

# Study of Various Route Tracking Techniques and Open Street Map Data

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**Abstract:** - Routing is one of our basic activity that we perform in our everyday life, whether it's about reaching from home to office where we work, to go for some party in evening from home. We basically are doing routing from source to destination. Source point is the point from where we start and destination point is where we stop. The main purpose for writing this paper is to study the work already done in the field of routing and to study Open Street Map project. As we all know about the widespread use of open source project these days, why people are more after using them. One of the main reason is its open nature, i.e anyone who wishes to contribute or participate towards it, can freely do it. One such example is discussed in this paper and that is Open Street Map project, how it came into existence. Users are the base here. Various ways that we can use to find routes will be discussed in papers. About the quality of OSM data and an application development framework is also discussed in this paper with one example.

**Index Terms**— Open Street Map, Routing, APIs, Shortest path Algorithms

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## I. INTRODUCTION

Routing is what we use every day. We go to our workplace, what we basically doing here is routing. We go from our house to the company we work in, where our house is the source and company is the destination point. Technically speaking, routing is finding path from source to one or multiple destination points with one or more optional points to be crossed while reaching final destination. These optional points are dependent on the requirements of situation and application developed. There are a number of ways to route like using APIs, algorithms, software libraries, etc [20]. There are a number of libraries available which helps to do routing. Open source projects are more widely used nowadays mainly because of the fact that they are free to deal with, which means anyone can use them, make additions to them, change them and all such activities are totally free of cost. Open Street Map is one such example which we will discuss in this paper [10]. In this paper we will discuss about various method to find routes, application development framework and then at last the conclusion for writing this paper. Section III gives short review of OSM data and section IV discusses about Cordova framework. Section V will discuss about various routing techniques which includes APIs and algorithms.

## II. LITERATURE SURVEY

Hacklay and Weber (2008) stated that **Open Street Map** is about users more than any one particular industry or personnel. Here users contribute towards it and utilize it.

The number of users are increasing every day. The data quality is also improving with time as its contributors and users got to know its patterns and mistakes like what needs to be improved or changed in order to utilize it in a better way. And now **Open Street Map** has its own official site too.

Neis and Ziel (2014) have stated that user generated data is gaining huge hike nowadays and such data available through a number of devices like mobile phones and is available online. Such type of data which is generated by users or by anyone who wants to participate towards it or contribute towards it is called VGI which stands for Volunteered Geographical Information data. The considered OSM as one such example. They studied about the fact that VGI data is popular nowadays but to confirm their usability for different areas, continents, countries, a check should be made by its user. OSM data is found to be heterogeneous. Also that VGI data is used and usable by a number of different applications.

Jheng et al. (2010) state the need of routing services for small town areas and also provided a solution for it by using OSM data by the use of APIs. API used here was the one available through mapping services on web which adds users data with its own data. These routing services in small town areas will be really helpful to overcome two of the main problems that the author's found during the research. One was the cost issue, which means the cost of getting and developing it. Second problem faced was the quality of data, its accuracy, its detailing. Considering these problems, the author's used Open Street

Map as the solution because this data is freely editable and anyone can make additions to it and change it according to the use required. Also a prototype system was developed for mobile application which was proved to be a success for a variety of vehicles like car, bicycle and also for pedestrians. API used was Cloud Made API.

Chadwick (2008) proposed that the oxford cycle maps for the cyclists' needs specifically were supposed to be developed by the cycloX in the next year which was 2009. In this paper work, he mentioned why **Open Street Map** is useful for the work and that **Open Cycle Map** is already present as a part of OSM to work on cycle route tracking. Various editors of **Open Street Map**, softwares, workflow i.e. how to add and upload data to **Open Street Map** site. Also Open Street Bug was mentioned which was to spot bugs or even find them by the users. Routing softwares are also mentioned in this paper.

Luxen and Vetter (2011) state that the routing services are available on internet from years back and that it is useful for the users as it was provided by the previously present mapping services like google maps, etc. There were some problems which were faced by the users using it. Also that the **Open Street Map** data is growing everyday and quality of its data is also found to be good which matches quality of other maps data. In this research work, they worked for hand-held devices as well as for servers by the utilization of the data **Open Street Map**. Both of these works were done on huge dataset like continental data where there was a large number of segments of streets. These implementations worked well for the computation of real-time and shortest path. Various fields studied in this research work in order to accomplish the above mentioned tasks are **Open Street Map**, routing, google maps, real-time data, basics of maps, shortest path problem and about servers.

Artmeier et al. (2010) proposed an improved shortest path algorithm which works with the batteries which are rechargeable. They studied the nature of the vehicles which run by the use of batteries and they found that these sort of vehicles will be helpful in order to address the traffic issues on road. Also that such vehicles have a number of positive features like regain of energy when decelerating, cruising range is limited, time of recharge is long enough. The authors worked to generate an algorithm which will be not only shortest path but economical as well. The algorithm they generated was with respect to the shortest path algorithm with hard and soft constraints and an algorithm which is energy-efficient using rechargeable batteries. They tested their algorithm using some prototypic approach for the energy-efficient output of routing.

### III. OPEN SOURCE PROJECT-OSM

**Open Street Map** is vast and one of the most used project nowadays. OSM is open source project which means anyone can use and contribute towards this project. A number of different maps are now available in open projects. Similarly, a number of softwares, editors, tools, database management tools are now available which are open source in nature [10]. One such example is discussed where OSM project is discussed, about its open source nature. Its freely editable by anyone and all type of users like technical users, non-technicals, learners, etc can participate in this project to add more data to it or/and to make changes in order to improve its quality [11]. One of its implementation is **Open Cycle Map** is also discussed which is useful particularly for cyclists, to find routes for them, main emphasis is on cycling paths and here routes for trucks, motorcycles are de-emphasised [12]. It also adds shadings and contour to the mapping. Quality of OSM data is also studied as the contributors are from different backgrounds, so to see whether the data they input is good for use or not.

### IV. CORDOVA

This is a mobile application development framework like many others, for example, android studio. This framework is useful to develop application files for android operating system, iOS, windows Operating Systems. What happens here is we have a special browser called WebView, within which the application file like for android, we have .apk file. That .apk file will run on this webview browser of cordova framework. Lets take the example of android operating system, how this framework develops .apk

This framework follows few commands to be executed in order to generate .apk file for android based system. These commands can be executed on your system's command prompt. After generating the file, user will download that file on its android mobile phone and install it. After installation, user will run and can use that developed .apk file [14]. This is one of the mobile application development frameworks available nowadays.

### V. ROUTING TECHNIQUES

#### A. APIs

API stands for Application Programming Interface. These are available for a number of uses. These are the basic requirement to communicate in or via devices, to generate results, to transfer data or information from one place to another, to request for the transfer, etc. APIs are that set of rules or functions which makes possible the creation of new web or mobile phone based application, with new added features. They help to send requests, to receive results, etc. One such example is that of Yelp application where the

result is shown on maps of google for the respective restaurants with addresses and additional information on the google map itself. All that is made possible via APIs [16]. In this paper we will discuss about some of the APIs useful for route finding function. Here the next heading starts it.

### **1. ROUTING API:**

This API is useful to find routes quickly and easily. It provides a number of features along with find routes on map like support for pedestrians i.e. whether to use elevator, stairs, walking or travelling through buildings, tunnels, parks, etc. It helps to calculate path between selected points and also to update pre-calculated path. It also supports a number of static routing attributes like traffic flow, road types, road conditions, blocked areas, speed options, closing of areas seasonally, restrictions applied, etc. Restrictions could be applied for the route to be found in terms of particular time in a day or for particular days or combination of both as per the request requires. Information in public transportation like names, station names, etc are also available here. Information about truck attributes is also available here like legal restrictions like where to allow trucks, turn restrictions on trucks, physical restrictions like its weight, height, length, and which material it should be allowed to carry which will not harm people and environment, etc, all such information is provided by this API. It is useful for tracking applications, for mobile phones to find routes and for navigation[17]. Few more APIs are discussed in this paper. In the next point, we will cover Cloudmade API.

### **2. Cloud made API:**

It provides the feature to users using which the user can easily add simple and interactive maps into their pages on web. It is built on top of the existing OSM project and is may be used with a leaflet library which is actually a javascript library[18]. Leaflet itself is quite useful for mapping services like it can provide features like creating a map, zooming feature on map, to add more layers to the application for better visualization of results. It also provides support for tiled map display, a number of other types are also supported like image overlay, circles, polygons, etc.

### **3. Attribute API:**

Here we use attributes to find routes which gives more control over web api. Here attributes are used to direct from URL to particular action to handle requests.[19]

### **4. Bing routes API:**

It is used for creating routes between two or more pointson major roads and also for creating routes for walking as well as driving, where in driving routes, traffic information is also added. Here REST, SOAP protocols are used and responses are made in XML, JSON and JSONP

formats. Here JSONP stands for JavaScript Object Notation with Padding which removes the restriction imposed by browsers regarding the retrieval of resources from same origin. [20]

### **5. Convention-based routing:**

Here we have three main things to understand, routes: which contains a route table containing the routes and whenever some request by an url comes, the application will first see this table for the route match[21]. Second is ignore routes, which contains collection of routes which are to be ignored by the application and the last one is map route, which will add new route to the table.

### **B. Algorithms:**

Dynamic routing is the way in which we can adapt to the changes the situation may demand like when our car isn't working, we switch to other option in order to reach our destination like we may want to reach the office. For that if our car fails we will look for options like bus, rickshaw, taxi, etc [23]. Static routing is the one where we cannot makes changes as the situation may require. Like for example we have route table where entries are being made and the user will get results by accessing through entries without any option to makes changes in them[24]. Static routing is useful for backups use, to find no more than two or few routes, for transferring information from one place to another, to stop a fixed final point for the route. Next we will discuss some of the algorithms for finding shortest path one by one .

#### **1. Dijkstra's algorithm:**

Dijkstra's algorithm is one of the most popular algorithm for finding shortest when only source point is known in advance. It does greedy search to find shortest path. The algorithm searches in all directions [25]. This is one of its drawback. It consumes a lot of time and resources to find paths in all directions. Considering an example to illustrate its working, here let's take starting point as V1. We start from V1 node and search for next possible shortest path in terms of the weights assigned to each edge out from V1. Weights are actually the cost to find the shortest path. This algorithm will look for all the possible edges going out form V1 and will finally select the one with least weighted edge out of the ones available from V1. Likewise, this selection method will continue until it reaches the end node on that least cost path it finally finds. Hence, its drawback is, it is time and resource consuming more than required. It does a greedy search in all directions rather than focusing on the one required and it works with only one given point i.e. starting point with no particular destination point given.

#### **2. A\* algorithm:**

This is another algorithm to find paths. Here we are given both the starting and destination points and this is one



of its main advantage over Dijkstra's algorithm as now the algorithm will search towards the destination point and will not search for all possible solutions. Hence, resources and time will not be wasted and deals with negative edges as well unlike Dijkstra's algorithm.[26]. These are the main advantages it has over Dijkstra's algorithm otherwise both are same algorithms[27]. Next algorithm to discuss is bellman-ford algorithm.

### 3. Bellman-ford algorithm:

This algorithm is yet another algorithm available for finding shortest path. Here we can deal with both positive as well as negative edges. If a negative edge arrives from source point, there will be no shortest path corresponding to this way followed. We will discuss one example to explain its working briefly. It first arranges all the edges given in the diagram in increasing order (in terms of nodes) eg. (V1, V2) (V1,V4), (V2,V3), (V2,V4), etc.

Then after it arranges all the edges, the algorithm picks each edge one by one to assign minimum weight to the node it (end point of the edge) reaches. Similarly, if instead of edge we have a path including a number of edges, then the minimum weighted path will be assigned to the end node of that path. After reaching the last edge of the figure, next pass starts. This algorithm continues until all the nodes get minimum weights assigned to them. And it is possible that one node that got more weight in the previous pass, may get lesser weight in the next pass as it calculates the weight again in the same order of edges in each next pass possible.[27]

## VI. CONCLUSION

From this study it is concluded that **Open Street Map** data is widely used and its data quality is also good enough for use in a number of applications. Routing is field which is in use and is one of the focused field by a number of professionals. Different techniques have been studied here in this paper for routing by making use of open source data. Each have its own advantage over the other method. It all depends on the requirements of the application or site the user is intended to develop. An application development framework is also discussed for different operating systems to support which can work with only commands to type and run and your application will be instantly generated. It's fast, easy and efficient.

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