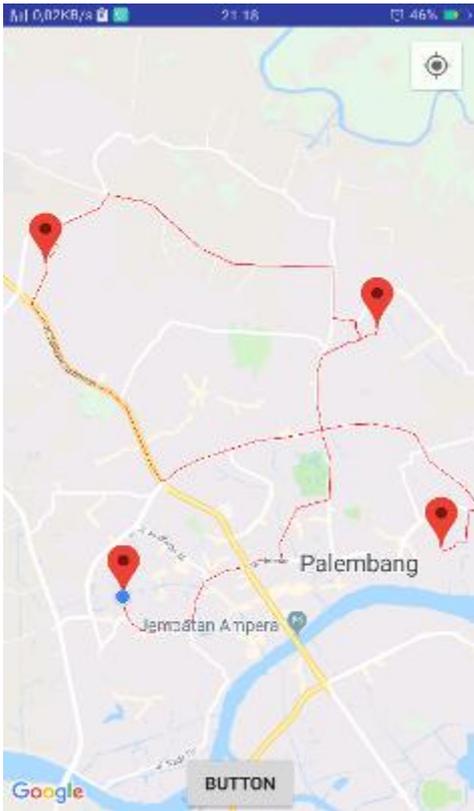


Figure 5. Display menu A\*

We tried 3 Examples of determining the shortest route in BTS 2, BTS 29, and BTS 37, as shown in Figure 6. The application worked to find the fastest way to BTS 2, BTS 29, and BTS 37 by applying the A \* algorithm, as shown in Figure 7.



Figure 6. Display of BTS 2, BTS 29, and BTS 37 inputs

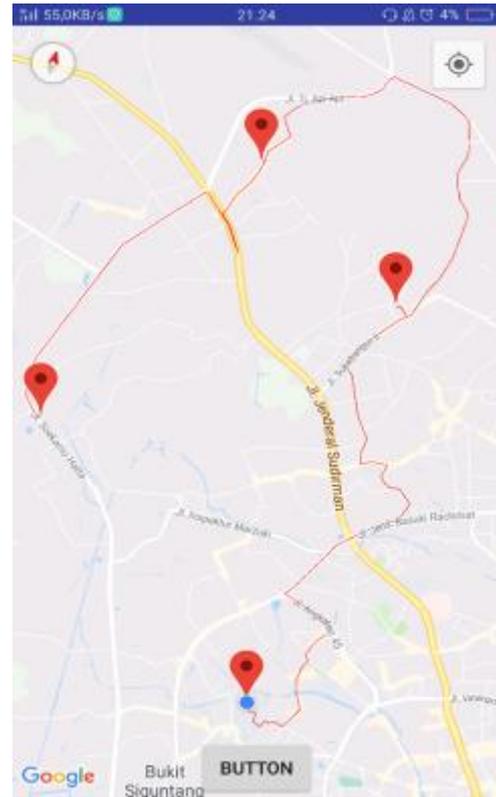


Figure 7. Display the shortest route to BTS 2, BTS 29, and BTS 37 by applying the A \* algorithm

Table 1. Value of route costs between BTS 2 nodes, BTS 29 and BTS 37

No	Start Node	Destination Node	Distance (km)
1	0 (Start Position)	1 (BTS 2)	12 km
2	0 (Start Position)	2 (BTS 29)	9,0 km
3	0 (Start Position)	3 (BTS 37)	9,8 km
4	1 (BTS 2)	3 (BTS 37)	5,4 km
5	3 (BTS 37)	1 (BTS 2)	6,7 km
6	3 (BTS 37)	2 (BTS 29)	8,1 km
7	2 (BTS 29)	3(BTS 37)	9,1 km
8	2 (BTS 29)	1 (BTS 2)	9,9 km
9	1 (BTS 2)	2 (BTS 29)	6,6 km

The value of route costs between BTS 2 nodes, BTS 29, and BTS 37 tabulated in Table 1. The closest BTS distance is 5.4 km, and the farthest BTS distance is 9.9 km, which results made, as shown in Figure 8. This figure is the value of route costs and weighted distance graphs between BTS 2, BTS 29, and BTS 37 nodes.

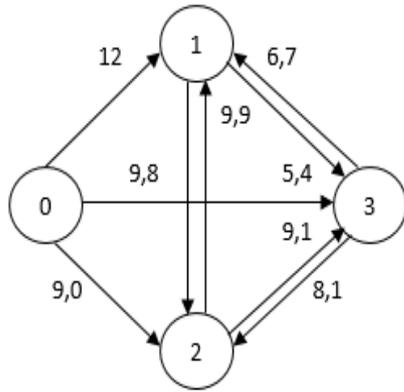


Figure 8. Weighted graph the distance between BTS 2, BTS 29, and BTS 37

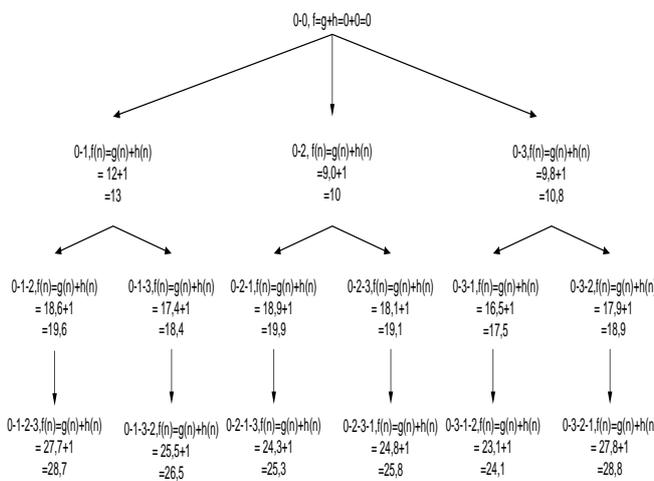


Figure 9. Graph of A\* algorithm

In Figure 9. the results of the manually A\* algorithm. The shortest route is 0-3-1-2, which is 24.1km. It can be said that the quickest way chosen from the current technical position is the starting position - BTS 37 - BTS 2 - BTS 29 that is as far as 24.1 km.

#### 4. CONCLUSION

Application of the shortest path search for the Base Transceiver Station (BTS) using the A\* algorithm has been successfully designed. It produces the same indicator between the shortest path results generated by the android application with the shortest path results generated by calculations manually using the theory of algorithm A\*. The speed of the application in processing data and finding the shortest path is very dependent on the quality of the internet telephone network used.

In the future, we also want to modify our application system. Determining the best and fastest route is not

only the shortest distance that counts, but also consider other variables such as road congestion so that it can predict the estimated time taken.

#### AUTHORS' CONTRIBUTIONS

Ikhthison Mekongga conceived, designed, searches literature, analyzed data, and drafted the manuscript. Aryanti Aryanti supervised the analysis, reviewed the script, and contributed to the discussion.

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