NEAR REAL - TIME WEB BASED VEHICLE GUIDANCE SYSTEM

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ABSTRACT

Traffic is a big issue in almost all big cities in the present world, causing mainly wastage of man hours which affects a country's economy and the high consumption of the non-renewable resource - Petroleum. Thus attention should be paid on identifying remedies for this problem. The focus of this research is to develop a web based system to help motorists to reach their destination on the least time consuming path by utilizing near real-time traffic conditions (amount of traffic in selected hot Spots) in addition to the shortest path analysis. Starting location and the destination of the motorist would also be inputs to the system. Study area is a selected part of Colombo city. The web application is designed using web programming languages such as HTML, JAVASCRIPT, CSS, AJAX along with Google API V3. The data base is supported by My SQL. This system alters the time duration given by Google maps by adding near real-time traffic information based time delays, as a novel factor, making the time duration for a particular route more accurate than that of Google maps.

A comparison of the time slots by Google maps and the designed system was done whereas the actual time taken was also measured in order for the verification of the results.

Importantly, this system would provide novel experience, since there are no other systems presently available in Sri Lanka of this caliber. This method is also assistive to minimize the traffic congestion as this reduces vehicles being driven to already congested areas & could be applied to take the initiative in controlling traffic jams in other parts of Colombo and as well as other urban areas of the country.

1.0 INTRODUCTION

As far as Sri Lanka is concerned, traffic congestions are mainly seen in Colombo. It is the business capital of the island. The highest number of vehicles are operated within this city than any other city in the country. Many firms, factories, companies, leading schools & hospitals are located and as a reason a high percentage of the working crowd is based in Colombo. The two major factors affecting traffic in Colombo is the work force and school traffic. In general, Colombo offers much more facilities to the citizens in commercial, political activities and in education that people are attracted significantly than to any other city in Sri Lanka.

Traffic congestions in Colombo is a major problem Sri Lanka. It badly affects the communities within and visiting the city including job occupants, students, motorists and pedestrians etc. This negatively causes the development of the Capital and as well as the whole country. (Tourism, 2013)

1.1 Research Problem

It is time new strategies and methods are implemented to overcome this issue with the aid of novel Science and Technology. An approach to provide the citizen with traffic information would reduce issues up to some extent. Traffic is something which can't be predicted. It's heavily dynamic. Suddenly a "no traffic zone" could turn into an area of traffic jam.

"Even if you had complete knowledge of current traffic conditions and known changes (ex: road works starting or a football match finishing), there's nothing that can predict a crash or a slow truck changing route." (Russell, 2013)

Thus it would be appropriate to consider real time or near real time traffic information. In effect, a real / near real time dynamically changing traffic information system for vehicle guidance through the web, which is automated and which covers every inch of the city would be convenient, consistent and reliable. Importantly this system would be interesting and would provide novel experience, since there are no other systems presently available in Sri Lanka for real time determination of optimum route.

1.2 Main Objective

Designing an automated system, that guides vehicles on a least time consuming path, that is depicted on a Google map based web page, and which adds near real-time traffic pertaining data as a novel factor to Driving Directions provided by Google maps.

1.3 Study Area

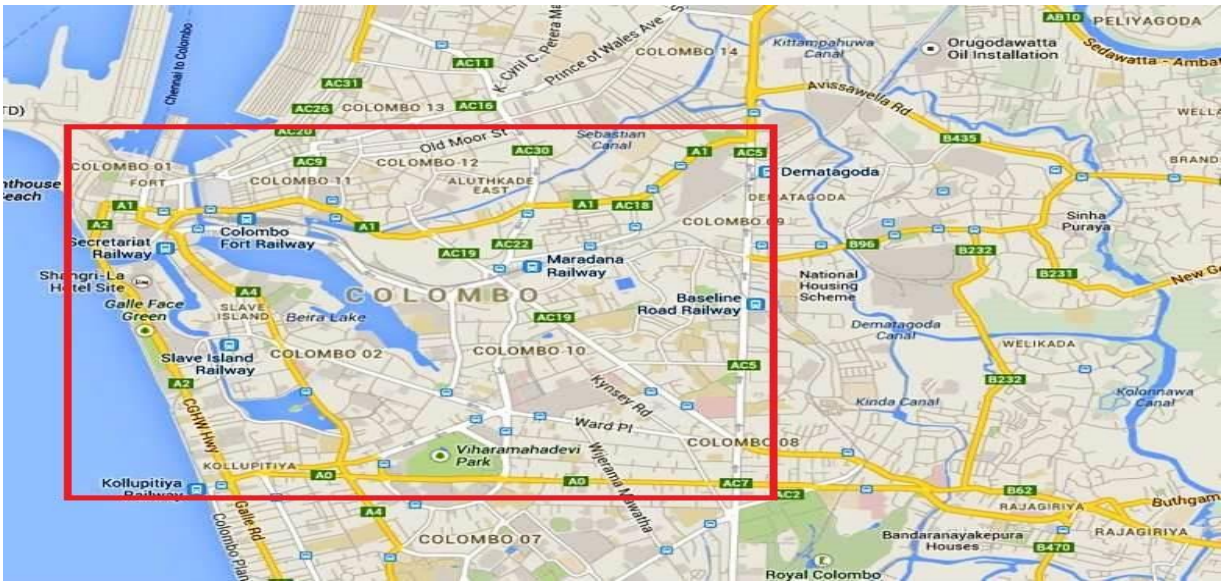

Figure 1. Study Area

(Courtesy of Google Maps)

2.0 LITERATURE

Google Maps is a desktop and mobile (on Android OS, IOS) web mapping service application and technology provided by Google. Developers can integrate Google Maps into their websites. An important feature in Google maps and its API is the "Directions" service. It uses Dijkstra's algorithm which is the algorithm for the shortest path. (Byrne, 2015). Meanwhile, Google maps also provide time durations for travelling between locations.

Generally called "ETA" (Estimated Time of Arrival). They mix data from whichever sources they have, and come up with the best prediction they can make." (Szoldra, 2013).

3.0 METHODOLOGY

Identifying Traffic Hot Spots: Sensitive locations are chosen which would have a direct impact on the traffic state which are referred to as traffic hotspots.

Identifying Factors Which Affect the Traffic Situation, And Then to Classify the Traffic Situations at Hot Spots as "High", "Medium" Or "Low": In a road network, the "factors" may include the road type, width of the roads, speed limits allowed and distance of each road segment, one ways, two ways, available U turns, intersections, junctions. All these mentioned factors contribute to the number of vehicles in particular distance, on a road. According to this factor we could conclude the state of traffic & for this proposed system, the state of traffic is categorized into 3 sections as "High", "Medium" or "Low". A hypothetical data set is used and it mentions the state of traffic as "H" (high), "M" (Medium) or "L" (Low). According to (contributors, Traffic flow, 2015)**,** with the average number of vehicles that occupy one mile or one kilometer of road space, expressed in vehicles per mile or per kilometer, it was decided to categorize the traffic state as;

H- if the traffic flow is completely stopped.

M - if 12–30 vehicles per kilometer.

L- if less than 12 vehicles kilometer.

Interface Designing and Web Implementation:

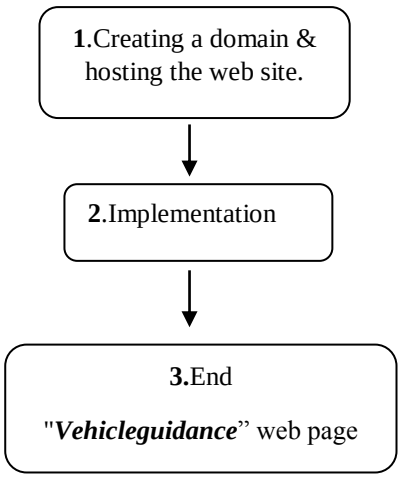

Figure 2. Flow Chart

1.Creating A Domain & Hosting The Web Site: The free domain is created through the web site "www.dot.tk". The site is hosted free of charge through "www.1freehosting.com ".

2.Implementation: Web programming languages like HTML, JAVA script, CSS are used together with Google API V3. Traffic information (Hypothetical Data set) are uploaded to the data base and retrieved through My SQL and AJAX. The automation part is done through the web site itself which is also a crucial segment that is achieved by coding.

Automation:

- The user inputs the two nodes- the starting node and the destination, through the web page.
- Meanwhile from the identified hot spots, the near real time or real time dynamically changing traffic information (Hypothetical data) will be uploaded to the data base.
- Then all the routes which could be used to travel between the two nodes will be found out.
- Subsequently for each route, time based values will be applied to the near real time traffic information pertaining to that route and added to the time of travel provided by Google API (The formed algorithm will be executed).

Calculation: For every two input nodes (Starting point, ending point), Google generates a maximum of three routes. For the calculations, the time durations generated by Google maps are taken ($\mathbf{t_i}$) and the time based values assigned for the different types of traffic states at the traffic hot spots are added. These time based values**(r)** are assigned on the basis of how long the motorist will be late in seconds, if he is caught in each type of traffic. If the traffic state is;

"H"- High; r = 100 s

"M"- Medium ; r = 20 s

"H"- Low ; r = 00 s

Let's consider one route generated by Google maps. The time duration to travel on that path is given as **(t_i).** Next, from the codes it's found out what hot spots are contained in the generated route. For those hot spots, the above mentioned values are assigned and summed up to find the delay (in seconds) created by the traffic. Then for this summed up value **($\sum$ r)**, the time duration given by Google maps **(ti)** is added. Finally, the total time (**T_i)** will be;

(1) $T_i = ti + \sum r$ (seconds)

So this calculation is done for all the routes generated by the Google API and the path with the lowest T_i which is the least time consuming path will be determined.

- Then the Google API will be commanded to depict the path on a Google map in dark black colour on the Google map. But at the same time, the user is also given the privilege of viewing the other routes produced by the Google API (routes with light blue colour) as well, if available.

3.Final Web Page: At the end of coding, which is done simultaneously with testing and debugging, the final web page will be created.

Validating The System: This consists of two sub sections.

I. Comparing the results generated by Google maps and the proposed system.
II. Field verification of the results, generated by the proposed system.

Table 1. Field Verification.

Route	From	To	Hot spots(Number-Traffic state)			Google API		Designed System		Actual	
						Distance (km)	Time	Distance (km)	Time	Distance (km)	Time
1	Indo Ceylon	De Soysa St	2-L	17-L		2.3	6m 54s	2.3	6m 54s	2.4	7m 45s
2	De Soya St	Baladaksha Mw	15-L	14-L		1.8	4m 1s	1.8	4m 1s	1.8	4m 10s
3	Baladaskha Mw	Public Library	1-L	2-M		3.2	8m 3s	3.2	8m 23s	3.9	8m 5s
4	Public Library	De Soyza St	3-L	2-M	17-M	1.9	5m 57s	1.9	6m 37s	2.0	8m 20s
5	Junc: Near the square water body	Club Maya at ice	16-L	18-M	19-M	3.1	10m 27s	3.1	12m 27s	3.5	12m
6	Go Nuts with Donuts	Oppoiste of Maradana Police St.	4-H	21-H		2.5	10m 52s	2.5	14m 12s	2.45	14m 6s
7	Opposite of Maradana Police St	Town Hall	20-M	19-M		2	7m 4s	2	7m 44s	2.29	16m 2s
8	Town Hall	Indra Traders	3-L	2-H		1.7	4m 54s	1.7	6m 34s	1.55	5m 4s
9	Indra Traders	BOC ATM	17-L	15-L	14-L	2.8	7m 34s	2.8	7m 34s	2.9	7m 2s

H - High traffic M - Medium traffic L - Low traffic

Hot spot number – the number which was assigned to identify the hot spot selected for the task

I. **Comparing The Results Generated by Google Maps and The Proposed System:** The directions generated by Google maps and the proposed system are exactly the same and it should be, as the proposed system calls for directions through the Google API. In both the systems, distance between the starting and the ending node are same but differs in time duration. As per the Table 1, the only occasion where time duration of both the systems equals is when the all traffic hot spots of a particular route becomes "Low"(L) where the assigned time based value for “L" is 0 seconds (For instance Route1,2 and 9). In all the other occasions the proposed system generates higher values for time duration when compared with the results of Google maps and it should be, as the proposed system considers traffic states on the routes while assigning time based values for them.

II. **Field Verification of the Results, generated by The Proposed System:** When we study the Table 1, we see that the actual time duration differs from the time duration calculated by the proposed system. The main reason might be because all the traffic hot spots were not selected. Also assigning weights (time based values) for the traffic states should be done consulting experts and it would produce much authentic and acceptable results. Thus the prevailing time based values should be changed accordingly.

3.1 Materials

Software: Notepad++

Languages: HTML, Java Script, CSS, AJAX, My SQL, Google API V3

4.0 RESULTS

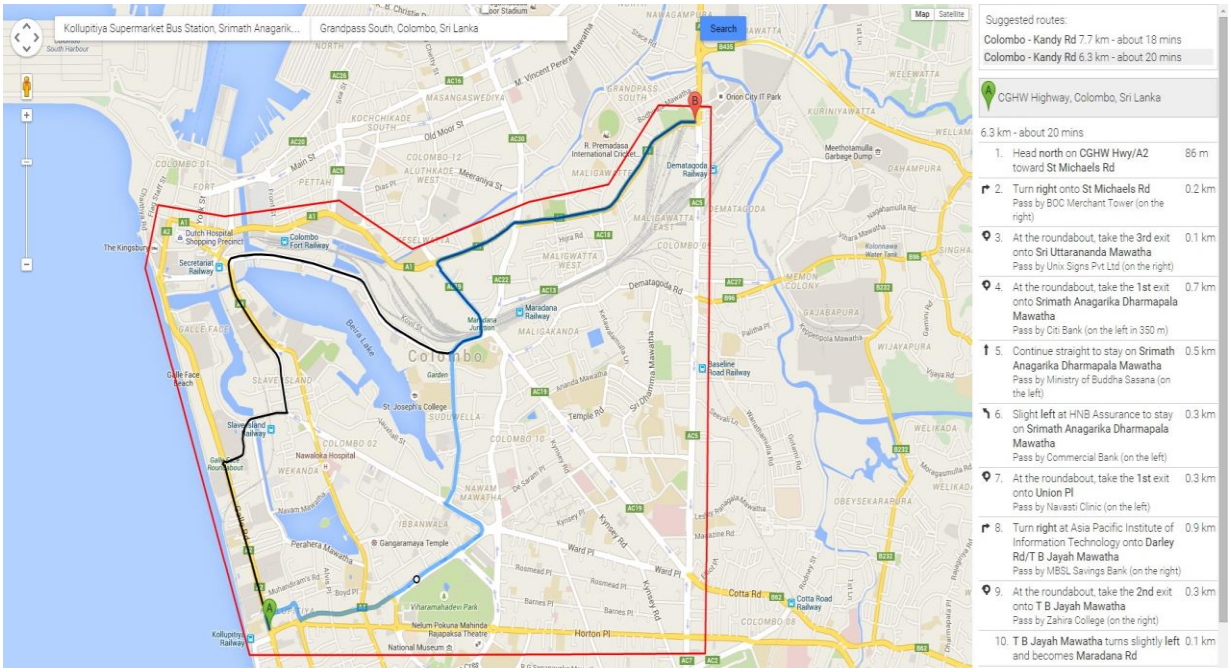

Figure 2. Final Web Page

(Red line indicates the study area.)

Available Facilities:

1. When entering locations by the names of places, this system provides suggestions of the place names when part of the place name is entered. Facility for auto completion of the place names is also added.
2. Mouse click is also applicable in entering locations. Geocoding capability is also available.
3. In the above 1&2 cases, when one node is entered, that particular place is focused with a marker on that place, regardless of whether it's a mouse click or a place name insertion.
4. Dragging the map by clicking, for viewing requirements is another important feature. The mouse click for this particular operation does not fill the blanks allocated for inserting nodes.
5. In the final output, the Black or the dark Blue route reflects the least time consuming route, whereas the other routes generated by Google API are given in light blue colour if such optional routes are available.
6. Optional routes could be selected as per the wish, using the panel on the right side of the web page. This panel includes the least time consuming path as well and all the route details with their turning points. Thus all the routes could be viewed and examined by a simple mouse click on the name corresponding to the route, on the panel.

5.0 CONCLUSION

1. As per the expertise, hot spots could generally be selected; near schools, at road junctions (near colour lights), near city access road points etc.

2. The Google API generates normally 3 routes. In calculations, the final weighted values for those routes are compared. As the final value, we take the time slot of each route given by the Google API plus the time based values of the hot spots contained by each route. For each route the sum of the time based values of traffic hotspots are introduced as a correction for the Google API's time duration. Based on the corrected time slots by traffic hot spot information, the least time consuming path is determined.
3. The path is selected based on the "lowest time consumption". Cause if the shortest path is selected, it might sometimes be better off taking a longer distant route, to reach the destination in shorter period due to mainly less traffic jams. Thus understanding this issue is critical.
4. Traffic data gathering could be automated. Even in this system we can make provisions for uploading data to the system by general public.
5. The real / near real time traffic information could be gathered using video cameras fixed at the hot spots. Using neural networks, in real time the videos could be processed and could find out the speeds of the vehicles. The speeds imply the state of the traffic.

   Real/near real time satellite image processing approach with the use of neural networks is also applicable for this matter where as when coded properly it will also give the speed of vehicles.

6. Real/near real time traffic data gathering through mobile network service providing companies could also be applied. Those companies have information about where its clients are (by tracking the mobile). So from that, the distance which the client had travelled in the considered time slot, could be easily determined and subsequently the speed of the client can be calculated. The speed reflects the traffic state. So from this basic idea and if we could get access to that information from mobile network companies, real time traffic data collection will not be an issue.

   "When we combine your speed with the speed of other phones on the road, across thousands of phones moving around a city at any given time, we can get a pretty good picture of live traffic conditions," wrote Dave Barth, product manager for Google Maps." (Szoldra, 2013)
7. This proposed solution could be used to take the initiative in controlling traffic jams in other parts of Colombo as well as other urban areas of the country if the system is expanded island wide. If so any person using the web site could find out the least time consuming path to reach their destination. Containment of traffic congestions in some amount would result in saving of man hours, less vehicle and fuel usage (less vehicle cost), control in road accidents etc.

8. The system could be implemented to consider different types of vehicles (Dual purpose, 3 wheelers, heavy, etc.). Should give the user the privilege of selecting what type of vehicle he is using since some roads might have restrictions for particular types of vehicles.
9. Giving the user the option of opting whether he wants the least time consuming path or least cost path or shortest path etc. would be interesting.
10. The capability of selecting way points can be considered in the future development.
11. Even though the routes are generated, their traffic conditions could change in the next few minutes. Then the initially produced least time consuming path would have to be altered. So as a solution, we need to upgrade this system so that it takes real time traffic data regularly and updates the directions and displays while keeping

the initially generated directions. Then the user could opt the newly generated routes or could stay with the initial results of the web page.

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