ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

Least-Congested Route Estimation Using GPS Equipped Vehicles in Urban Road Networks

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ABSTRACT: Vehicle traffic is increasing in urban areas ,so to overcome this traffic modern techniques are introduced and is helps peoples to get least route to reach their destination Modern vehicle tracking system use GPS technology for locating the vehicle. This our project presents an e cient technique to estimate the least congested route from source to destination in large urban road networks. This concept is based on GPS base stations which are equipped with tracking software and geographical map useful for determining vehicle location. The source-to-destination least-congested route is estimated by making communication among the servers attached to various base stations in the city.

KEYWORDS: Base Station, Global Positioning System (GPS) Probe Vehicles, Route Estimation, Traffic State Estimation

I. INTRODUCTION

In recent years, many advanced sensor techniques have been adopted to collect real-time traffic information, such as loop detectors, Global Positioning System (GPS) probe vehicles, cameras, cell networks and magnetic sensors .These sensor techniques all bear their advantages and disadvantages; they are thereby applied according to the different environment requirements. A variety of sensors may be accustomed to get traffic data. GPS receivers are used within vehicles and periodically transmit data like vehicle's location and speed, in conjunction with the associated GPS time, to a central system. A GPS-based vehicle tracking system will inform where your vehicle is and where it has been, how long it has been. The system uses geographic position and time information from the Global Positioning Satellites.

A systematic solution to efficiently estimate the traffic state of large-scale urban road networks is presented in [1]. In this paper a new approach is used to construct the exact GIS-T digital map. Then, two effective methods basedon GPS probe vehicles for the traffic state estimation are presented: 1) the curve-fitting-based method and 2) the vehicle-tracking-based method. An information-fusion-based technique for the estimation of urban traffic states is proposed in [2].The approach can fuse online data from underground loop detectors and global positioning system (GPS)-equipped probe vehicles to more accurately and completely obtain traffic state estimation than using either of them alone. Some large-scale field-testing results of real-time freeway network traffic surveillance tool have recently been developed to enable a number of real-time traffic surveillance tasks. [3] Introduces the related network traffic flow model and the approaches employed to traffic state estimation, traffic state prediction, and incident alarm**.** To estimate and predict traffic conditions in arterial networks using probe data have proven to be a substantial challenge. R. [4] proposes a probabilistic modeling framework for estimating and predicting arterial travel time distributions using sparsely observed probe vehicles.

An application of the Sequential Monte Carlo which will help to improve the accuracy of travel time estimations in historical data is presented in [5]. Estimation filter is relay on the Monte Carlo Method and was modeled in such a way that it will be applicable to new kind of information in order to estimate travel time per section of road. A signal process approach is planned to collectively filter and fuse spatially indexed measurements captured from several vehicles in [6]. Measurements from affordable vehicle-mounted sensors (e.g., accelerometers and world Positioning System (GPS) receivers) square measure properly combined to provide higher quality road roughness information for cost-efficient paved surface condition observance. Period GPS location knowledge is collected to implement the

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vehicle pursuit algorithmic program throughout the urban GIS network. Average velocities on these tracks are calculated and distributed proportionately in [7]. By integration the speed contributions on every road link, traffic states are finally calculable on rolling time periods. In order to estimate the state of urban traffic flow, a Probe-Vehicle-Tracking based technique is projected by [8] [9]. The tactic collects traffic flow information with international Positioning System (GPS)-equipped taxies and introduces the Curve-Fitting Estimation Model (CFEM) [9], which is one of the typical methods using GPS data to estimate the traffic flow state.

In this paper, we propose an algorithm for route estimation as per traffic on roads. This algorithm provides least-congested route from source to destination to the driver before he leaves from the source. The concept presented is based on the base stations which receive precise coordinates of the GPS vehicles which might be utilized in personal computers for process. Each base station receives coordinates of every GPS vehicle. With every base station we are attaching a server and a database as shown in Fig.1. **Fig.1**

Fig.1: Base station attached with server and database

Base stations are equipped with tracking software and geographic map useful for determining the vehicle location. Maps of every city and landmarks are available in the based station that has an in-built Web Server. The position information or the coordinates of each visiting points are stored in a database, which later can be viewed in a display screen using digital maps. However, the users have to connect themselves to the web server with the respective vehicle ID stored in the database and only then s/he can view the
location of vehicle traveled. In section II, the proposed approach and its system architecture diagram is depicted. In section III, we are presenting the implementation and results achieved.

II . PROPOSED ARCHITECTURE

The basic concept used in this paper is to provide a least-congested route to the driver when he starts from the source. The inputs which he enters in his GPS receiver of the vehicle are source (from where he leaves) and the destination. Based on these inputs, the system estimates the traffic on the route. **Fig.2:**

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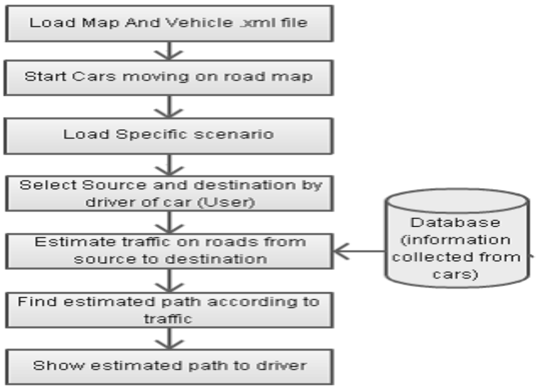

Fig.2: System Architecture

In Fig.2 ,it is shown that map of the city and the vehicle coordinates are loaded. As soon as the driver enters the source and destination ,this request is sent to the nearest base station's server. Then according to the requested route this server will search for other base stations required to estimate the traffic in this route. And also sends the request to other base stations to reply the status of vehicles along the route which are moving under their range. As each base station holds the latest status of the vehicles(in its range) in the database, this information can be immediately sent to the first server by other servers. Based on the information collected by first server, it will show the status of traffic with different colours in the GPS receiver of the vehicle.

Vehicles status in the database:-

As the vehicles move, their latest coordinatesare received by base stations. This information is stored and processed in the database immediately. The database will hold the information such as Base- station-code, vehicle_id, Coordinates and the status-code of the vehicles. Base-station-code is required because a number of base stations have to be mounted just like mobile-phone towers. This is because each base station has a particular range to get vehicle's coordinates. This range may be between 2-4 miles (3-7 kms) depending on the type of base station used. The status-code of the vehicle represents whether the speed of the vehicle is good, slow or it is stuck in the traffic (i.e. stopped). This code is updated depending on the coordinates of the vehicle along a particular road. If server finds in the database that several of the vehicles coordinates don't seem to be moving in any respect for few min (eg:3 min) then it means there is a traffic congestion and status code will be set to 0. If the status code is set to 1 then it represents that the coordinates of particular vehicle is changing continuously and it's in moving state. If many vehicles are finding traffic and there coordinates are not changing continuously or smoothly but they are in moving condition then the status code of these vehicles will be changed to -1 as shown in Fig.3.

Each base station will hold the information of the vehicles which are moving under its range as well as it will also hold the information sent by other base stations. This concept is presented by the table shown in fig.3.This table shows the entries for base station2 in the database. Assume that vehicles with mentioned vehicle_ids are moving along the base station's range such as BS2, BS6 etc.In this table, the vehicles which are moving in its range are shown as well as the vehicles with BS1, BS6 and BS2 are also shown. This information is actually sent through base station1, base station 6 and base station 2 on request of base station 2.Based on the data collected by base station 2, the traffic status based on status_id(along the route) is then reflected to the GPS receivers of the vehicle. Consider base station range to be 5kms and each server stores road map of the city. If the driver asks for source ='A' and destination='B', then this request will be sent to the nearest server. As within 5kms of range of B.S., there will be many roads in different directions but this server will check the status code only those vehicles which are moving along the requested route. Also this server will pass the request to only those servers which are needed to compute the traffic along this requested route. And each server will similarly check the status of vehicles and will send back the reply to the 1st server. After getting

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replies from all the servers, the first server will send the traffic status to the driver's vehicle which is then displayed in the GPS receiver of the vehicle as:

a) Smooth run of vehicles: Green
b) Slow run of vehicles: Yellow
c) No run of vehicles (traffic Congestion): Red

Base_Station	Vehicle_id	Longitude	Latitude	Status_id
BS 2	1377524680	36.7824016846716	124.398186748847	1
BS 2	1377524680	36.3728293849389	124.349589382928	1
BS 2	1377524680	36.291828392829	124.392839448394	0
BS 2	1377524680	36.291828392829	124.392839448394	0
BS 2	1377524680	36.291828392829	124.392839448394	0
BS 2	1377524680	36.291828392829	124.392839448394	0
BS 2	1377524680	36.4989293849489	123.491384948394	-1
BS 2	1377524680	36.1039384940404	123.293941839394	-1
BS 2	1377524680	35.3949328293939	123.493938293303	-1
BS 2	1377524680	35.4939393928273	123.339494938393	-1
BS 2	1377524680	35.3927493937494	123.493474949473	-1
BS 6	1377524680	35.1029384758499	123.128364936394	-1
BS 6	1377524680	35.2938394840383	122.029374893393	-1
BS 6	1377524680	35.4938394894849	122.498349493994	1
BS 6	1377524680	34.9848494839383	122.398483948397	1
BS 6	1377524680	34.9288483738388	122.487392912304	1
BS 6	1377524680	34.3872827837403	122.39443739293	1
BS 2	1938848484	40.4928393839202	118.374549383628	-1
BS 2	1938848484	40.3843736483838	118.483937292202	-1
BS 2	1938848484	40.3928281722929	118.393392829393	-1
BS 2	1938848484	40.3827389292829	118.392839378293	-1
BS 2	1938848484	40.3949938921834	118.448728332992	-1
BS 1	1938848484	37.493934048303	120.498594839384	-1
BS 1	1938848484	37.3948575940404	120.298475894949	-1
BS 1	1938848484	38.5483928594849	121.483938412245	0
BS 1	1938848484	38.5483928594849	121.483938412245	0
BS 1	1938848484	38.5483928594849	121.483938412245	0
BS 1	1938848484	38.5483928594849	121.483938412245	0
BS 1	1938848484	39.4948593838399	121.993883748449	-1

Database: trafficestimation Table: base_station2

126 row(s) Conne

Fig.3: Status-id of Vehicles

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III.RELATED WORK

In stochastic shortest path problem, least expected travel time (LET) is often used as a routing criterion. A path is optimal if it guarantees least expected travel time. To achieve it, many researchers study this optimization problem. Hooks and Mahmassani [2] provide a thorough review and discussion on a time dependent LET path problem without waiting policy. In [3], Dean solves time-dependent LET path problem with waiting policy. Waller and Ziliaskopoulos [4] address the LET path problem considering correlation between random link travel times. The attractive finding fromLET is that the problem can be transformed into a deterministic routing problem and solved efficiently. However, a path with minimum expected travel time may still have a high variance (i.e., risk), which is undesirable for some applications.

To address the risk issue in LET criterion, Nikolova *et al.* [5], [6] propose a mean-risk model. In this model, they seek the path which minimizes the weighted combination of expected travel time and travel time standard deviation. The mean-risk model can also be solved efficiently by converting it into a deterministic shortest-path problem with respect to certain weight on each road link, which is a linear combination of corresponding mean and variance. This model alleviates the risk issue, but still has some limitations. In particular, there is no direct physical meaning of the weighted combination of expectation and standard deviation. Therefore, drivers may not be able to understand and gain actual expectation from solution of the optimization. The stochastic shortest path problem can also be formulated based on probabilistic comparison as described in [7] and [8],

where optimal path has highest probability of being faster than all alternatives. The studies conclude that it is more desirable for drivers to achieve probabilistic fastest path instead of LET path. To determine the optimal path, Sigal *et al.* [7] propose to compute for each path the probability of being faster than all alternatives. On the other hand, Fastenrath and Becker [8] iteratively perform pair comparisons until the best path is obtained. This probabilistic criterion is much more robust and reliable,but its computation complexity may become prohibitively time consuming as the road network scales up, because those solutions are derived based on enumeration. To overcome all above disadvantages, a probability tail model, which incorporates both expected travel time and reliability, is proposed as an optimal criterion in [9]. It defines the optimal path as the one that maximizes the probability of arriving at destination before deadline.

This criterion is reasonable in that it is consistent with people's travel planning behavior. One common query could be that "I want to reach hospital in 40 minutes. Please find a path with maximum chance." The key objective of routing in such a circumstance is to reduce the risk of arriving late rather than to minimize the expected travel time. Unfortunately, the solution to get such an path has not been laid out in [9]Consequently, many subsequent studies investigate this problem and various solutions have been proposed in [5],[10]–[12].

Among those solutions to the probability tail model, three seminal works are [5], [10], and [12]. An adaptivemethod is developed in [10] to achieve the maximal probability of arriving on time, which provides an optimal policy to select next road junction rather than a prior path. In that solution, a further road junction will be determined only when vehicle arrives at the preceding one, which is inconvenient and not applicable, especially for a pre-planning scenario. By contrast, the works in [5] and [12] aim to search a complete path. In [5], Nikolova *et al.* show that for a large range of deadlines, solving the problem requires maximization of a quasi-convex function over the path polytope. Due to a specific form of its quasi-convex objective, the optimal path can be obtained at an extreme point of the dominant, which is the projection of path polytope onto a two-dimensional plane. Lim *et al.* [12] propose to efficiently search the optimal path by examining probe points, which can eliminate futile searching space. This method improves the performance in terms of computation complexity comparedwith that of [5].

IV.PROPOSED ALGORITHM

1. Map and Vehicle information as input (.xml file)
2. Forming efficient map
 a. Points: Longitude and Latitude.
 b. Line: Connection to different longitude And latitude Points (roads represents connection of two points)
3. Vehicles movement is presented on road map.

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4. As cars moves on roads each car's information like (stop, fast, slow, longitude, latitude) is stored into database. For example, slow car's value is set to -1 with its vehicle_id, longitude and latitude.
5. Load particular road map scenario
   5.1. Select source and destination
   5.2. Estimate traffic by the information stored in the database.
6. Find estimated route as
   6.1. Select randomly one route from source to destination.
   6.2. Compute traffic according to data obtain from database as:
      For each route from source to destination
      For each car on route
      If status-code of car is 0 then
        Stopcount++
      If status-code of car is -1 then
        Slowcarcount++
      If status-code of car is 1 then
        Fastcarcount++
      End for
      End for
   6.3. Compute route with minimum count of stop and slow car.
7. Show estimated route to user (driver on GPS vehicle)

Section III describes the current state of implementation and results achieved. Some conclusive remarks are given in the final section.

V. SIMULATION RESULT

Input Dataset:-

For input data, we take each vehicle's location.ie by which direction vehicle is travelling. In this section we are presenting practical environment, dataset used, and metrics computed. Base Stations are assumed as they are really not mounted on the roads. We have used an XML file and a road map on which vehicles movement along different routes are shown. In this map, we have assumed that there are few base stations and the vehicles are communicating with the base stations.The coordinates of the vehicles are getting stored in the database.

Outcomes:-

Following figures are showing results for practical work done. In Fig 4, map for road is loaded. This can be done by selecting the needed XML files for map and the scenarios (i.e. to loadthe vehicles on road).After this step, the moving vehicles can be seen along the routes of the map.

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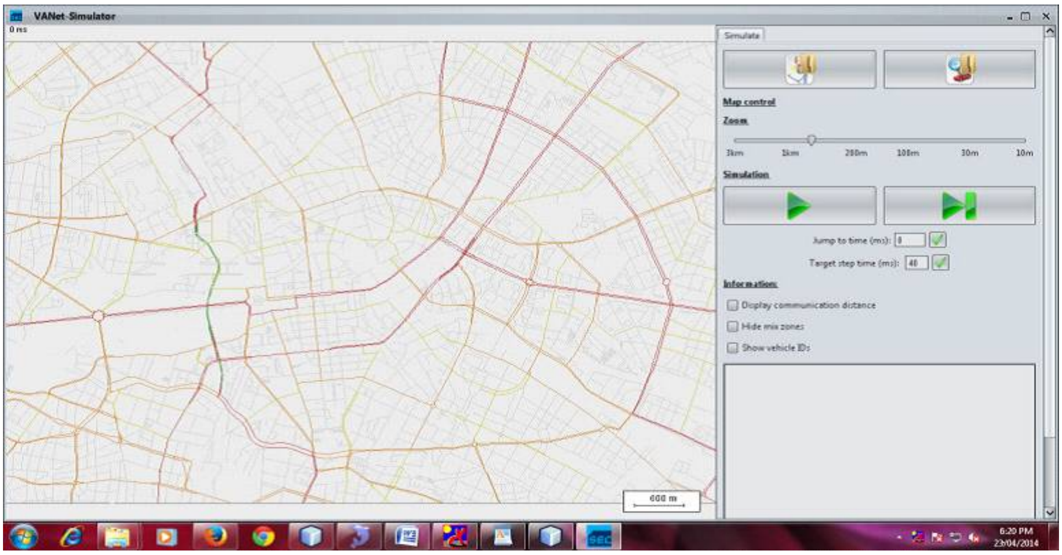

Fig.4: Maps of Roads

When any of the vehicles is clicked then a circle is drawn around it and the path is shown to its destination which contains less traffic. Fig.5 shows the moving vehicles on road and by click onvehicle its source, destination, vehicle id is displayed.

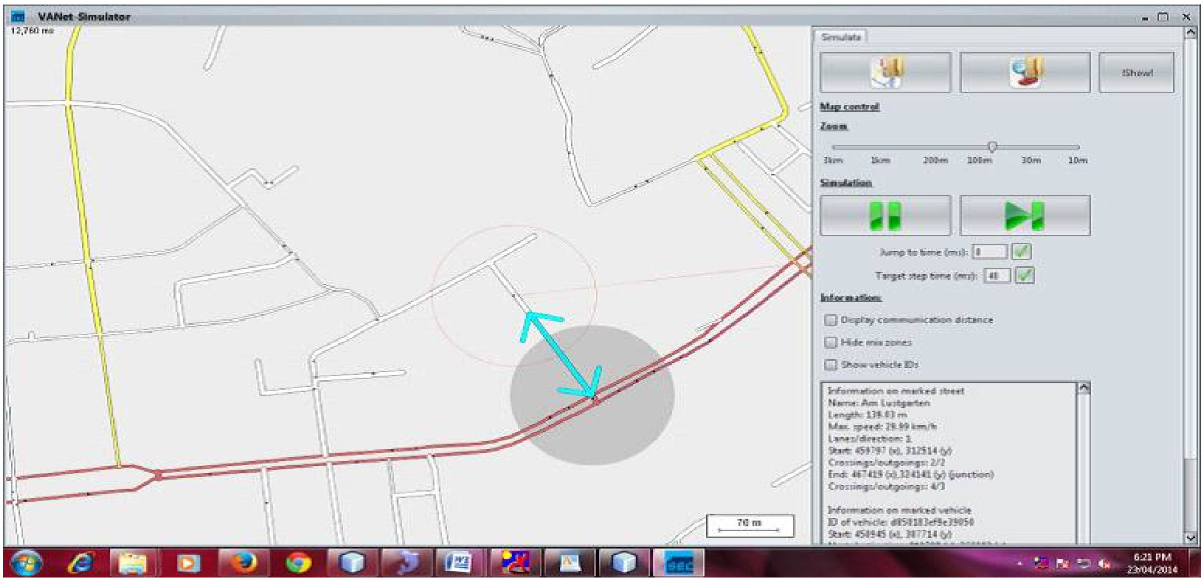

Fig.5: Vehicle moves on road.

In Fig.6, it is shown through a static diagram that what concept is basically used to estimate the least-congested route. Consider, the scenario that red dots are representing vehicles which are stuck in the traffic, yellow dots represents slow cars and good traffic flow is represented with green colour.So, if we select a source and a destination, then it shows the 'suggested route' with minimum no. of red and yellow cars.

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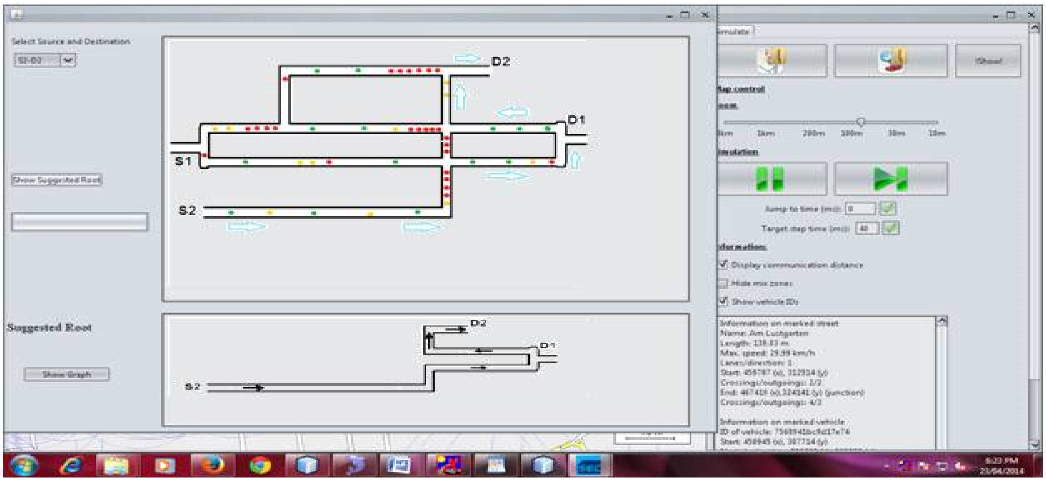

Fig.6: Suggested Route for Scenario

Based on the demand from the driver, it's shown in Fig.7 that how queries can be executed in the database. For example if we need to calculate that how many vehicles are there between, say, Longitude=35.2387463738 and Longitude =51.4874477362728 and Latitude=121.37261728 and Latitude=130.283746372 then after processing the request whose status code is -1 (slow run of vehicles) or 0(cars stopped due to traffic congestion), the output is shown in Fig.7. For this example, the output(count) for the above query is13.That means there are 13 vehicles which are either moving slow or are stopped within these coordinates.

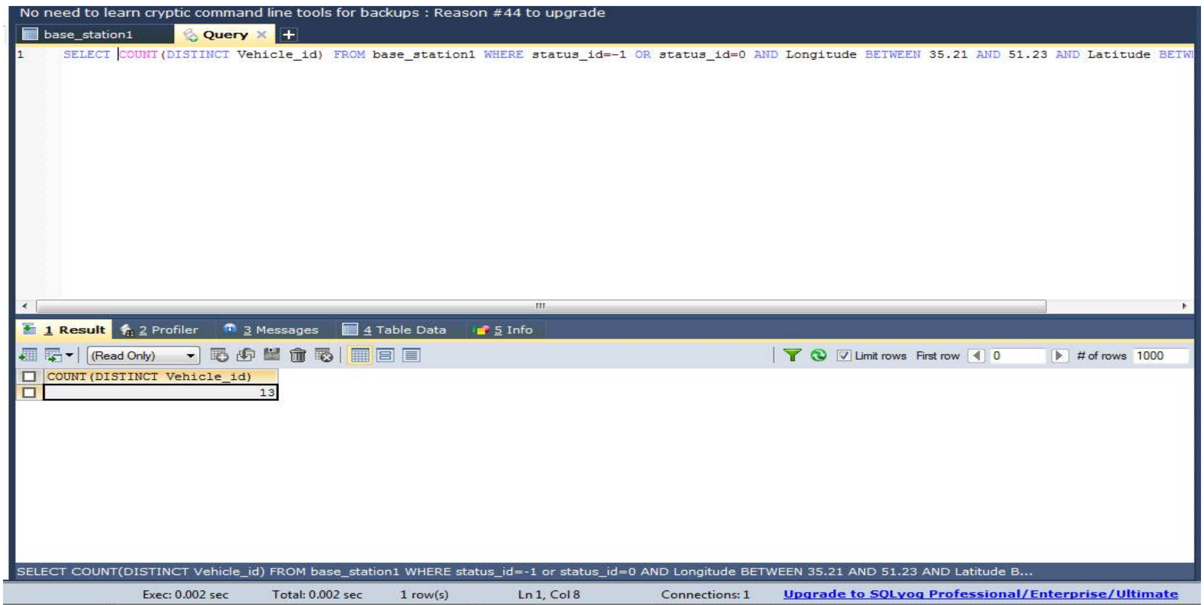

Fig.7: Example for no.of vehicles between certain coordinates

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ISSN (Print): 2320-9798

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Vol. 5, Issue 4, April 2017

As there are many base stations and with each base station there is attached a server and database in which the information of the GPS vehicles is updated immediately, it will take less time for computation. This is because each base station is holding information of the vehicles in its range and this information is sent to other base stations on their request. So, there will be no overload on any of the servers and information can be stored and retrieved immediately. And therefore accuracy will increase and computation time decreases as shown in Fig.7.

VI. CONCLUSION AND FUTURE WORK

We will conclude that an elective and efficient solution on how we can estimate the traffic status of routes from source to destination on large-scale urban road networks with an outsized variety of GPS probe vehicles. The concept is based on the base stations which receive precise coordinates of the GPS vehicles which might be utilized in personal computers for process. Each base station receives coordinates of every GPS vehicle. With every basestation we are attaching a server and a database.

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