# WVGM: Water View Google Map, Introducing Water Paths on Rivers to Reach One's Destination using Various Types of Vehicles

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## ABSTRACT
Google Maps is a web mapping and consumer supported application developed by Google which provides satellite view, street maps with view, route planning with real time traffic conditions from user's source to destination via foot, car, beta version of air and public transport. In addition, Google Maps provides road layouts, state or country's boundaries, geographic features, restaurant views and so on. Despite offering enough facilities to its users, the application circumscribes its functionalities when it comes to showing the direction of rivers, canals, and so on. As per our knowledge, Google maps does not have the features of water path showing as substitute of roads to reach a desired destination easily which could save time and cost at the same time it will minimize the distance by suggesting waterway with water vehicles. Adding a water path in Google map will introduce a new dimension in this application: alternative shortest path to the user, providing reliable directions to reach one's destination with shortest time. Moreover this new proposal of adding waterways in the google map will enable the features of shortest available water path with vehicles in riverine places especially the research-observed areas Barishal and Dhaka. This paper will inspect how adding the new feature of water path in Google map can facilitate future possibilities to make this virtual application more effective and user friendly with realistic and convenient facilities.

## General Terms
Google Map, Water path, Dijkstra Algorithm, GPS

## Keywords
Shortest Path, Water Surface, Vehicles, Optimal Path, Location

## 1. INTRODUCTION
A graphical visualization of an area of land or water surface is defined as a map showing information about Topographic, Climatic, Resource, Road etc. Road information that helps people to find a place or make a plan to go to a destination and so on. In order to find a place or make a plan, several service providers give street or road information such as Bing Maps, Google Earth, Google Maps, Mapbox etc. Most riveting features of those applications are source to destination route, average estimated time of arrival, current location of an individual, shortest routes, traffic status, location of restaurants, hotels, etc. and so on. All of those applications are providing sample features; however most of the people in Bangladesh use Google maps because of its simplicity and widespread use.

In Bangladesh, Google maps showing the shortest path as user need and user feedback are also favorable in land surface but water surface paths are not well defined and difficult to map. Some of the shortest routes such as, travel using only one vehicle like bus, train etc which are provided by google maps are not suitable. Instead of that, changing the route and using multiple vehicles are more suitable, provide low travel cost and shortest time.

Section 2 discusses literature review, section 3 gives problem statements. In section 4 discuss research questions. Section 5 gives implementation and design. section 6 result and path optimization and section 7 conclusions.

## 2. LITERATURE REVIEW
Humansalways find such ways where they can go one point to another with shortest travel time and for this, they want to discover new shortest paths again and again. By updating technology day by day, finding shortest path with lower time is easier now where different types of road maps, route planner websites and apps help us to find desirable paths. Global Positioning System (GPS) Algorithms like Dijkstra and A* , tools like MATLAB, API like Google map api, Bing map api, Mapbox map api enhance to unravel finding shortest path problems. To reduce travel time and also discover shortest path, researchers always try to develop new formulas that can minimize the path or time and make the path suitable for travelers or users. Because of this purpose the Researcher analysis with several topics.

The work on [1] focuses on security issues, two types of path are shown, one is shortest path and another is safest path .The author's work with safest path and this path will select with minimum number crime records which compare with other alternative paths. This safest path can be the shortest path or not from source to destination.

The authors on [2] not only discussed about different feature of a travel app but also developed a app "Travelhelp". Herein, the author focused on UI/UX, access location and route without internet, suggest touring places, provide travel time and approximate rent from source to destination and have a special feature of voice translator that help traveler to communicate and works with GPS.

Gathering latitude and longitude, create custom routes and break every route in sub-route where calculate distance every sub-route and measure distance from source to destination is discussed in [3].And also measure distance between source to

bus location on this path by gps, display in a app which developed by author in this paper.

For choosing path author on [4] gives close attention to find out the traveling time, select some path for same source to destination and collecting data about this path by different types of sensors, CCTV and latitude, longitude takes from google maps, processes data on MATLAB with different types of parameter such as of straight path delay, signal point delays and cross section delays etc and provide a path that are lower travelling time.

## 3. PROBLEM STATEMENT

There are various road maps such as Microsoft Bing Map, Google maps where Google map and Bing map are the most popular. With dynamic features like travel mode, street direction, restaurants, grocery, hotels location etc in Google map, it is suitable and user friendly for people. Path direction is the most valuable part in a map which is used for traveling to find new locations and people always desire to choose the shortest, safest and low transit cost route.

Google maps suggest routes with few travel modes like driving, transit, walking, cycling, or flight to go from source to destination in the shortest time. If someone selects driving mode, Google maps shows a route that the user can go to the destination by driving in a vehicle.

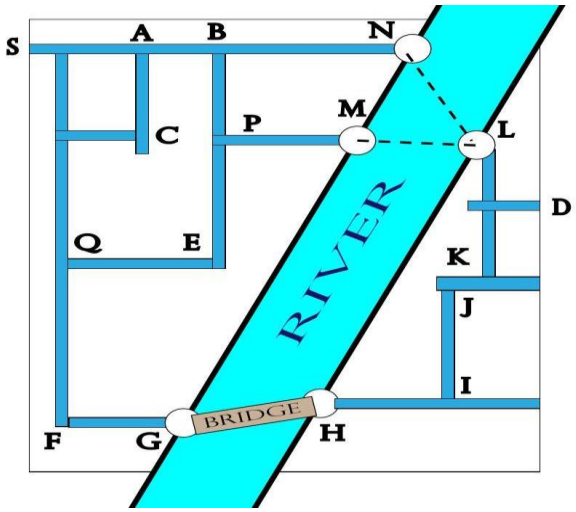



**Fig 1: Example Image of Land Route and River Route**

But users who do not use personal vehicles or use local vehicles, sometimes for their driving mode the path is not suitable. Driving mode allows the user to go all over the route with one vehicle. In reality, some shortest paths are like that if a user does not use one vehicle all over the route means to use multiple vehicles, then the user can go the shortest route with low transit cost. In fig:1,we assume S is the Source and D is the Destination and there are several routes for going S to D. such as

**Table 1 . Route of Example Image with which Vehicle can use**

| SL | Path | Can go with one vehicle | Have to use Multiple vehicle |
|---|---|---|---|
| 1 | S>Q>F>G>H>I>J>K>D | Yes | not prerequisite |
| 2 | S>A>C>Q>F>G>H>I>J>K>D | Yes | not prerequisite |
| 3 | S>A>B>E>Q>F>G>H>I>J>K>D | Yes | not prerequisite |
| 4 | S>A>B>N>L>D | No | prerequisite |
| 5 | S>A>B>P>M>L>D | No | prerequisite |

In Google map Driving mode shows the path S>Q>f>G>H>I>J>K>D among 1,2 and 3 number route (table1) and 4,5 number routes are not counted by Google map because one vehicle can't travel the whole route with this number of route.But the shortest path is S>A>B>N>L>D. Google maps does not show this path because users can't go by driving one vehicle (this path is divided into three parts: the 1st part is the land surface, 2nd part is the water surface, 3rd part is the land surface and the change of vehicle for two times). But for those who do not use personal vehicles or use local services, this path is suitable there.

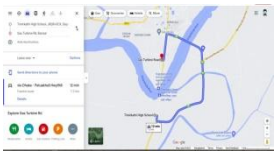
## 4. RESEARCH QUESTIONS

RQ1: Why is it necessary to include a water path along with a water vehicle in the existing Google map application?

In Bangladesh, rivers are available everywhere and sometimes rivers are the easiest way for communications and transportation. Some places are like that where travelers or users can go through many different routes and in the shortest route, vehicles are changed by users or travelers multiple times including the river's path. Since travelers can't go with this route with one car, that's why google maps does not suggest this route. The routes, suggested by Google, are not shortest as users or travellers demand. Some examples are given below where the blue line is Google's suggested route and the green color line is the proposed route with a water path.

**Fig 2 : Google suggested route**

**Fig 3 : Comparing Google suggested route and the proposed route**



**ig 4 : Google suggested route**

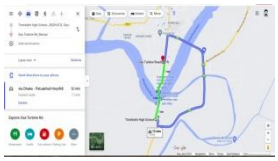


**Fig 5 : Comparing Google suggested route and the proposed route**

**Fig 6 : Google suggested route**


**Fig 7 : comparing Google suggested route and the proposed route**

RQ2: What features will be introduced by adding the water path?

In Bangladesh, river routes are not well organized and somewhere people are using river routes that are suitable for them. For the river route, travelers or users easily reach the destination which is better than Google map suggested path.

## 5. IMPLEMENTATION & DESIGN

Some paths do not always support all types of vehicle because of developing conditions or narrow channels or this path is a water path. But sometimes this type of path connects to other paths which support most of the vehicles and this type of path is called a connecting path. If we develop a route with a connecting path and identify which path is connected by it then the new route is the shortest distance instead of the shortest path with a fixed vehicle shown by Google in bangladesh.

Look upon (Fig:1) where S>A>B>N>L>D is a path that is the shortest path instead of the Google map suggested path. The user uses the source S to N path in a land surface vehicle, N to L uses a water vehicle, then again the L to D path uses a land surface vehicle, then the user can go to the destination in the shortest path by using multiple vehicles.

To analyze the shortest path problem, usually people are using dijkstra or A* algorithms. Dijkstra's is a greedy and graph search algorithm which is used to find the shortest path with a single source and does not have a negative side cost on a graph. A* algorithm is a heuristic method algorithm that finds a path from a given initial node and goal node. Both give same output on a small area but in large area A* gives a better solution.[5]

Uniquely identifying a place or getting an exact location for a place, Global Positioning System (GPS) plays a vital role all over the world. GPS, a navigation system that provides positioning, navigation, and timing services. Using the Mobile Global Positioning System (GPS) and Android, we have

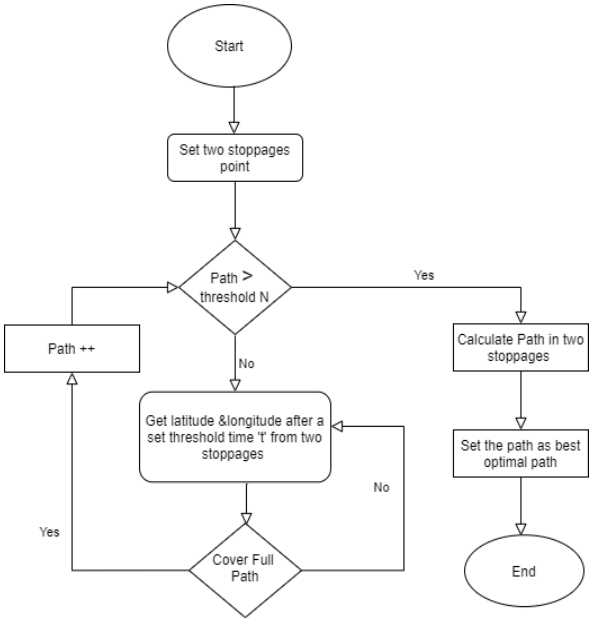



**Fig 8 : Process of creating a river route**

developed an application to get latitude and longitude where data is stored in a firebase database after a few seconds of interval.

To create new routes , we have gathered all Latitude and Longitude of paths from source to destination and found the shortest one. Here we can divide two parts:

1. To create river paths and find the shortest one: For creating river paths, we have to collect latitude and longitude after a few seconds of interval for all possible routes and store them in a variable array. And to find the shortest path among them , we have to use dijkstra for better output.(fig 8)

2. To gather all possible paths for one route and find the shortest one: At first we have divided the total paths from source to destination and created some sub path for better calculation then collected latitude ,longitude and other information(which vehicle is suitable,how much rent for each) for every possible path in the land surface and also collected for water surface path which connects two land surface paths.

Secondly, After collecting all latitude, longitude and other information of paths, searching the shortest path with dijkstra algorithms. This shortest path will be displayed by an android application with all travel information that what type of vehicles should be used and rent cost also.(fig 9)

Creating paths on rivers is more difficult instead of roads because all places seem to be the same . In fig 8, we have taken all possible points to create many paths in the same route where step by step we have gathered latitude and longitude of stoppage,when reached to destination then again started with source and found next stoppage until all routes are finished and selected the best optimal path using dijkstra.

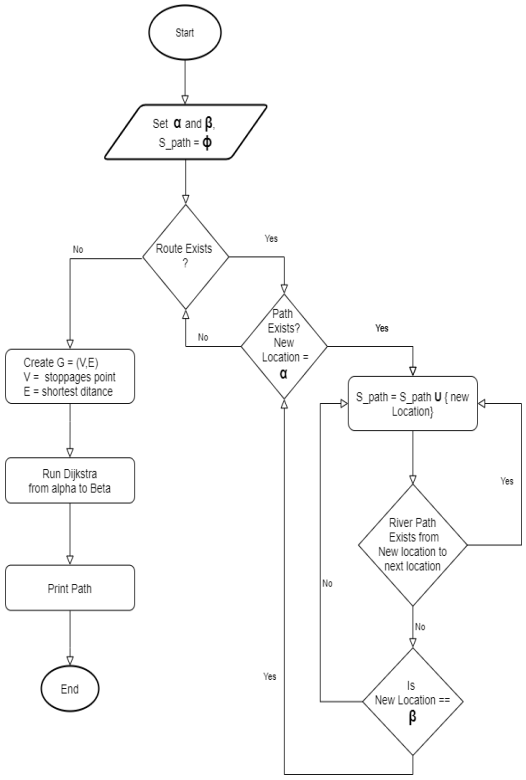



**Fig 9 : Process of creating full path with latitude & longitude**

The optimal route makes their journey more easy and fresh where every traveler wants to choose or find the optimal route. In fig 9, for creating a full optimal route rather than Google maps suggested routes, here firstly we have taken **α** and **β** as source and destination also initialized  as empty where total path store. Then we have to check if route exists, store the location in  and if the path in river path then find optimal path with (fig 8) and gather location end of the destination. Repeating this process if a route exists and find the optimal route with dijkstra.

**Algorithms : create shortest path for multiple vehicle**

**1 Input** : Source, **α** and Destination, **β**
**2 Output:** shortest path with details
**3 Begin**
**4** Initialize: set of total Path, ← ∅
**5 loop :**
**6** **if** route exists then
**7** **for each** new stoppage = α ∈ (α ,β)
**8ϕ** U {α}
**9** **if** (**α**, is a river path)
**10** **for each** River path, **R**∈ set of possible River path
**11** **dijkstra(R,α )**
**12** **end for**
**13** **end for**
**14** **end if**
**15 dijkstra(ϕ ,α )**
**16 End**

In line 1-2, Source, **α** and Destination, **β** both contain latitude and longitude as given by users and show the output. **ϕ** ← ∅ , initialize the set of path is empty set (line 4) and search path beginning from the **α,** taking every stoppage location, storing in **ϕ**. For the river's path, gather every point in **R** and find the shortest path with dijkstra, which returns the main set. When all path locations are found, then choose the shortest path with dijkstra in line 10 -14.

# 6. RESULT and PATH OPTIMIZATION

In this section, we compare the distance between source and destination of our proposed path and Google suggested path and evaluate the result of which path is more suitable for use. We assume some fixed path for result evaluation where there are several possible paths from source to destination. We have taken Google map suggest path and our proposed path where calculated result in table 2. That shows Google map suggested path distance is longer than our suggested path.

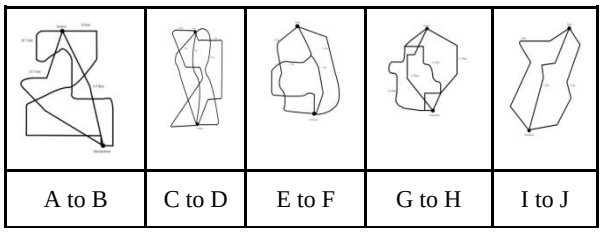



**Fig 10 : Route image with distance**

In fig 10, we take five sources and destinations to show the result and display all possible routes with distance. Some routes include a river path and some are not. In table 2, we have added Google Maps suggested route and proposed route distance, also added latitude, longitude of every location in the table.

**Table 2 : a table of source to destination distance of Google map route and proposed route**

| **SI** | **Source to Destination** | **Source to destination** (lat,long) | **Distance km (Google map route)** | **Distance km (Proposed Route)** |
|---|---|---|---|---|
| 1 | A to B | p to q | 14.3 | 4.8 |
| 2 | C to D | r to s | 18.1 | 2.1 |
| 3 | E to F | w to z | 7.7 | 2.7 |
| 4 | G to H | x to y | 4.1 | 2.1 |
| 5 | I to J | t to v | 4.9 | 7.9 |

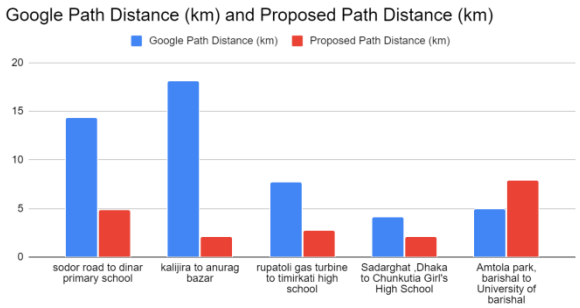



**Fig 11 : compare range of Google maps route and proposed route**

The above bar chart is showing distances information on the proposed map and the existing Google map route. Overall, the chart gives information about four different distances from the source to the destination using the proposed route in Google maps. The first route, from Sadar road to Dinar primary school on Google maps shows around 13 km whereas the proposed route decreased to nearly 4 km. The most noticeable data is shown in the second route where Kalijira to Anurag bazar's distances become shortest possible to 17 km to nearly 3 km only. The data shown in the 3rd and 4th bar, the distance from Rupatoli gas turbine to Timirkati High School decreased from 8km to 3 km, from sadarghat, Dhaka to Chunkutia Girls High School becomes short by nearly 2.5 km from 4 km shown in the Google maps.

## 7. CONCLUSION & FUTURE WORK

In Bangladesh, the number of map users is increasing day by day but the transportation ways are not well formed because of the road system, transportation cost and not enough connecting bridges between two or more roads. For this where a bridge is not available, people are using a boat, motor boat, speed boat, etc. and Google does not suggest this path. But sometimes this path is more suitable for distance,rent and time rather than Google suggested path. In this paper, we have collected locations (latitude and longitude) and created some paths including river paths where the bridge is not available. Most of the time, this path is low rent cost, short distance and reduces waste of time than Google suggested. Between source and destination, Paths are divided in some sub routes where users have to use multiple vehicles. We strongly believe that our proposed work can make a new dimension to the society as well as to our transportation systems.

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