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# Simulation of the BFS Algorithm for Determining the Shortest Route to Sawarna Beach, Banten Province

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**Abstract:** Sawarna Beach, located in Lebak Regency, Banten Province, is a popular tourist destination. However, limited information and poor accessibility remain challenges for potential visitors. Many rely solely on general mapping services, which may not reflect the most efficient routes. This study aims to simulate the Breadth First Search (BFS) algorithm to determine the shortest travel route to Sawarna Beach. The BFS algorithm, effective for unweighted graphs, explores all vertices level by level. A simulation-based quantitative method was employed, and the system was implemented using PHP. The results reveal multiple alternative routes that could serve as references for travelers unfamiliar with the area. While shortest routes were identified, travelers are advised to consider additional factors such as traffic, road conditions, and available facilities.

**Keywords:** Alternative; BFS; Design; Tourism; Travel

## Introduction

Optimizing travel to tourist locations is an important aspect for tourists, because it not only saves travel costs, but also improves the quality of their experience during the trip (Pasaribu et al., 2022). One of the popular tourist destinations among domestic and foreign tourists is Sawarna Beach which is located in Lebak Regency, Banten Province (Savira et al., 2023). This beach not only offers a beautiful panorama, but also during the trip tourists will be treated to truly impressive natural views. However, limited information and accessibility to locations is still an obstacle for some people who want to travel (Arystiana, 2021; Karim et al., 2004; Sudarwan et al., 2021), Many of them only know the name of the beach without ever visiting it (Sumiarti, 2023). One of the factors is caused by the distance of the travel route which seems relatively far when seen from general information such as Google Maps or maps. In fact, if people have knowledge of a more structured and complete route, there are other routes that are more effective in terms of distance. This alternative route can shorten the journey from certain locations, thus making the journey more effective and optimal.

One alternative technique for finding paths or travel routes from one node to another is to use the breadth first search or BFS algorithm (Barahama et al., 2021; Ginasta et al., 2024; Zai et al., 2016). This algorithm is very effective for finding the shortest path in an unweighted graph, because it works by exploring all vertices at the same level before moving on to the next level. Implementing BFS can help tourists find the fastest and shortest route to Sawarna Beach by mapping all possible routes and choosing the most efficient one. Although there are several algorithms such as Dijkstra or A* which are also often used for path finding, especially in weighted graph (Umar et al., 2021). BFS is still an alternative choice because it is simple and effective in certain situations (Armanda et al., 2024; Hindarto et al., 2023; Putri et al., 2023).

The breadth first search algorithm can be implemented in several applications, for example research conducted by Zudianta (2020), with the research title Searching for the Best Route for Delivery of

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Goods Using the Breadth First Search Algorithm. The results of the research show that the BFS algorithm can be effectively implemented using the Traveling Salesman Problem method which was developed in an Android-based application (Zudianta, 2020). Apart from that, the application of the BFS algorithm in searching for the closest route has also been implemented by Sitinjak et al. (2023) with the title Search for the Closest Distance to Locations of Traditional Restaurants in Palangka Raya City Using the Breadth First Search Algorithm. His research aims to build a geographic information system that displays information and locations of traditional restaurants presented in the form of digital maps. The BFS algorithm that has been implemented into the system is tested using the Haversine Formula method to search for the closest location. The system built is capable of producing a mapping of the locations of traditional restaurants in the city of Palangka Raya which is equipped with information about these locations (Sitinjak et al., 2023). Even though there is a lot of literature that has applied or implemented the BFS algorithm into a system/application or in the form of simulating finding the nearest travel path/route, this research has a different focus. This research aims to apply the BFS algorithm to find the shortest route to Sawarna Beach, which is a popular tourist location in Lebak Regency, Banten Province. By simulating the BFS model into a shortest path search system for travel routes to tourism locations, it is hoped that this system can provide more efficient and accurate route recommendations to people who have plans to travel to these locations.

## Method

The research method used is a quantitative method approach (Musdalipa et al., 2022), namely simulating the Breadth First Search (BFS) algorithm by collecting numerical data to find the shortest route to the Sawarna Beach location. The data is then made into a simulation model in the form of a tree, where the results of the simulation model will be analyzed for its effectiveness based on tracing the edges that connect between nodes to find the closest/shortest alternative path. Next, the simulation model design which has been tested for effectiveness based on the results of data analysis is implemented using the PHP programming language (Muhardono, 2023). So the system designed is expected to be able to provide information regarding alternative optimal travel routes for people who want to travel to Sawarna Beach.

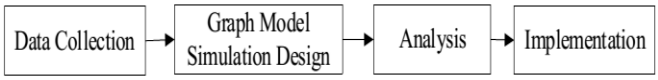


**Figure 1.** Research steps

*Breadth First Search Algorithm*

The Breadth First Search (BFS) algorithm is a search method that explores nodes extensively (Parlaungan et al., 2022). This algorithm will visit nodes that are adjacent to the initial node first before continuing to further nodes. Following are the steps of the BFS algorithm (Romlah, 2021): (1) Insert the end (root) node into the queue. (2) Take a node from the beginning of the queue, then check whether the node is the goal state. (3) If the node is in the goal state, the search is complete and must be returned. (4) If the node is not in the goal state, insert all the nodes that are neighbors of that node (child nodes) into the queue.

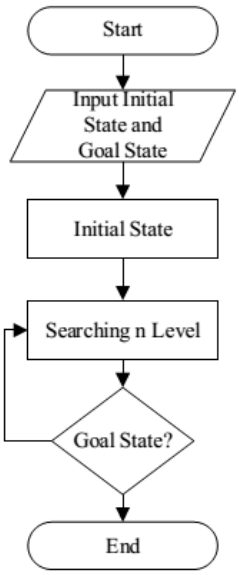


**Figure 2.** Flowchart BFS algorithm

## Result and Discussion

*Data Collection*

This data was obtained by direct observation at the location that was the object of research (Wirgiawan et al., 2021), in this case it is the goal state of the travel route. Apart from that, researchers used various sources of information such as the Google Maps application, globe and maps as a guide in finding and identifying alternative routes to the Sawarna Beach location. Below are travel routes to the location from several routes/directions that researchers have identified:

**Table 1.** Travel Path/Route to Sawarna Beach

| Path/Direction | Route |
|---|---|
| East | Jakarta – Ciawi – Bogor – Cibadak -Pelabuhan Ratu – Cisolok - Sawarna |
| | Jakarta – Ciawi – Bogor – Cikidang – Pelabuhan Ratu – Cisolok - Sawarna |
| | Jakarta – Bogor – Cijeruk – Cikidang/Cibadak – Pelabuhan Ratu – Cisolok – Sawarna |
| | Jakarta – Bogor - Parung Panjang – Jasinga – Citorek - Sawarna |
| West | Jakarta – Tangerang – Serang – Pandeglang – Saketi – Malingping – Bayah – Sawarna |
| | Jakarta – Tangerang – Rangkas Bitung – Gunung Kencana – Malingping – Bayah – Sawarna |
| | Jakarta – Cilegon – Anyer – Labuan – Malingping – Bayah - Sawarna |
| | Jakarta – Tangerang – Rangkas Bitung – Malingping – Bayah – Sawarna |
| | Jakarta – Tangerang – Parung Panjang – Jasinga – Citorek - Sawarna |
| Bandung | Bandung – Cianjur – Sukabumi – Cibadak – Pelabuhan Ratu – Cisolok - Sawarna |

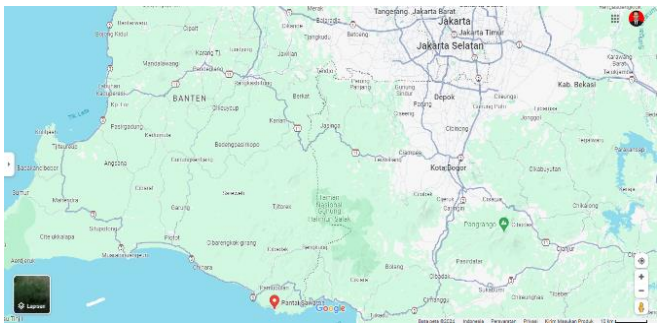


**Figure 3.** Location map viewed from google maps

*BFS Algoritm Model Simulation Design*

Sawarna Beach is part of Lebak Regency, which is an administrative area in Banten Province. Lebak Regency directly borders one of the provinces and several cities/regencies. In the northern region it borders Serang Regency and Tangerang Regency, in the eastern part it borders West Java province, namely Bogor and Sukabumi, while in the southern part it borders directly on the Indian Ocean, and in the western part it borders Pandeglang Regency. Lebak Regency consists of 28 sub-districts which are divided into 340 villages and 5 sub-districts. Geographically, Lebak Regency is located between 105 25′ – 106 30′ East Longitude and 6 18′ – 7 00′ South Latitude.

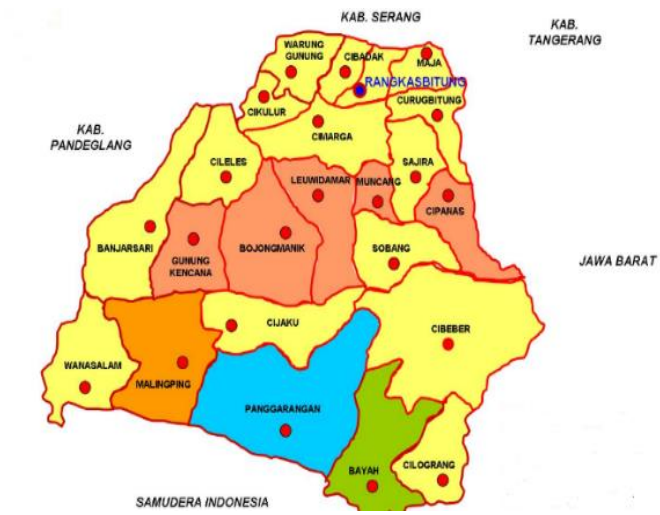


**Figure 4.** Route tracing process from initial state (Source: https://pa-rangkasbitung.go.id)

In this research, the BFS algorithm simulation model for finding the shortest route to Sawarna Beach is simulated from the north, while the initial state is simulated from Serang City. As seen in figure 5.

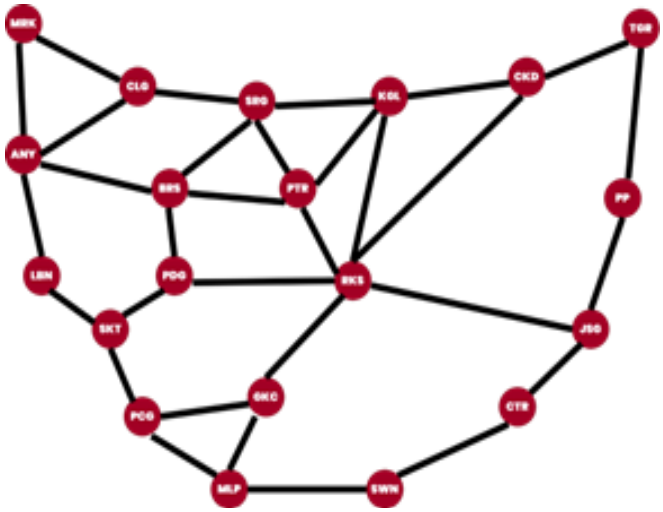


**Figure 5.** BFS algotithm model and simualtion design

**Table 2.** Travel Path/Route to Sawarna Beach

| Node | Information | Node | Information |
|---|---|---|---|
| MRK | Merak | RKS | Rangkasbitung |
| CLG | Cilegon | SKT | Saketi |
| ANY | Anyer | PP | Parung panjang |
| SRG | Serang | JSG | Jasinga |
| KGL | Keragilan | PCG | Picung |
| CKD | Cikande | GKC | Gunung kencana |
| TGR | Tangerang | CTR | Citorek |
| BRS | Baros | MLP | Malingpping |
| PTR | Petir | SWN | Sawarna |
| LBN | Labuan | PDG | Pandeglang |

Based on Figure 5, we can implement it into BFS to find the best travel route, in this case we take the initial state of Serang (SRG) and the goal state of Sawarna Beach (SWN) as an example, along with the steps for mapping the simulation model:

The First Step: if we take the initial state, namely SRG, SRG has a choice of paths, namely to CLG, BRS, PTR and KGL so that the search tree can be represented as follows:


**Figure 6.** Route tracing process from initial state/level-1

Second Step:Perform a path search based on the concept of breadth first search. The goal or goal state of the search is to find the SWN point. The search begins by tracing the starting point, namely the SRG point, because the SRG point is the point with the highest level, the search continues by exploring points at the level below it or nodes that are neighbors to that node (child nodes).

- The next search is at the second level or points neighboring that point, namely the CLG, BRS, PTR and KGL points.
- The next search is to enter points neighboring CLG, namely MRK and ANY.
- The next search is to enter the point that neighbors BRS, namely PDG, then enter the point that neighbors PTR, namely RKS.
- Next, enter the point that neighbors KGL, namely CKD.
- In this diagram, the SWN point is the goal point, so the search process stops when the goal state is found.

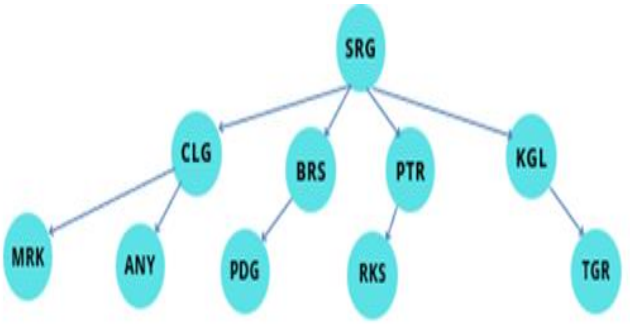


**Figure 7.** Level-2 route tracing process

Third Step: the next search is at the third level or points that are neighbors to that point, namely points ANY, PDG, RKS and CKD, point MRK is not traced because it no longer has neighboring points or routes to trace.

- The next search is to enter the point that is adjacent to the ANY point, namely the LBN point.
- The next search is to enter the point that neighbors PDG, namely SKT.
- The next search is to enter points that neighbor RKS, namely GKC and JSG.
- Next, enter the point that neighbors CKD, namely TGR.

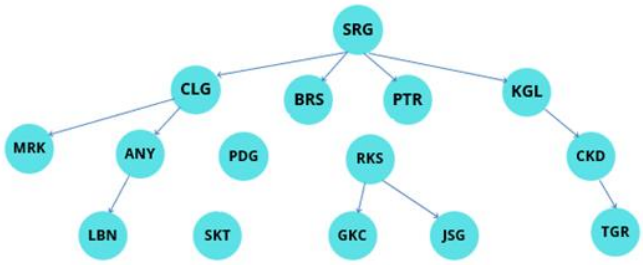


**Figure 8.** Level-3 route tracing process

Fourth Step: the next search is at the fourth level or the points that neighbor this point, namely the SKT, GKC and JSG points, the LBN and TGR points are not traced because they no longer have neighboring points or routes to trace.

- The next search is to enter the point that neighbors the SKT point, namely the PCG point.
- The next search is to enter the point that neighbors GKC, namely MLP.
- The next search is to enter points neighboring JSG, namely CTR and PP.

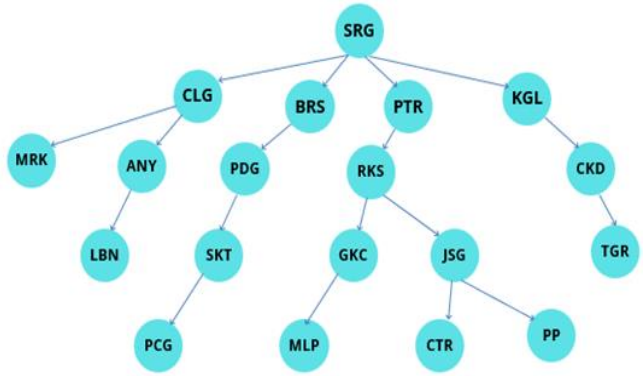


**Figure 9.** Level-4 route tracing process

Fifth step: the next search is at the fifth level or points neighboring this point, namely MLP points, PCG points, CTR and PP, which are not traced because they no longer have neighboring points or routes to trace.

- The final search is to enter the point that neighbors the MLP point, namely the SWN destination point.

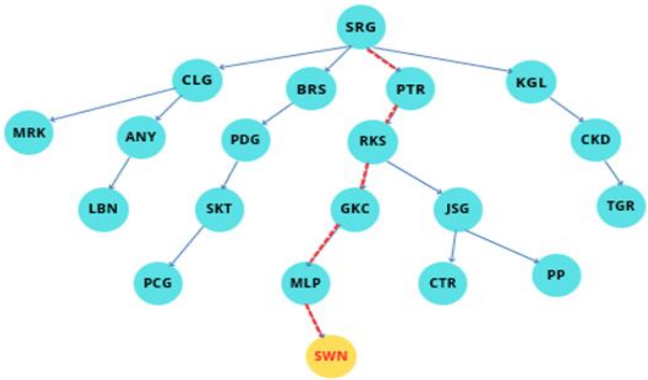


**Figure 10.** Level-5 route tracing process

The SWN point is the destination point (goal state), so the search or search program for the travel route from Serang to Sawarna Beach using the Breadth First Search method stops with the route taken, namely SRG – PTR – RKS – GKC – MLP – SWN, even though other routes are still available. Can go to the destination point.

*Analysis*

Based on the BFS algorithm simulation model data that has been designed, there are several routes as alternative routes and can provide informative solutions for the community. The BFS algorithm has relatively low computing time compared to other search algorithms, such as Depth-First Search or DFS[15], as can be seen from the table 5.

**Table 3.** Alternative Path/Route for Travel to Sawarna Beach

| Alternative | Travel Route |
|---|---|
| 1 | Jakarta - Tangerang – Parung Panjang – Jasinga – Citorek – Sawarna |
| 2 | Jakarta - Tangerang – Jasinga – Citorek – Sawarna |
| 3 | Serang – Petir – Rangkas Bitung – Gunung Kencana – Malingping – Sawarna |
| 4 | Serang – Rangkas Bitung – Jasinga – Citorek – Sawarna |
| 5 | Serang – Tangerang – Jasina – Citorek - Sawarna |

For tourists from the direction of Jakarta/Tangerang, alternative travel routes number 1 and 2 can be considered as travel routes which generally use the travel route: Jakarta – Tangerang – Serang – Baros - Pandeglang – Saketi – Picung - Malingping – Sawarna. Likewise, people in the Serang City/Regency section can consider alternative travel routes number 3, 4 and 5. Figure 11 is the simulation model:

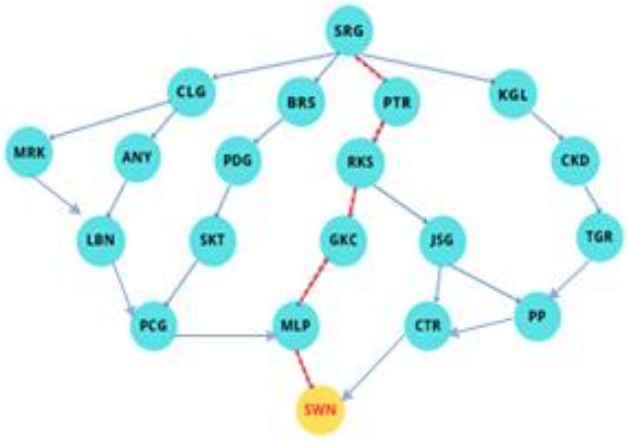


**Figure 11.** BFS algorithm simulation model data

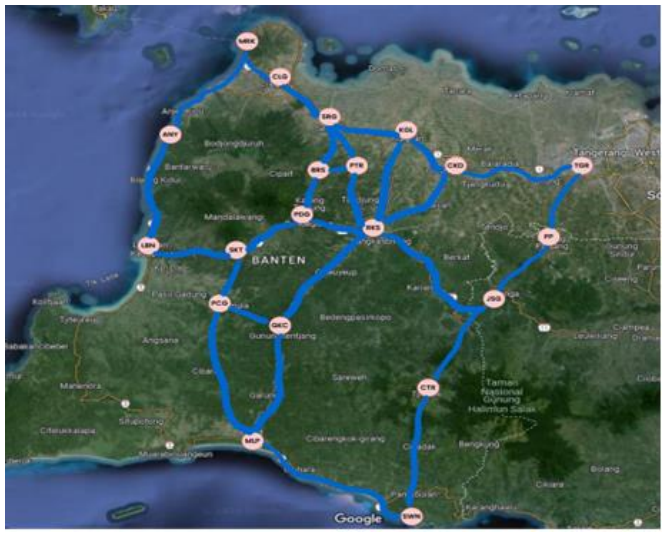


**Figure 12.** Alternative route mapping

*Implementation*

From the results of the model that has been designed it is then implemented using the PHP programming language software for simulation. The following are some examples of simulation results from the designed model:


**Figure 13.** Example-2 implementation of the BFS algorithm system model

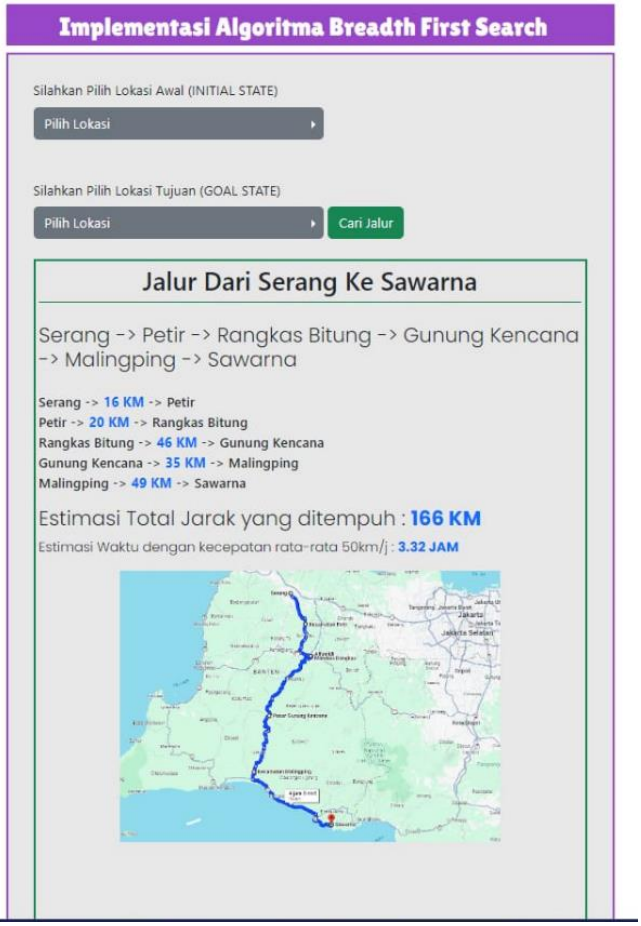


**Figure 14.** Example-2 implementation of the BFS algorithm system model

## Conclusion

The Breadth First Search (BFS) algorithm proves to be an effective alternative for determining the shortest travel route to tourist destinations like Sawarna Beach. Its simplicity and suitability for unweighted graphs make it a practical option for route recommendations. The simulation model developed in this study offers multiple alternative routes and can serve as a decision-making tool for travelers. Future improvements could integrate real-time data such as traffic conditions to enhance the route accuracy and relevance.

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No conflict interest.

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