Public Transport Information System for Chennai city using GIS - A Pilot Project

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Abstract:

A Transportation System is the lifeline of any country. Life would come to a standstill without a proper and effectual transportation system be it Railways, Roadways or Airways. A Public Transport Information System seeks to provide people, especially the traveling community access to information, which would allow them to choose the optimal route and at the same time effectively manage time. Hence, the authors envisage a need for an Information System based on a GIS to provide information for the public who use the public transport system. A pilot project was undertaken for the same in Chennai City. The Public Transport chosen for the project was the MTC (Metropolitan Transport Corporation) bus transport system, which is the heavily used transport system in Chennai. During the course of the pilot project, it was found that the algorithm was the major hurdle and it has been implemented successfully in this pilot project. Thus, the algorithm forms the focus of this entire paper.

1. Introduction

The current fast pace of life around the globe demands an effective, fast and reliable Public Transportation System. This system has become indispensable for the people. It is just not enough to have an efficient, effectual or an unswerving Public Transportation System, but in a huge city like Chennai it is also imperative that the commuter knows which bus he should take to his destination. So, the need of the hour is an Information system – A Public Transport Information System. The tech savvy public, have become heavily dependent on such systems, which would allow access to information at the click of a mouse. It puts an end to the various hassles which commuters face en route to a new place.

Not every one of us may know almost all the bus routes that are available, but, if a necessity arises to travel to a new place, it is customary that someone in the boarding place comes to the rescue or the guide map guides us to the destination. Hence it augurs well for the development of a Public Transport Information System, which would provide the following,

i) Timings/frequency of the various buses,
ii) Buses connecting various places of interest to the commuters, from their place of boarding,
iii) Buses connecting places of tourist interest from the commuters' boarding place, and
iv) Shortest possible route for the commuter with respect to time and/or distance.

2. Study area description and data used:

The study area (routes) taken for this pilot project was (were) from Vadapalani bus terminus to five termini. They were Parys, Vallalar Nagar, Beasant Nagar, Triplicane and Foreshore estate. The routes were so chosen that they tested the algorithm for its fullest capabilities and represented all the needs of the information system.

S.NO.	BUS NO.	FROM-TO
1	5E	Vadapalani --Beasant Nagar
2	12B	Vadapalani – Foreshore Estate
3	17, 17M (Cut) & 17C	Vadapalani – Parys
4	25	Vadapalani – Triplicane
5	37	Vadapalani – Vallalar Nagar

Table 1: Bus routes selected for the project

The data used for the pilot study was the TTK Chennai City guide map, at a scale of 1:25,000. The map was scanned using an A0 scanner for the purpose of onscreen digitization. A handheld GPS, Trimble Scout guide model was used for the acquisition of the control points- to geocode the scanned map, and the co-ordinates of each bus stop and the termini along the routes.

3. Methodology

The study "routes" for the project were those from the Vadapalani bus terminus in West Chennai. This terminus served as the nodal terminus from which routes to five other termini were selected. The hub of the project is the development of the algorithm to obtain the shortest or optimal route of travel for the commuter. The eventual outcome from the algorithm is a graphical output in the form of a map for the information required.

3.1 FIELDWORK

The data required by an information system has to be inexhaustible but with its own limitations. Hence, the data collected for this purpose was extensive. First of all, the various bus stops on each of the five routes were identified. This was done, by traveling along each of the five routes. Both the to and fro routes had to be traversed as the bus routes in both the cases differed due to one way roads. Other information collected were the one or two nature of the road, important landmarks for the bus stops and the total time for the journey (the latter may vary depending on the hour of the day). The information collected was then stored in the database and used for further analysis.

Any GIS demands known and well-defined coordinates without which no analysis can proceed. Keeping this fact in mind, the authors collected the geographical coordinates of seven precise control points using the hand-held Global Positioning System (GPS). In addition, the GPS was used to collect the geographical coordinates of individual bus stops for each of the five routes. Where there was much obstruction at the bus stop, a nearby spot was chosen and the corresponding geographical coordinates were recorded.

The fieldwork was followed by on screen digitization of the road map of Chennai city. The TTK Chennai city guide map was made use of from which the roads were extracted. The road map was scanned and on screen, digitization performed using ArcView. Then the road theme was transformed to GPS co-ordinates with the help of control point data taken using the hand-held GPS. Then bus stop point data was extracted using the road theme.

3.2 Algorithm

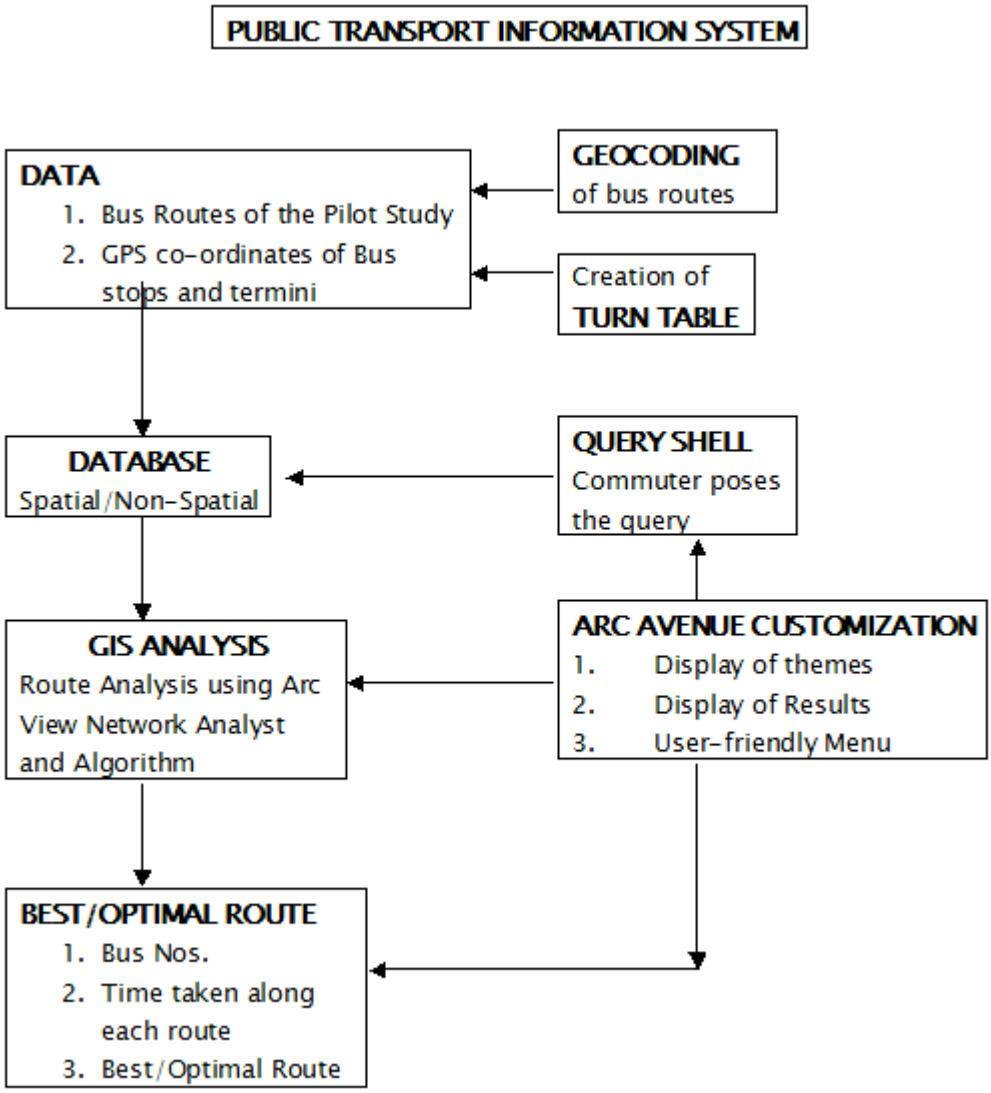
Optimal Routing is the process of delineating the best route to get from one location to another. The "best route" could be the shortest, the quickest or the most aesthetic, depending on the GIS user's preference for defining "best". In our case, we define the "best" route, which takes the shortest time with minimum number of transit points.

As already stated, the algorithm is the essence of the project. Using the algorithm, which is being written in Arc Avenue the bus routes are analyzed for

1. Optimal route of the available routes between the point of boarding and destination.
2. Comparison of direct routes with transit routes for evaluating the travel time of the optimal route.
3. Comparison of time of travel with frequency and timing of the buses to arrive at the optimal route.

The algorithm considers the following parameters

a. Time of travel from place of boarding to destination, that is, time as an impedance
b. One or Two way nature of the road
c. Minimum number of transit stops – limited to one
d. Frequency of the buses



The algorithm proceeds as follows

i. Consider the place of boarding and destination of the commuter.
ii. Traverse along the routes to obtain all possible paths of travel for the commuter.
iii. Take one route at a time
iv. Take up all the bus numbers, already in the database, and go comparing with bus numbers to find the ones, which travel from the place of boarding to a particular bus stop along the selected route.
v. Eliminate the bus numbers, which do not travel up to that particular bus stop.
vi. Proceed in the same manner for the various bus stops until the destination is reached or all the bus numbers are exhausted.
vii. If the destination is reached, retain the route and the corresponding bus number.
viii. If the destination is not reached and the bus numbers are also exhausted, consider the bus stop as the first transit point
ix. The algorithm is such that it allows for a maximum of one transit point.

x. From the transit point to the destination, obtain the bus numbers in the above fashion.
xi. Retain the routes with a transit point also.
xii. To select the best route with time as impedance, the total travel time is determined to obtain the "best route", as the one that takes the minimum time.
xiii. The "best route" could be the one with a transit point or it could be a direct route from the place of boarding to the destination.
xiv. If there is only one bus route with as many number transit routes then that is given as the best route.

3.3 Customization using Arc Avenue

Customization is the process of adapting and extending the basic GIS product to the specific application requirements, and using the GIS to create an empty database with a suitable structure to support those requirements.

Avenue will be used to customize the way ArcView works for the public, to enable easy and correct user input. The algorithm is only the way the information system functions, but for user input the Public Transport Information System looks towards customization. . Some new tools can be added to get input. This would enable the public to just key in the source and destination. The output would be the desirable route or rather to say the optimal route with the time taken.

4. Results

The algorithm was introduced into the GIS using Arc Avenue Script. The impedance for the various routes was given based on the average velocities of the roads along each route. The best route was found out based on the travel time taken and frequency of the bus. With the authors being conversant with the bus routes chosen for the study, the results were predetermined. The routes for which the algorithm was applied were Vadapalani to Parys and Vadapalani to Thiruvanmiyur. While the former was chosen for the normal direct route, the latter was selected for the transit route comparison. The results were found to be consistent with the expected results.

5. Conclusion

The algorithm, which has been the focus of this entire paper, has thus been validated for the obstacles that were being considered critical, by the authors. Further, with the results being fruitful, it augurs well for the GIS based information system's implementation in Chennai city.

6. Scope of the Project

The scope of the project

a) Addresses of the households when integrated to the database of the Bus Information System, then address matching can be performed which will be of much more use.
b) Touch screen facilities at all bus terminuses and at important bus stops can be set up for the utilization at the terminus or bus stop itself.
c) Bus route optimization and bus stop reallocation can be best studied with the output of the project.

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