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Traffic State Estimation for Urban Vehicle Tracking

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***Abstract*— Vehicle tracking is an effective approach to built-up traffic flow estimation. Founded on the data of GIS and GPS, a Vehicle Tracking method constantly referees, from a street network, the most reliable path between every two successively noticed positions of a certain vehicle, and then connections the routes to refurbish the genuine track. Conventional works focused mostly on the going by car expanse and chosen the shortest path as the answer. As in numerous positions, the shortest route is not inevitably the best alternative. Rather than, a route with the least time cost may be more sensible. Thus, a new hybrid real-time Vehicle Tracking procedure is proposed in this paper contemplating comprehensively two major time-costing factors, the total going by car distance and the number of traversed crossroads. Dijkstra's algorithm will be used to find out shortest path among possible path from one source to respected destination and at same time Pareto Frontier techniques will used to consider calculated time for shortest path. With the use of this two techniques ultimately achieve the shortest path within shortest time, which will improved traffic state.**

***Index Terms*— Coordinate transformation, Dijkstra's algorithm, GIS-T digital map, Global Positioning System (GPS) probe vehicle, large-scale road network, Pareto Frontier, traffic state estimation.**

I. INTRODUCTION

A vehicle tracking system combines the use of automatic vehicle location in individual vehicles with software that collects these fleet data for a comprehensive picture of vehicle locations. Modern vehicle tracking systems commonly use GPS or GLONASS technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. Vehicle information can be viewed on electronic maps via the Internet or specialized software. Urban public transit authorities are an increasingly common user of vehicle tracking systems, particularly in large cities. There is some self-diagnosing smart main road surveillance scheme and conceive productive answers for traffic surveillance. The data collection method uses GPS receivers to mechanically assemble time, local coordinates, and speed at normal sampling time span, for demonstration every one second. This paper suggests a systematic answer to explain the difficulty of real-time traffic state estimation for large-scale built-up street networks by utilizing a large number of GPS probe vehicles.

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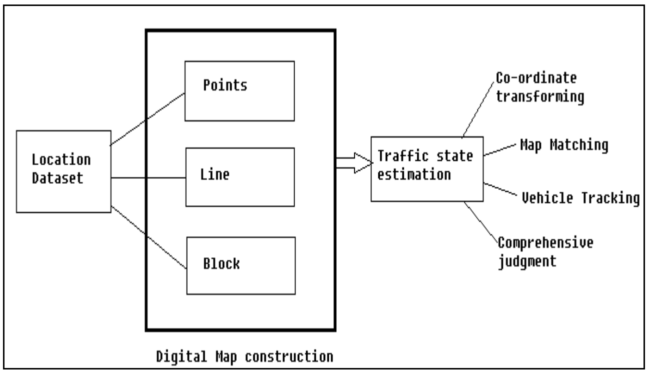
In this paper by doing combination of different algorithm traffic state will be establishes. The details of these techniques are discussed in further sections.
In next section II, the Architecture and Implementation is depicted. In section III we are presenting the current state of implementation and results achieved. Finally conclusion and future work is predicted in section IV.

II. ARCHITECTURE AND IMPLEMENTATION

A. Architecture



There are two main parts:
1. The digital map construction
2. Traffic state estimation of urban traffic states

B. Digital Map Construction

For the first part, the accuracy of the digital Map that was used in is further improved to reduce the systematic errors, and the map data structures are reconstructed to make the estimation system more efficiently operate. For constructing this map we consider three points Point, Line & Block.

Point denotes location that is particular longitude and latitude. Line consists of distance between two points and Block denotes green places etc

C. Traffic state estimation

This part includes following steps:
1. The coordinate-transforming algorithm: convert 3D map to 2D format
2. The map-matching algorithm
3. The Vehicle tracking.
4. Comprehensive Judgment.

Coordinate-transforming algorithm and map matching algorithm are used for generating map and displaying vehicles on generated map.

For Vehicle tracking and Comprehensive judgment, path finding algorithm and Pareto Frontier techniques are used.

Djikstra's algorithm solves the problem of finding the shortest path from a point in a graph (the source) to a destination. It turns out that one can find the shortest paths from a given source to all points in a graph in the same time; hence this problem is sometimes called the single-source shortest paths problem.

How Dijkstra's algorithms work? It can be easily understand by example, suppose one would like to find the shortest path between two intersections on a city map, a starting point and a destination. The order is conceptually simple: to start, mark the distance to every intersection on the map with infinity. This is done not to imply there is an infinite distance, but to note that intersection has not yet been visited; some variants of this method simply leave the intersection unlabeled. Now, at each iteration, select a current intersection. For the first iteration, the current intersection will be the starting point and the distance to it (the intersection's label) will be zero. For subsequent iterations (after the first), the current intersection will be the closest unvisited intersection to the starting point—this will be easy to find.

The reason behind to use of Dijkstra's algorithm is that it gives shortest path between source and destination from several possible path. The drawback of this algorithm is that one never knows about time taken by given shortest path.

Mean though Dijkstra's algorithm gives minimal path but these paths have number of cross lines then there is no use of this shortest path. To overcome this drawback and to keep balance between time and distance Pareto Frontier techniques will be used.

D. Pareto Efficiency Or Pareto Optimality

Pareto efficiency, or Pareto optimality, is a state of allocation of resources in which it is impossible to make any one individual better off without making at least one individual worse off is called a Pareto improvement. An allocation is defined as "Pareto efficient" or "Pareto optimal" when no further Pareto improvements can be made.

Pareto Frontier techniques are used to maintain the balance between time and distance. In short with the help of these techniques path form source to destination within short distance and short time is calculated.

Pareto Frontier's another parameter Time is calculated by considering factors like vehicle speed, road average speed & traffic on road.

Combining both path finding algorithm and Pareto algorithm traffic state is calculated.

III. PRACTICAL RESULTS AND EVIRONMENT

In this section we are presenting practical environment, dataset used, and metrics computed.

A. Input Dataset

For input data we take each vehicle's location.ie by which direction vehicle is going on. All points are in the form of x-axis, and y-axis.

B. Results Achieved

In below figure 2, result showing for finding shortest distance path from V0 to V12 using Dijkstra's and A star algorithm and in figure 3, result showing for Pareto frontier algorithm for finding shortest path which considers both time to travel and distance parameter.

Figure 2: Showing result for finding shortest path using Dijkstra's & A-star algorithm

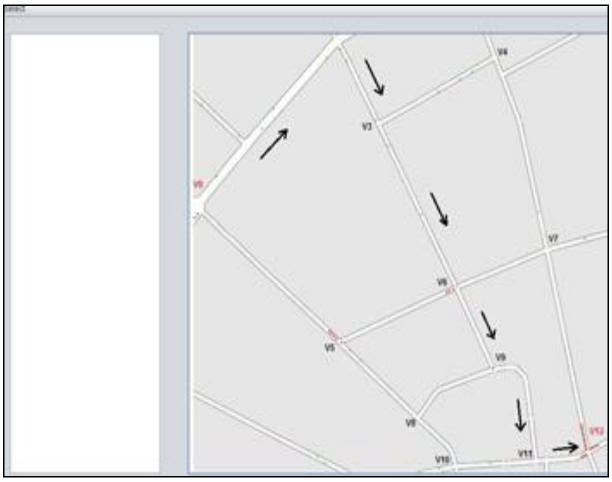


Figure 3: Showing result for finding shortest path using Pareto Frontier

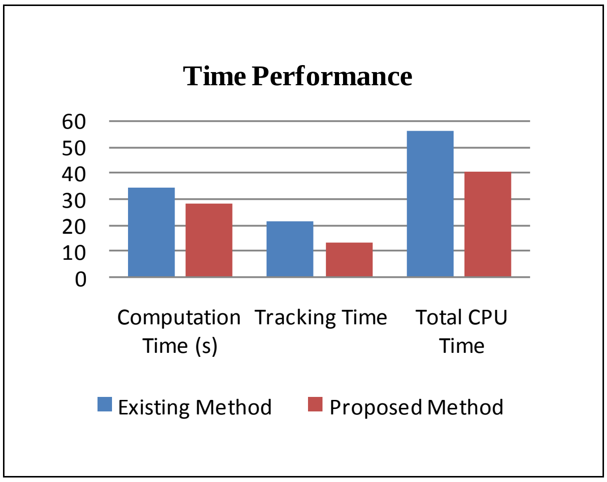


Figure 4: Time Performance Analysis

In above figure 4, the result showing that effective performance of proposed method for traffic state estimation under large scale city roads. In below figure 5 we are estimating the accuracy of both existing and proposed method. From this figure the accuracy of proposed method outperforming existing method.

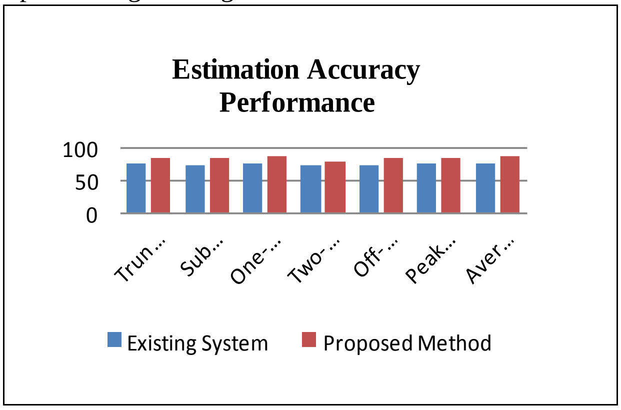


Figure 5: Performance of Accuracy of Traffic estimation

IV. Conclusions

The task offered a productive and efficient solution on how we can estimate the traffic states of large-scale urban road systems with a large number of GPS probe vehicles using Pareto opportunity methods. This answer encompasses a building procedure of the accurate digital map for the traffic state supervising system and a set of traffic state estimation algorithms. This set of algorithms consists of the methods of coordinate transformation, map matching, and mean-speed estimation. In the proposed answer, many efforts are presented on advancing the accuracy and the procedure speed of the estimation algorithm. With help of Dijkstra's algorithm we get possible minimal outcomes and at same time Pareto Frontier gives approx time taken by each outcome. At the end it will gives efficient solution to deal with the obligation of real-time traffic state monitoring in large-scale urban street networks. From the results presented above, it is showing that proposed method for traffic state estimation outperforming the existing methods in many ways.

V. Future Scope

Deploy this implementation under complex real time settings and observe its performances.

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