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Extended Kalman Filter approach to Crowd Sensing in VANET using Content-Centric Technique

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ABSTRACT

Problem of traffic congestion in VANET is an important problem which has drawn the attention of researchers all around the world. This paper proposes a novel position based routing protocol with the idea of baseline and distance minimization using EKF-based content centric approach. The protocol has been implemented successfully for a vehicular ad-hoc network as well as Manhattan model is applied. The vehicularmovement used a new concept of communication using minimization of distance from base line. The base line was drawn from source to destination node. Position, velocity, acceleration and direction are considered. The discussed protocol seems to work quite well and seems to yield encouraging outcomes. The delivery ratio of the packets was increased considerably and the average delay was reduced significantly.

Keywords: VANET, Manhattan model, MANET.

1. INTRODUCTION

Vehicular ad hoc wireless networks (VANETs) are a mainly stimulating class of mobile ad hoc wireless networks (MANETs) that remain presently appealing the widespread consideration of exploration in the arena of wireless networking as well as motorized manufacturing. The communication in mobile ad hoc wireless networks supports a number of dispersed applications between mobile nodes in infrastructure-free locations. So, it considered by reasonably high flexibility, communication in VANETs shows robust tasks than that in further general MANETs. [1]

As an important part of ITS research, the potential accomplishment of VANETs research lies on the expansion of vehicular communication system that allows convenient, steady and cost-effective distribution of data to profit the protection and comfort "on the road". Among several communication applications in VANETs, there is an extensive range of important applications involving traffic safety, traffic observing and unpiloted vehicles applications demand time control communication in Ad Hoc wireless networks. We call these disseminated time restraint applications as real-time communication. As deliberated above, highly dynamic nodes and no centre stationary server will cause the accident on wireless medium in the communication of VANETs.[14]

1.1. Topology and Congestion in VANET

High Dynamic Topology: VANETs have very high dynamic topology .The communication links among node changes offensively speedily. Communication among two nodes residues for terribly less time. As an example if two vehicles moving off since one an additional through a speed of 25m/sec and if the broadcast range is 250m, formerly the connection can only last exclusively for less than five seconds (250m/ 50ms-1). Consequently, this however extremely dynamic topology is existing in VANET

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Frequent disconnected Network: From the above distinguishing we have seen that association between two or additional vehicle residues for five second roughly. To keep up the uninterrupted property vehicles desires another association close without delay. But if failure occurs vehicles will link with Road side Unit (RSU). Frequent disconnected network in the main occurs wherever vehicle density is extremely low like country. [2]

Mobility Modelling and Prediction: The above two properties desires the data of positions of vehicles and their movements however this is frequently terribly dealt to expect since vehicle will move unsystematic and it doesn't have a pattern. Consequently quality models node estimate that supported the study of predefined road route model and vehicle speediness are use.

Communication Surroundings: The movement model extremely differs in different location since rural area towards urban area, from highways to that of city environment. Hence mobility modeling and vehicle movement estimate and routing algorithm should familiarise to these changes. [9] For highways mobility models are very modest because vehicle movement is one dimensional. But in case of city environment lots of vehicle existent different obstacle like building are present it makes communication application very difficult in VANET.

2. LITERATURE REVIEW

Förster et al. [3] This paper proposed PUCA – a organization which make obtainable complete privacy intended for authentic users, even at the side of scheming backend providers. The organization usages unidentified identifications for confirmation through the backend, although disappearing the communication between means of transportation as well as with road side units unmoved and in conformation with current criterions. For deduction of mischievous vehicles from the organization, the author take advantage about a friendly privacy cancellation mechanism which does not require resolution of assumed name. Through system, it determine that robust and provable confidentiality protection in vehicular networks can be accomplished, where as satisfying mutual safety necessities, such as Sybil resistance and cancellation.

Toutouh et al. [4]. The paper proposed, the usage of smart phones has analyzed, and laptops in vehicle-to-vehicle (V2V) communications which describing a test bed approved available in the city of Malaga. The author analyzed that it involved two dissimilar MAC/PHY terms: the commonly used in IEEE 802.11g also in IEEE 802.11a.So the author considered two dissimilar kinds of testing: the initially intended to estimate the strength of wireless signal which is produced by the examined devices, and the secondly, it dedicated on describing the QoS of V2V (vehicle-to vehicle) communications of these procedures.

Wang Yu et al. [5] This paper analyzes the data delivery delay for the persistence of roadside unit (RSU) placement in a vehicular ad hoc network (VANET) through discontinuous connectivity. A mathematical model is established to describe the connection between the average delay for delivering road situation information and the placement distance between two neighbour RSUs. The resultant mathematical model deliberates a sparse highway scenario where two neighbour RSUs are positioned at a distance without a straight connection and vehicles are sparsely distributed on the road with road situation information randomly created between the two neighbour RSUs. Furthermore, the model takes into interpretation the vehicle speed, the vehicle density, the likelihood of a happening, and the placement distance between two neighbour RSUs.

Wongdeethai et al. [6] The paper analyze about the road traffic collecting (RTC) procedure to collect information of the road traffic in a VANET on urban roads. The important operation of the protocol is the broadcasting of query which directs a query communication above a set of routes which is predefined in the direction of the destination position. To collect the information of the road traffic, then the nodes can contributing in the distribution of query which contain their specific speed to the query message so that blocking information on dissimilar locations of road divisions is collected.

Malhi et al. [7] In this paper, it based on the fuzzy trust expectation model is proposed to successfully calculate the belief of further vehicles for the protected route establishment in vehicular ad hoc networks (VANET). Then, the results and study of the planned model concluded the ordinary protocols are accessible by means of models.

David B. Johnson et al. [8] The proposed modeling flexibility for vehicular ad-hoc networks (VANET). In this, established on the movement of vehicles on actual road maps, the accurate model of node indication has been accessible. The ns-2 network simulator will be used in this model. The planned procedure is relay through the Random Waypoint mobility model. Outcomes show that the model in Random Waypoint mobility is an upright estimation for put on the movement of vehicles on a lane, but nearby conditions in which new model is well suitable.

3. PROBLEM FORMULATION

The problem in this thesis will utilize the Manhattan mobility model for vehicular movement. The Manhattan mobility model imitates the movement configurations of mobile nodes on streets distinct by maps. It is valued in modeling movement of nodes in an urban area or city situations. This model follows grid road topology. The map is distributed into number of vertical and horizontal roads. Intended for individually road is allocated into two lanes in each route. In vertical Street nodes move north and south route and horizontal streets nodes interchange in east and west route. The horizontal and vertical street creates several crossing points. The nodes can take turn from crossing point in left, right or go straight route. The model works built on a probabilistic approach for selection of nodes movements. The probability of moving in the same route is 0.5 and the probability of turning left and right is 0.25. The problem of crowd sensing in Vehicular Ad-hoc Network is a most commonly researched problem in current years**.** Many researchers use several machine learning algorithms to solve the problematic of congestion Mobile crowd sensing discusses to a broad range of community sensing paradigms. For instance a distinct procedure of crowd sourcing, mobile crowd sensing goals to make available a device to include members from the common community to contribute efficiently and effectively and exploit context of use associated sensing data from their mobile devices in resolving precise complications in associations**.** But lack of actual explanations to enumerate the connection among participants in crowd sensing encourages us to form a difficult solution for the same. Thus, it could not effectively assign the computing tasks and human based tasks of crowd sensing among individuals in VSNs simultaneously. Hence, one of the problems which have been taken in this paper is about task allocation of crowd sensing in VSNs. The first major phase toward attaining this goal will be to determine the effects of different driving environments on the signal propagation within the vehicular cloud framework. Also location based crowd sensing has been applied by many researchers but there has been very few works in by means of content aware approach. This paper targets to achieve the goal of crowd sensing using not only location but also velocity and direction of vehicles. The aim is to develop and improved version of Kalman filter to solve the problems of non-linearity in the traditional one. In our problem statement, an expected zone needs to be calculated for the conceive able location of the target node. It is a roundabout the target which can holds the predictable position of the target node.

4. PROPOSED METHODOLOGY

The paper aims to solve the problem of crowd sensing in VANET using context aware algorithm and Bayesian filters. We will use the usually accepted urban, suburban, and rural wireless communications environment categories. The content centric approach will be developed using various parameters such as location, velocity and direction. In this thesis, we proposed the Extended Kalman Filter intended for estimating the states for improved crowd sensing.

4.1. Extended Kalman Filter

One of the main expectations of the Kalman filter is that it is designed to approximate the states of a linear system based on dimensions that are a linear function of the states. Inappropriately, in many of the conditions where we would like to use a Kalman filter, we require a non-linear system model and/or a non-linear measurement equation. In detail, the scheme model is a non-linear function of the states and/or the measurements are non-linear functions of the states. Commonly, the non-linearities don’t spread to the system disturbances and measurement noise.

Since of the attractiveness of the Kalman filter, designers have established a set of mathematics to extend Kalman filter theory to conditions wherever the system model and/or measurement model are non-linear functions of state. The resulting Kalman filter is stated to as the Extended Kalman filter. As we will understand, the Extended Kalman filter uses the non-linear system model for calculating the expected state estimation, $\hat{x}(k+1|k)$ then the non-linear measurement model to form the expected measurement, $\hat{y}(k+1|k)$.

It relates to the problem which is non-linear in nature both in terms of process dynamics and measurement dynamics. Therefore, ordinary Kalman filtering cannot be realistic here. An Extended Kalman Filter needs to be designed based on Taylor series expansion about a nominal value which is taken as the preceding estimate in this case. The state transition matrix F is given by the Jacobian of the vector function f(x~, w~) about state x~ and the noise scaling matrix ô is given by the Jacobian of the direction function f(x~, w~) about state w~ .

Subsequently the process dynamics are uninterrupted though the measurements are commonly discrete in nature; a hybrid continuous-discrete EKF model is too developed. The EKF equations of discrete time cannot be used openly and continuous time EKF equations have to be derived. Also, later the measurements are discrete in nature; a hybrid of both is developed and defined below.

An observable, dynamical non-linear system, through dynamics continuous process and discrete measurement dynamics is defined by,

$$\tilde{x}(t) = f\left(\tilde{x}(t)\right) + \tau_c \tilde{w}(t)$$

$$\tilde{y}_k = h\left(\tilde{x}_k\right) + \tilde{y}_k$$

wherever x~∈ℜn represents the state vector of the scheme in n-dimensional, f (.) : Dx → ℜn is a fixed non-linear representing of system states to system inputs, z~k ∈ Dz, ⊂ℜp represents the p-dimensional scheme measurement, h(.) : Dx, ⊂ℜn → ℜp is a nonlinear representing of system conditions to output, τc ∈ℜn x w represents the uninterrupted procedure noise scaling matrix, w~ ∈ Dw, ⊂ℜw represents the w-dimensional noise in random process and ~v ∈ Dv, ⊂ℜv denotes the measurement noise in v-dimensional random

Take an arbitrary line between S and D , It will keep the IN intermediate node selection within the direct S-D route.

D2 is the minimum distance from this arbitrary line

- It will reduce delay in selection of node.
- It will be selected in such a way it will keep the shortest distance so no chances of getting any longer route or stale route.

4.2. Assumptions

- Fixed no. Of nodes and road structure is already defined.
- Each node is in authority to preserve a multicast tree in the form of ADJACENT NODE TABLE.(For multicasting) .
- Some of the predefined root nodes would be there.

4.3. Multicast tree

1. Root Nodes: Roadside units for reliable transmission and predefined
2. Leaf Nodes: Adjacent node table maintained as multicast tree.

In the vehicular ad-hoc network (VANET), the vehicles are connected through vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication. Towards vehicle to vehicle (V2V) communication is available to interchange important information between vehicles. To create path among various vehicles many routing protocols had remained proposed which remain of reactive and proactive type. In VANET, reactive routing protocols had significant presentation which usage the dissemination technique for route establishment. The dissemination technique will increase delay in the network and network resource using up will increase at fixed rate. To reduce delay in the network, the technique of multicasting had been proposed. The following are several supposition of the proposed system

1. The network will be arranged with the fixed number of nodes and roads structure already defined
2. Each node are in authority to maintain the table of its neighbouring nodes
3. For multicasting nodes some nodes in the network are predefined as root nodes.

In the complete network we describe some nodes which are root nodes, beneath these root nodes we will describes the leaf nodes. The leaf node derives under which root that will be definite through prediction based technique for multicasting. A novel node links the network which comes beneath the root node 1 on the basis of distance and time formulation by means of the predication centred method

Let us assume the leaf node changes and originates in the range of root node 2 and then leaf node 1 will link the root node 2. The leaf node will comes beneath which root node it will be definite on the base of distance procedure. The handoff takes place when the threshold distance takes place and the distance will be better than threshold value. On the basis of distance among the nodes, the root nodes are in authority to preserve the tree. In this routing table information about their leaf nodes are stored and the root nodes can maintain. Formerly ask for the path to target the root nodes can denote to the stored information's to RSU's. RSU give data about the leaf node for path establishment and the source node interconnects with the RSU. The source node send route appeal packets to only those root nodes, which have right to use to preferred leaf node.

FLOW CHART: Working of node assignment

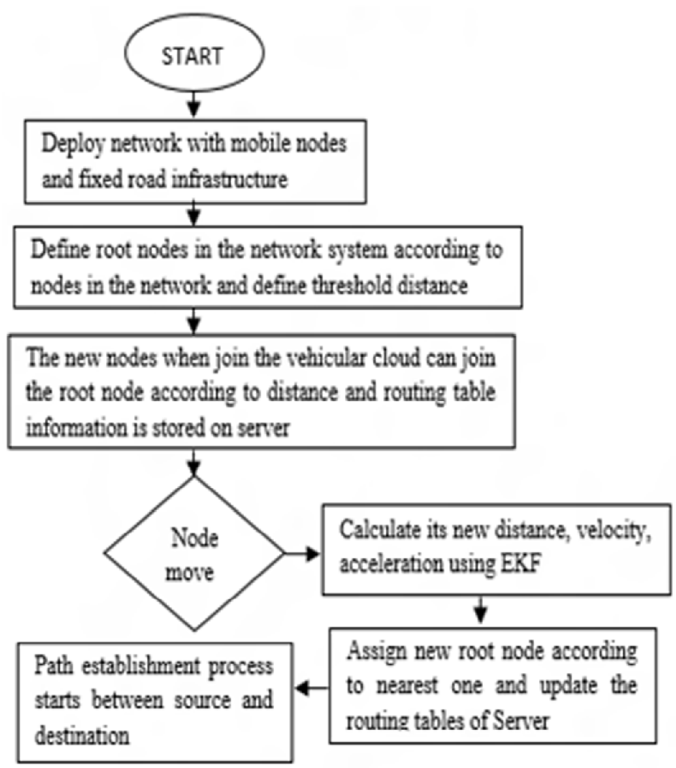

Figure 1: Working of Node assignment

PROPOSED METHODOLOGY

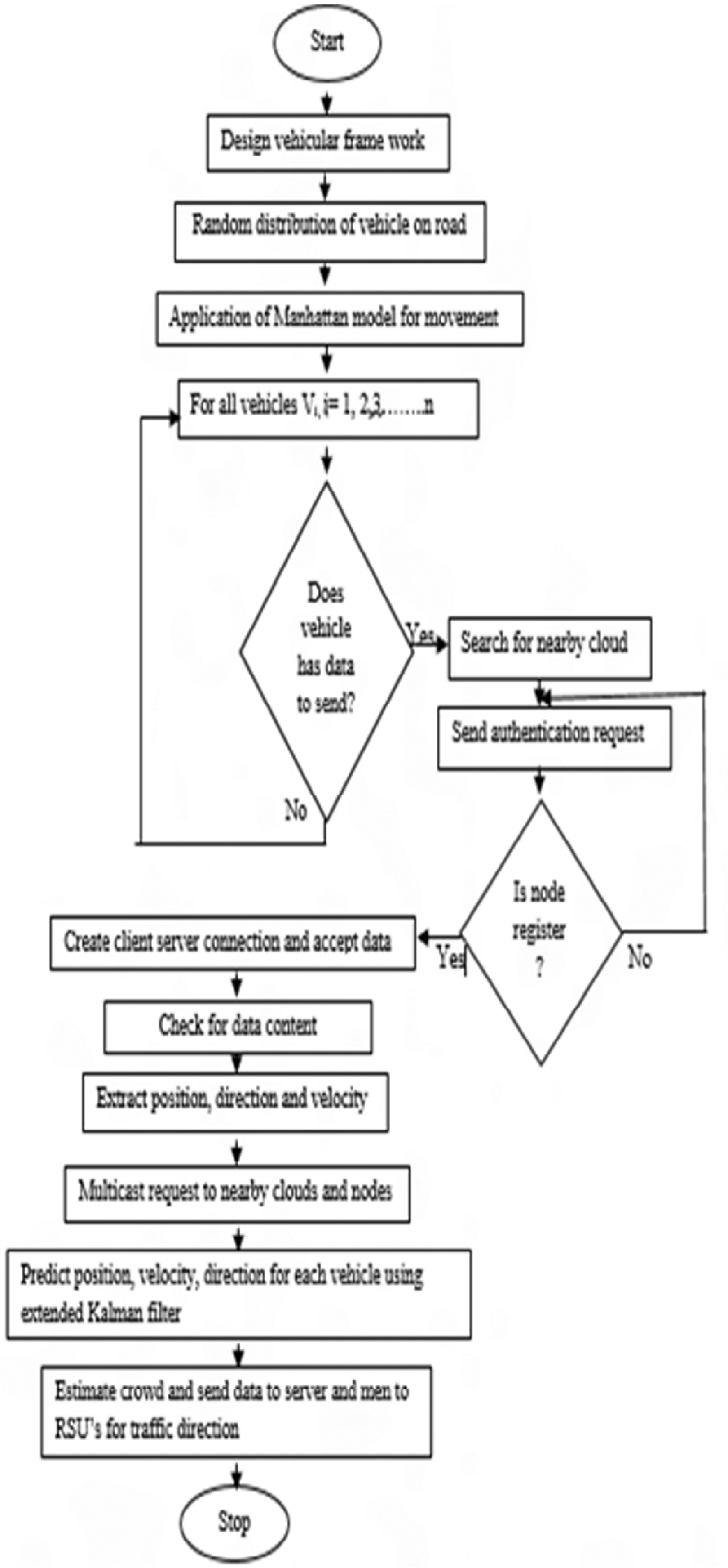

Figure2: Flowchart of Proposed methodology

5. RESULTS

The proposed technique has been implemented in for a VANET environment with 10 horizontal and vertical roads. 300 vehicles were placed in the roads randomly and they moved according to the Manhattan model. All the simulations were carried out in MATLAB R2013b in a core i5 processor based computer with 8 GB RAM and 500 GB hard disk.

Figure.3 representing the node distribution and vehicular cloud region ,communication between them is represented by green lines. The communication is done according to the proposed algorithm.

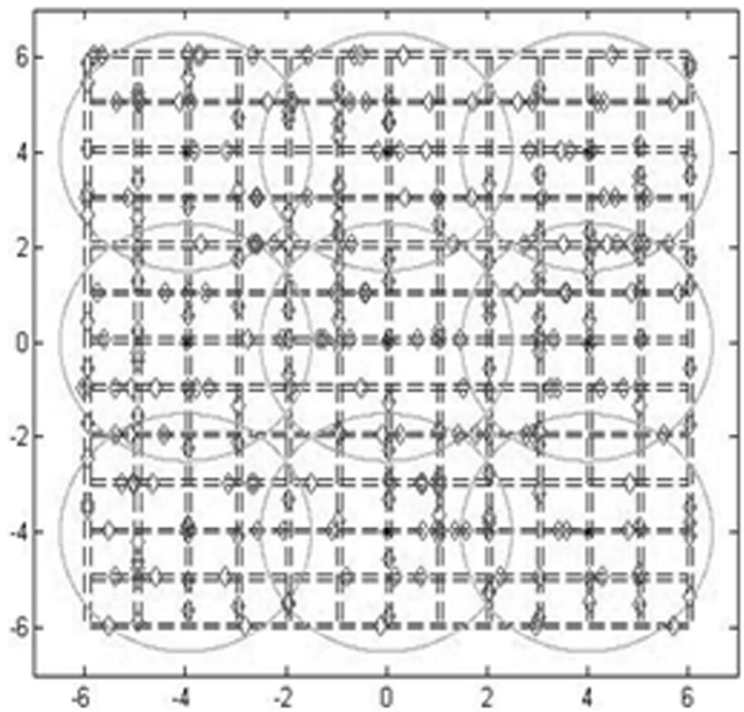

Figure 3: Representing node distribution and vehicular cloud region

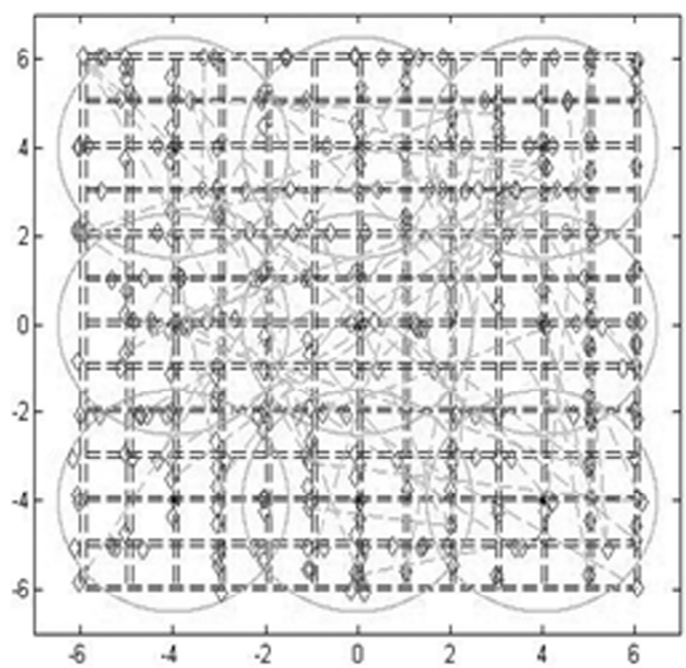

Figure 4: Plot of Communication (V2V and I2V)

Figure 4: representing communication between vehicle to vehicle and infrastructure to vehicle. The communication between them is represented by green lines. The minimum distance line is found out and then the vehicles in the vicinity are found out. The vehicles which have the minimum perpendicular distance to the line are selected for next hopping.

The communication is done according to the proposed algorithm

Figure 5 represents the plot of average delay versus each round. As observed the average delay of our proposed algorithm remains constant more or less around 3. This is a very low value and proves the efficiency of our algorithm. The communication between them is represented by green lines. The communication is done according to the proposed algorithm. The minimum distance line is found out and then the vehicles in the vicinity are found out. The vehicles which have the minimum perpendicular distance to the line are selected for next hopping.

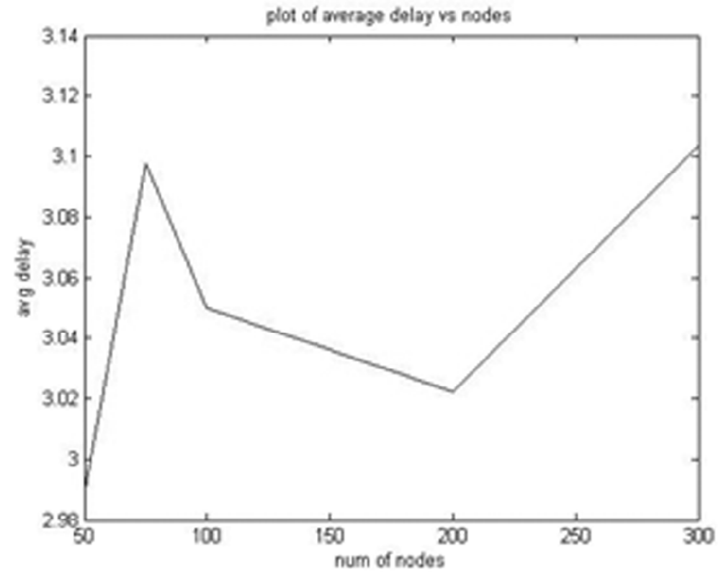

Figure 5: Plot of Average Delay versus Each Round

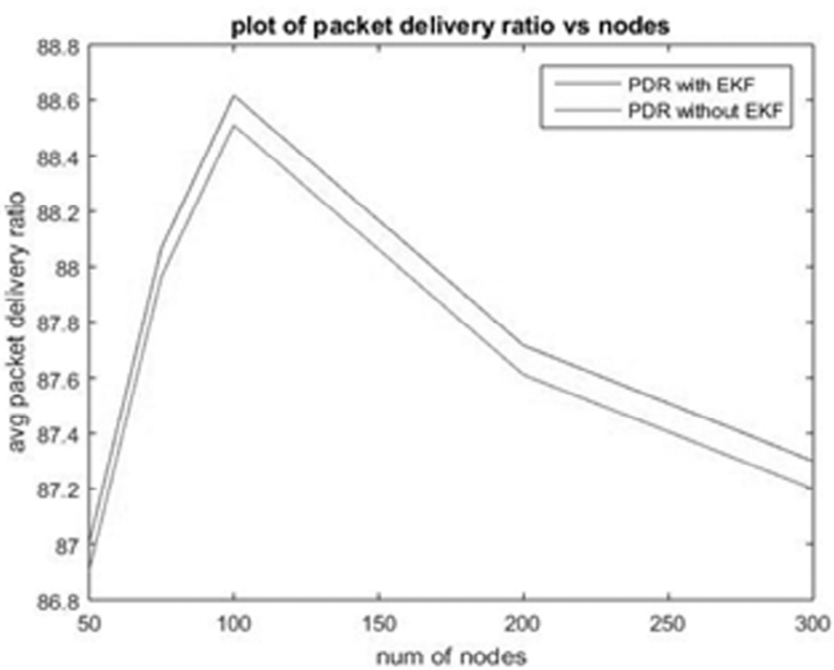

Figure 6: Packet Delivery Ratio vs. Nodes

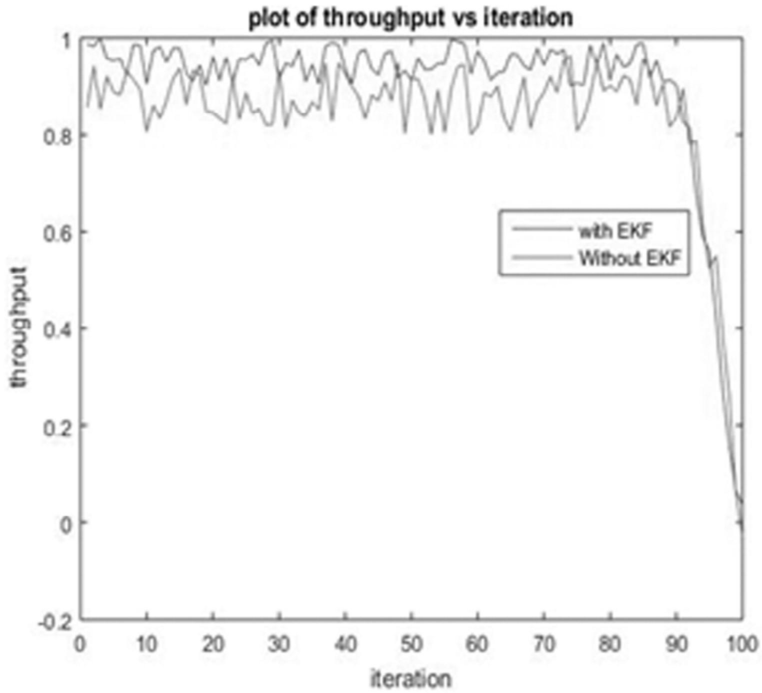

Figure 7: Plot of throughput versus iterations

Figure 6 show the plot of average packet delivery ratio vs. number of nodes. The packet delivery ratio of our algorithm is plotted against rounds and it is observed for our algorithm that it is very high nearly 87 % in each rounds. The high value of PDR represents that our algorithm performs quite well as compared to the traditional ones and the minor reduction in the average PDR is due to the decreasing energy of various batteries attached to the vehicles.

As observed in figure 7 the throughput in case of our algorithm is better than that of the without EKF and it starts decreasing at a later rate which is desirable.

6. CONCLUSION

The paper tries to design a novel location aided routing protocol with the concept of baseline and distance minimization. The protocol has been implemented successfully for a vehicular adhoc network and Manhattan model is applied. The vehicular movement used a new perception of communication using minimization of distance from base line. The base line was drawn since source to destination node. The discussed protocol seems to work quite well and seems to yield encouraging outcomes. The delivery ratio of the packets was increased considerably and significantly reduced the average delay. This shows the efficiency of our algorithm. In future other algorithms can be utilized for the same and our proposed model can be executed for hybrid networks. Also Meta-heuristic algorithms can be utilized for the same and the performance can be compared with our method.

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