ON-ROAD LOCALIZATION SYSTEM IN VANET USING GRID

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Abstract
GPS (Global Positioning System) is a space-based satellite navigation system that provides location information. GPS signals cannot get their location when they are inside a tunnel or where satellite signals are blocked. Modern vehicle systems commonly use GPS for tracking the vehicle. With the size of the vehicle, the signal reflection and interference problem increases, also based on the lane in which the vehicle travels, co-linearity problem arises. To address the above issues, Grid based On- Road location system is proposed. Vehicles with and without accurate GPS signals self-organize into a network called VANET (Vehicular Ad Hoc NETwork) which exchange location and distance information to calculate an accurate position of the vehicle inside the network. Grid calculation is of light- overhead and suitable for on-road real-time position evaluation. Error generated is reduced in the proposed system. Fuzzy geometric relationship among vehicles is used to formulate the grid. Based on the relationship in the grid, the vehicle locations are calculated
Keywords: VANET, localization, pattern, error, linear, grid-based.

I Introduction

A vehicular ad hoc network uses cars as mobile nodes in a MANET(Mobile Ad Hoc Networks) to create a mobile network. A VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, creates a network in a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.

GPS (Global Positioning System). GPS is a space- based satellite navigation system that provides location information. GPS also tracks the distance travelled and keeps a record of driving activity. Modern vehicle systems commonly use GPS for tracking the vehicle. First of all, because of the size of vehicles, the signal reflection and interference problem is more serious when measuring signal attenuation, and thus the calculated distance is likely to be more inaccurate. For example, to calculate the distance between two vehicles, if there is another vehicle in between, it is likely that the measured signal attenuation is inaccurate and so is the distance. Second, because of lanes, vehicles intend to drive along one line, resulting in the collinearity problem.
Although a vehicle can find three location-aware neighbors, it is likely that it still cannot calculate its location or the result is very inaccurate. Finally, some existing methods use a system of equations based on geometric relationships can work well if nodes do not need to propagate the calculated results. However, for a car inside a tunnel to calculate its location, a cascaded calculation is a must. Cars outside the tunnel help their neighbor cars which are inside the tunnel to calculate the locations. The cars with newly calculate locations, help cars further inside the tunnel to calculate their locations. In this situation, errors are propagated exponentially when using existing methods, resulting high inaccuracy. The above challenges call for a new on-road collaborative localization

system for VANETs without the help of roadside station.

II. RELATED WORK

A new localization system in VANETs, RFGPS, which exploits a RFID system [1]. It develops the mobile version of the DGPS system. RF-GPS calibrates GPS error and thus allows a vehicle to compute its accurate position. The proposed RFID- assisted localization system has been evaluated extensively via simulations and real world experiments. The results from Qual Net-based simulations showed the impact of traffic volume and speed variations on the performance of the RF-GPS system. The simulations and the real world experiments together show feasibility and performance of the proposed RF-GPS system.

VLOCI2 algorithm [2] to improve the location error of VANETs where the vehicles, traveling on a four lane highway, receive an initial inaccurate GPS coordinate and use imprecise distance measurements to their neighboring vehicles. All vehicles place themselves ineither the correct lane, or an adjacent lane, while the number of vehicles placing themselves in lanes further away does decrease as the distance measurement accuracy improves or the network density increases.

A novel method for vehicular Cooperative Positioning (CP) [3] for the functionality and performance of the method is verified. Doppler based range-rating, using DSRC packets, is tested and verified practically and the obtained statistical model is used for setting the simulation parameters. A section of a real highway is surveyed and used as a map for defining motion models for the model vehicles with different speeds. The motion models were defined for a GPS signal generator and required GPS-based positions and velocity for the CP algorithm are obtained with a real GPS receiver.

A novel approach to robust localization of a mobile beacon using TDOA measurement data [4] when no receiver positions are given. A sensor model which considers the Gaussian characteristics of the TDOA measurements at the receivers and explicitly takes into account measurement outliers for accurate and robust localization. In motion model, a continuous movement of the signal beacon, this enables a quick recovery in case of temporary signal loss

III PROPOSED METHODOLOGY

3.1 SYSTEM OVERVIEW

A proposed system is represented in figure 1. Vehicles with and without accurate GPS signal self-organize into a network called VANET (vehicular ad hoc network) which exchange location and distance information to calculate an accurate position of the vehicle inside the network. Grid calculation is of light- overhead and suitable for on-road real-time position evaluation. Each vehicle is equipped with a regular GPS handset with a preloaded map, which is already very common nowadays. When the GPS can receive signals from satellites, it provides current location information and driving direction. It may lose satellite connection in some circumstances and when this happens, the GPS obtains its location. Vehicles are equipped with a wireless card and are self-organizing into a Vehicular Ad Hoc Network and communicate with each other and can calculate distance between them by measuring received signal strength. Vehicles can find their neighbors through periodical exchange of beacon messages, which can be done efficiently.

To address the co-linearity problem, a grid-based on- road localization (GOT) system for vehicles is proposed. The grid formed using DSR routing protocol using the formula

$topo load_flatgrid
$val(x)$val(y)

The tunnel through which the vehicles move is first divided into equal spaced grids.

1) Δm, the distance measurement error,
and
2)Δc, the grid-calculation error.

For a location-unaware vehicle n1, the maximum error is calculated using the below Eqn(1).

$\Delta E1 = \Delta$��1 + Δc -----------> (1)

If n1 propagates its computed position to another location unaware vehicle n2, then the error for n2 is calculated using the below Eqn(2).

$\Delta E2 \leq (\Delta E1 + \Delta m2) + \Delta c2 = \Delta m1 + \Delta m2 + \Delta c1 + \Delta c2$----------> (2)

CBR agent is created and attached to the node and source is attached to sink. Node information has been exchanged and shared by the neighbor node. When the unknown vehicle move, the location information is passed by the known vehicle. Vehicles can find their neighbors through periodical exchange of beacon messages. Vehicles which are near to unknown vehicles alone will exchange the information. For security purpose, Vehicle which are authenticated can only be used to provide the location information.

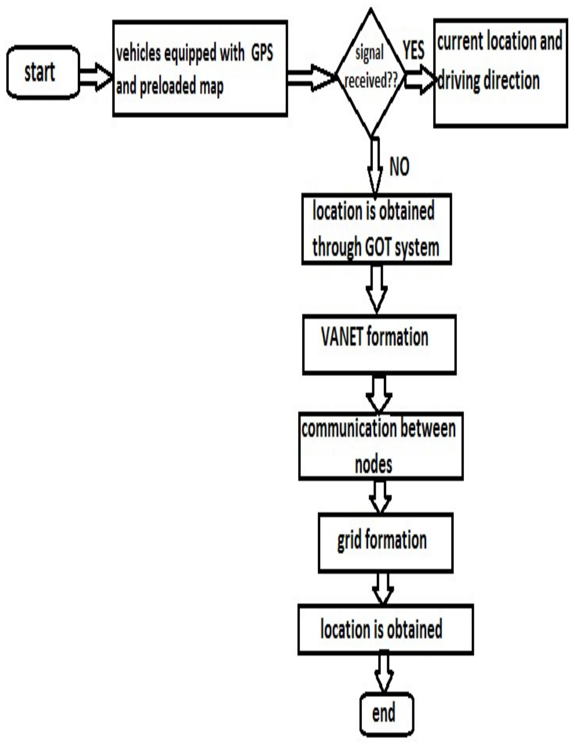

Fig 1 System model

Input: xj , yj , di,j , r and f(x, y), which is a function returning true when point (x, y) is within the road Output: xi[ ], yi[ ]

1: c=0, d=_ di,j r_ • r
2: for (p=-d; p<=d; p=p+r) do
3: for (q=-d; q<=d; q=p+r) do
4: if (| p2 + q2 − d| < r) ∧ f(p + xj, q + yj) then
5: c++; xi[c]= p + xj ; yi[c]= q + yj
6: end if
7: end for
8: end for

Si to denote the possible positions of ni(number of vehicle) and use Si,j to denote the possible positions of ni determined by the distance di,j to its neighbor nj ((xj, yj)).

IV RESULTS AND ANALAYSIS

The vehicles are represented as nodes in NS2 stimulator and the unknown vehicles are traced according to the neighboring node information. The number of nodes used are 25 and gradually increased to 100. The formation of Grid will reduce the collinearity problem by viewing the possible location in all possible direction.

Figure 2 shows the result for error rate that has occurred while finding the location for the unknown vehicle.

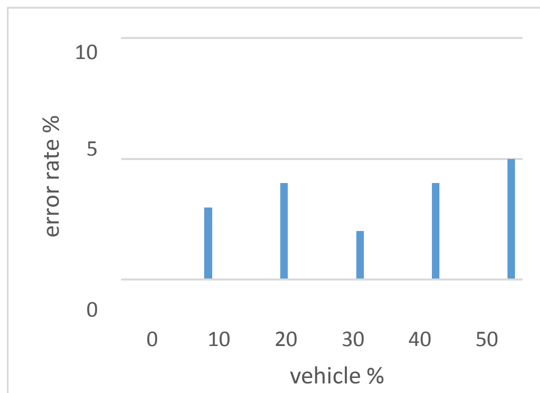

Fig 2 error rate

A grid-based computing method to control the error propagation is proposed. Error propagates linearly and slowly in grid-based schemes, while the error in non- grid-based scheme grows fast with big variance. Thus, when the location information propagates, the naive non-grid based scheme will cumulate high calculation error. Schemes with non-grid-based calculation usually use complex recursive optimization methods, which cause delay. Without adjustment, the propagated error in these schemes will be unacceptable. To evaluate the computational complexity of GOT, the average number of comparisons in location evaluation is used as the metric. This includes the location evaluations done with all the patterns.

The result in figure 3 is the comparison with the genetic algorithm where better result is obtained. Genetic algorithm finds the location with the anchor node. The node position is assigned. Location aware vehicle sends request message to its neighbors. The Grid helps to find the location of the unknown vehicle. The result obtained to find the location of unknown vehicle is compared with the trace file to check the accuracy.

Fig 3 Comparison between Genetic algorithm and Grid-based

V CONCLUSION

Grid-based On-road localizaTion (GOT) system is proposed for vehicles with blocked GPS signal to accurately calculate their locations through the help of vehicles with good GPS signals. In GOT, the inter- vehicle distance is also measured through the signal attenuation, which is used to calculate the location of the adjacent vehicle. GOT system can also be used for different geometric pattern relationships among vehicles. The G3 patterns provide the criteria to determine when a geometric relationship can generate a unique solution and when it cannot, and formally prove it. According to the simulation results, in the tunnel scenario, a vehicle away from tunnel exit can evaluate its location with less error and delay. In the city scenario, in the extreme case when only 10% of vehicles are location-aware, the system adds less localization error. In hybrid scenario (city and tunnel), the performance of the system is similar to that of city scenario. In addition, on average, for a vehicle to successfully evaluate its location, it only needs to send less than 2 requests, thereby reducing the overhead. When 40% of vehicles are location-aware, more than 90% of location-unaware vehicles can successfully evaluate their locations.

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