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Hybrid Data Forwarding Strategies for Distance - Bounded Routing Protocol in Vehicular Ad-Hoc Network (VANet)

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Abstract: This paper focuses on distance-bounded routing, whose goal is to deliver messages to the destination using proper delivery strategy and by utilizing radio network in necessary condition so minimizing the cost of communication network. Most of the researches emphasize on minimizing the end-to-end delay without focusing on minimizing the usage of radio. The messages can be delivered to the destination by hybrid technique i.e. data mulling (data carried by the vehicle) and packet forwarding (data transmitted through radio network). In this paper we use Euclidian distance relationship to predict the distance between the vehicles. This Euclidian distance between two vehicles is compared with given threshold distance to predict the proper delivery strategy.

Keywords: AODV, Data Forwarding, Mulling, VANET.

I. INTRODUCTION

Vehicular Ad Hoc network (VANET) is a special type of mobile Ad Hoc network (MANET), which is specially designed for Vehicle-To-Vehicle (V2V) and vehicle-To-Infrastructure (V2I) communications [1]. It could realize the function such as video & voice communication between the vehicle, highway toll and traffic information query, traffic alert [2]. VANET has attracted a lot of researcher attention recently. Most of the researches work on minimizing the end-to-end delay without attention toward the usage of wireless network. Different application requires different delay, some application needs the data to be sent to the destination urgently and some application can tolerate delay [3]. It is not important for lower priority message the data to be sent immediately but deliver it within the threshold and using less radio network is much important. Therefore in this paper we are focusing toward delivering the message within given threshold time by using less wireless network. There are two types of data forwarding strategy to be used data mulling and packet forwarding. Mulling means data carried through vehicle and packet forwarding means data carried through radio network. Our protocol uses hybrid of mulling and packet forwarding for effective sending of data. When there is distance between the vehicles is greater than threshold distance means mulling technique is not possible for data forwarding. In this situation our protocol uses packet forwarding technique i.e. data is transfer through radio network and when distance between the vehicles is greater than threshold distance means time is enough and therefore data is transfer through vehicle. This way, a vehicle can switch to a proper delivery strategy at a proper moment [3]. Therefore, our protocol can make a better usage of the available time and reduce usage of network resources which minimizes the communication cost of the network.

II. PROPOSED RESEARCH WORK

To improve the delivery strategy we proposed novel based efficient distance bounded routing protocol which uses the Euclidian distance [4] relationship to model the delivery strategy. Euclidean distance or Euclidean metric is the "ordinary" distance between two points that one would measure with a ruler, and is given by the Pythagorean formula. The distance between two points is the length of the path connecting them. In the plane, the distance between points (x_1, y_1) and (x_2, y_2) is given by the Pythagorean Theorem which is given in Equation 1[4].

$$D = \sqrt{(x2 - x1)2 + (y2 - y1)2} \quad (1)$$

In Euclidean three-space, the distance between points (x_1, y_1, z_1) and (x_2, y_2, z_2) is given in Equation 2.

$$D = \sqrt{(x2 - x1)2 + (y2 - y1)2 + (z2 - z1)2} \quad (2)$$

In general, the distance between points x and y in a Euclidean space is given by Equation 3.

$$D = |x\text{-}y| = \sqrt{\sum_{i=1}^{n} |x_i - y_i|^2} \quad (3)$$

For curved or more complicated surfaces, the so-called metric can be used to compute the distance between two points by integration. For example, there are an infinite number of paths between two points on a sphere but, in

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general, only a single shortest path. The shortest distance between two points is the length of a so-called geodesic between the points. In the case of the sphere, the geodesic is a segment of a great circle containing the two points. Let ϒ(t) be a smooth curve in a manifold from x to y with ϒ(0)=x and ϒ(1)=y. then ϒ(t) € T $_{\Upsilon(t)}$ where T_X is the tangent space of M at x. The curve length of γ with respect to the Riemannian structure is given by Equation 4 [4].

$$\int_0^1 |\Upsilon(t)\ |\Upsilon\ (t)\ \ dt \quad (4)$$

and the distance d(x, y) between x and y is the shortest distance between x and y given by is given by Equation 5.

$$d(x,y) = \inf_{\gamma : x \text{ to } y} \int |\gamma'(t)|_{\gamma(t)}\, dt. \quad (5)$$

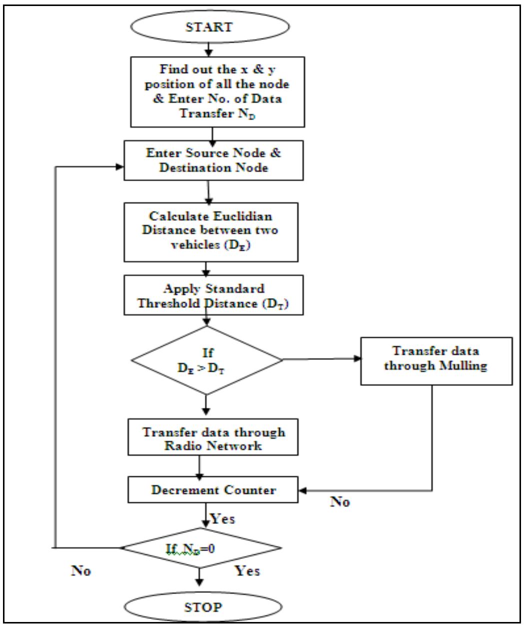

Figure 1 Flow Chart of Proposed Methodology

Figure 1 shows the flow chart of proposed methodology which describe the algorithm

- Find out the x and y position of the vehicles in which we want to perform the data transfer.
- Apply Euclidian distance formula to find out the shortest distance between the vehicles.
- Apply standard threshold distance.
- Compare the distance threshold and distance between the vehicles calculated by using Euclidian distance formula.
- If the distance between the vehicles greater than distance threshold transfers the data through radio network otherwise transfer through vehicle.

III. SIMULATION AND PERFORMANCE EVALUATION

To observe the performance of proposed hybrid distance bounded routing protocol we analysed it with different number of parameter such as average delivery time, end to end delay & packet delivery ratio.

In this protocol we use NS2 (Network Simulator 2) to simulate our protocol, the various simulation parameter are shown in Table I

Table I Simulation Parameter

Parameter	Value
Routing Protocol	AODV
Simulation Area	500*500
Transmission Range	250m
Number of vehicles	5-50
Threshold Distance	0-400

To evaluate the performance of proposed routing protocol we consider different nodes in the network. Fig 2 shows the terminal window of the proposed work, in which node 0 act as a base node. According the algorithm stated above threshold distance considered as 200. Fix out the source node and destination node. Calculate the Euclidian distance between source node and destination node as stated in above formula. If it is greater than threshold distance transferred data through radio network as shown in Fig 3 & Fig 4, otherwise transferred through vehicle as shown in Fig 5 & Fig 6. So in this way we are effectively using radio network for data transfer. To visualize properly in NAM scenario only 5 nodes are considered.

The performance metrics observed in the simulations are:
Average Delivery Delay: The average of the delivery delay Of all successful delivered messages within the delay threshold. Fig 7 shows the impact of delay threshold to average deliver delay, which is increasing with delay threshold which indicate that our protocol usage better usage of available time.

Packet Delivery Ratio (PDR**):** It is the fraction of generated packets by received packets. That is, the ratios of packets received at the destination to those of the packets generated by the source. As of relative amount, the usual calculation of this system of measurement is in percentage (%) form. Higher the percentage, more privileged is the routing protocol. Fig 8 shows the impact of Packet Delivery Ratio to delay threshold which is also increasing with delay threshold which indicate that our scheme uses better usage of available time and reduces the frequency of Data forwarding and thus improve delivery ratio.

Average End-to-End Delay (E2E Delay**):** It is the calculation of typical time taken by packet (in average packets) to cover its journey from the source end to the destination end.

In other words, it covers all of the potential delays such as route discovery, buffering processes, various in-between queuing stays, etc, during the entire trip of transmission of the packet. The classical unit of this metric is millisecond (ms). For this metric, lower the time taken, more privileged the routing protocol is considered. Fig 9 shows the scenario when all the data passed through the channel

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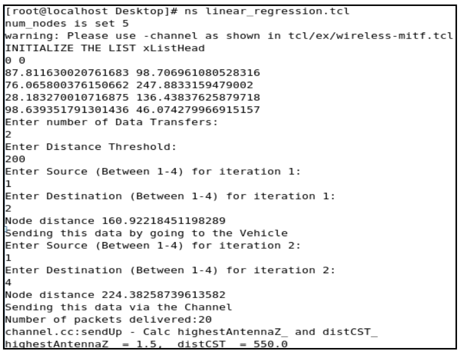
therefore the time require to transfer the data is decreasing which indicates that our protocol makes fast delivery of the data.



```
[root@localhost Desktop]# ns linear_regression.tcl
num_nodes is set 5
warning: Please use -channel as shown in tcl/ex/wireless-mitf.tcl
INITIALIZE THE LIST xListHead
0 0
87.811630020761683 98.706961080528316
76.065800376150662 247.8833159479002
28.183270010716875 136.43837625879718
98.639351791301436 46.074279966915157
Enter number of Data Transfers:
2
Enter Distance Threshold:
200
Enter Source (Between 1-4) for iteration 1:
1
Enter Destination (Between 1-4) for iteration 1:
2
Node distance 160.92218451198289
Sending this data by going to the Vehicle
Enter Source (Between 1-4) for iteration 2:
1
Enter Destination (Between 1-4) for iteration 2:
4
Node distance 224.38258739613582
Sending this data via the Channel
Number of packets delivered:20
channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5, distCST_ = 550.0
```

Figure 2 Terminal Window

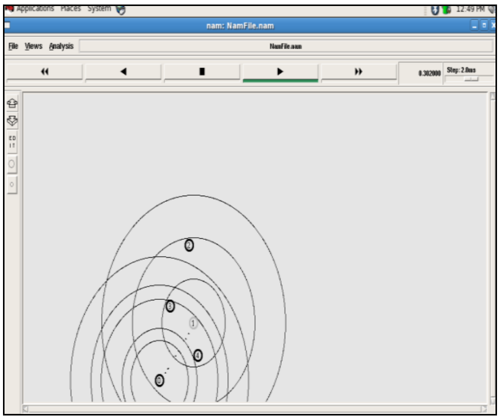


Figure 3 Data Transfer through Radio Network

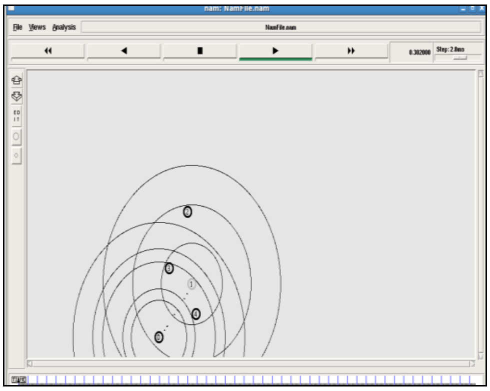


Figure 4 Data Transfer through Radio Network

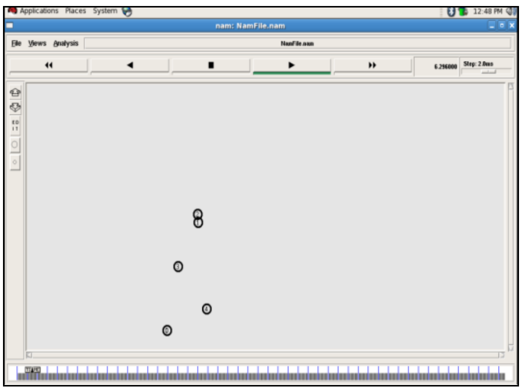


Figure 5 Data Transfer through Vehicles

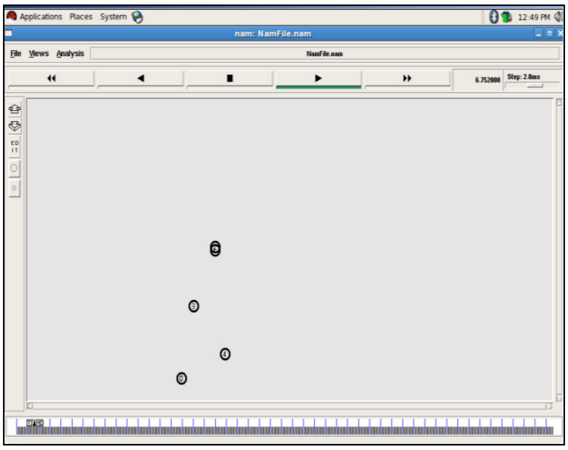


Figure 6 Data Transfer through Vehicles

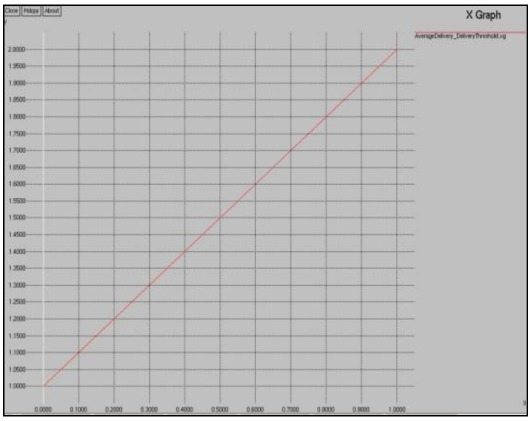


Figure7 Average Delivery Time

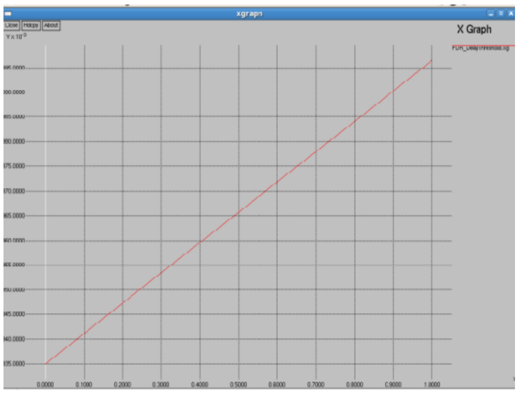


Figure 8 Packet Delivery Ratio

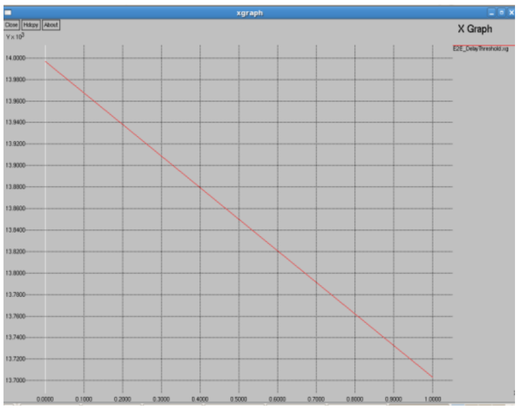


Figure 9 End to End Delay

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CONCLUSION

In this paper, we have presented a distance-bounded routing protocol for vehicular ad hoc network which uses proper delivery strategy according to available distance threshold. For this we presented a Euclidian distance method to find out the direct distance between the vehicles. By comparing threshold distance with Euclidian distance the protocol suggest delivery strategy either mulling or packet forwarding. In this way we are effectively using radio network resource which reduces the communication cost of the network. Graphical simulation shows that it performs well in terms of delivery ratio and end to end delay.

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