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Enhancement of energy efficient routing and Minimized outage based on fuzzy optimization in VANET

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Abstract:
Vehicle ad hoc network provides the seamless communication in road transportation system and it is based on movement of vehicles which provides exchange of information from one vehicle to another vehicle. The existing opportunistic neighbour selection and vehicle localization (ONS&VL) routing logic suffers from more energy drain on finding the neighbours based on position, distance and direction that result in higher routing overhead. To overcome these drawbacks, fuzzy optimization routing logic is proposed. Energy and link acceptance are the factors that are considered to influence vehicular communication. A fuzzy based decision making system is used to decide upon fluctuating factors of energy and data acceptance rate to ensure reliable routing and relevant neighbor selection. It provides high throughput and less energy consumption when compared to existing routing logic. Simulation results demonstrate that proposed fuzzy optimization routing outperforms the existing ONS&VL protocol in terms of throughput, packet delivery ratio, energy consumption and routing overhead.

Index Terms: Fuzzy Optimization Routing (FOR), Opportunistic Neighbour Selection and Vehicle Localization (ONS&VL), Vehicular Ad hoc Network (VANET)

I. INTRODUCTION

Vehicular ad hoc network (VANET) is a promising way of intelligent transportation system. The safety for the transportation system is improved in VANET. The topology of VANET is swiftly converting due to many challenging research troubles in particular in multi-hop broadcasting. In VANET, broadcasting needs high reliability and delivering emergency messages efficiently.

In Vehicular Ad Hoc Networks (VANETs), many routing protocols have actively researched for efficient Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications [1]. The goals of these researches are to develop applications for enhancing road safety and transportation efficiency. Designing an efficient routing protocol is one in all key problems in VANETS. Connected vehicles can be utilized to improve transport applications such as traffic light control, information dissemination, electronic payment and public transport management [2]. As the quantity of vehicles in exponential growth, vehicular ad hoc networks (VANETs) surfaced to attach vehicles in an ad hoc way via Wi-Fi hyperlinks. In addition to the distributed nature of VANET, the urban environment characteristics inclusive of street topology and intersections generally limit the network's connectivity. Diverse efforts have tried to improve network's connectivity through proper choice of relay node for urban VANET. The vehicular ad hoc network is a rising widespread to improve the protection and efficiency of transportation inside the destiny. The distribution and movement pattern of vehicles are constrained by means of road layouts, traffic rules, virtual maps and geographical locations of vehicles may be beneficial for making routing choices.

A unique type of networks in complicated urban environment is VANET, in which vehicles are ready with communication gadgets. Within the urban VANETs, the subsequent traits are excessive mobility the topology of the networks are frequently changes. But, due to excessive mobility, uneven distribution of vehicles and confined movement in urban environments, it's very complicate to maintain the global topology of VANETs for every vehicle [3]. In VANETs, nodes commonly move at excessive speeds; the data approximately the placement of neighbor vehicles is therefore rapid outdated. The simple approach for dealing with this difficulty is to growth the frequency with the aid of which periodic messages containing a node's function are exchanged. This solution might lead an unfeasible overhead significantly losing the bandwidth available for the trade of services' data.

The topology of networks can be regarded as a subset of city map and the movements of vehicles are restricted along the streets and by the traffic conditions. They could easily gain the statistics about their geographical positions, moving direction and velocities, and so forth. The usage of global position system (GPS) and a street-level digital map that are already equipped in vehicles. The vehicles distributed along the street in ununiformed and it depends on the conditions of streets, such as single and double way streets, limited speed of vehicle and traffic conditions.

Fuzzy logic primarily based greedy routing protocol which assists in turning in protection messages to the destination vehicle with minimum delay. The FLGR is a multi-hop routing protocol that makes use of a couple of metrics of neighbor vehicles to decide which neighboring car may be the approximate high-quality next-hop node for further forwarding the packets. FLGR is used inside the communication range of the modern-day forwarding node that employs fuzzy good judgment for deciding on the first-class subsequent-hop node in multi hop VANETS [9].The routing manipulate nodes pick out the finest route through which statistics is transmitted from a source node to a destination node and determine whether to use the transferring vehicles as a cell relay to transmit data based totally at the course of motion in addition to the locations of the source node and the destination node. The best routing route design in phrases of reliability and energy efficiency inside the presence of jammers. Effects display that the maximum energy constraint and the direction loss exponent have a huge effect on the routing design in addition to the network overall performance. The full energy consumption of the network does no longer encompass the vehicle's energy consumption. This is because the transferring vehicles aren't taken into consideration as part of the network, so its energy consumption will no longer be taken. The routing protocol for selecting the finest path is Fuzzy Based Energy Efficient Multicast Routing and the energy consumption of the nodes is minimized based on the fuzzy logic. The lifetime of the ad hoc network is extended regarding energy efficient multicasting routing using this routing protocol [7].

Using fuzzy logic system, a set of potential forwarders is identified by the receiver vehicle, which relies on mobility and coverage factors, to choose a set of candidate forwarding vehicles, and depends on the distance-to-mean value of each vehicle on this set of candidate forwarders, to rebroadcast or drop the message is decided by the receiver vehicle. A receiver-based totally intelligent broadcast protocol the use of fuzzy logic is proposed in which each receiver vehicle decides whether or no longer to rebroadcast a broadcast message. The main disadvantage is rebroadcast the successful message delivery in terms of reliability is low on highway scenario.

The fuzzy logic primarily based multi-hop broadcast protocol for data dissemination in high-density vehicular ad hoc networks. Reveals low message overheads through the use of only a subset of neighbor nodes to relay messages. It reduces the number of broadcast messages effectively via using simplest a subset of neighbor nodes to relay messages. Inside the relay node choice together considers more than one metrics of inter-vehicular distance, node mobility and signal strength through using the fuzzy logic [8].

II. EXISTING ROUTING LOGIC

The key issues in existing algorithm cause the poor link quality and local maximum problem because it does not consider the actual path of forwarded packets. The existing routing logic aims to address network connectivity issues. It involves two algorithms in its execution process: Opportunistic Adaptive Neighbor Selection (OANS) and Vehicle Localization (VL).

Source vehicle determines the vehicle density of in-range vehicle and checks the mobility and direction of the vehicle. Source vehicle identifies its neighbor vehicle based on the speed and direction towards it and will also consider the distance of source vehicle and current vehicle should be lesser than the current neighboring vehicle. This will create a link between source and neighbor vehicle. Once the link is established to the neighbor vehicle its link state is updated and acknowledgement is received by the source vehicle using Opportunistic Neighbor Selection Method.

In vehicle Localization method, RSU is used to update the position of multiple in-range vehicles to the source vehicle. The in-range vehicle distances are estimated and a vehicle with more link availability is selected. This is followed by the update of the current position of the neighbor vehicle to the source vehicle. The integration of vehicle localization method and opportunistic adaptive neighbor selection method cause increase in performance parameters like connectivity and good put.

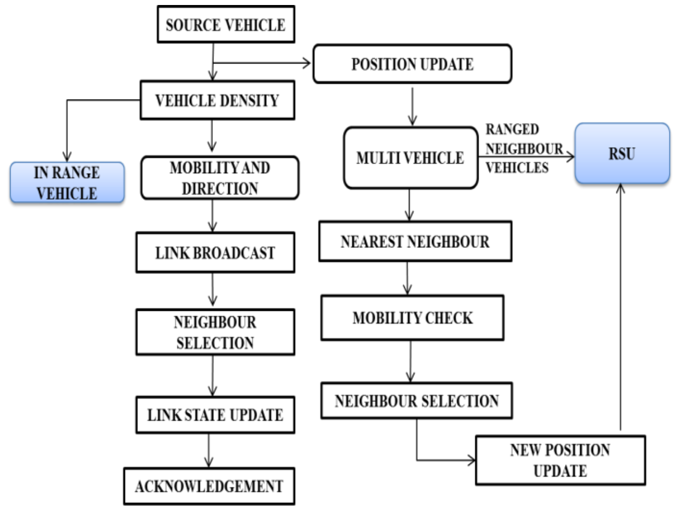

Fig.1: Block Diagram for existing routing

C. Integration of OANS and VL

The source vehicle checks for the density of vehicles in its range, this is done by broadcasting messages. When vehicles are determined the source vehicle then calculates the position and distance of the in-range vehicles. If the number of vehicles in-range to the source vehicle is greater than 1, the mobility and direction of all the vehicles are estimated. The slow moving vehicles are shortlisted; among them the vehicle moving in the direction of destination is selected. Else it broadcast message until vehicles were determined. The availability of link Id for the particular node is examined otherwise a message is sent to the Road Side Unit (RSU).

The RSU uses on-demand vehicle localization to update the position and distance for multiple vehicles in its range thereafter the mobility and direction is checked and suitable node for transmission to destination is chosen. This case is for unavailability of link between source vehicle and selected vehicle. On the availability of the link a request for transmission message is sent to the selected node that has less mobility and moves in the direction of destination. On accepting the request of the source vehicle the selected node sends a positive acknowledgement message in return. When the source vehicle receives the acknowledgement, it sends the packet to be delivered to the destination. The selected node in turn receives the message and transmits it to the next neighboring vehicle and the process continues until destination is reached.

III. PROPOSED WORK

The major issues in existing ONS&VL algorithm causes maximum outage and less energy efficient because it choose only direct neighbours from the source and step by step procedure is needed to find the neighbour based on mobility, distance by using opportunistic neighbour selection and vehicle localization his algorithm. This step by step procedure has sent more control packets this higher routing overhead. The proposed work improves in energy efficient and outage based on fuzzy decision system and analyses the parameters like distance, mobility, energy and outage of the nodes. The data acceptance is one the parameter calculated how much data is accepted by node for transmission.

The proposed working is to improve energy conservation and data acceptance rate in order to minimize the outage for relative neighbor of the non-topological vehicular network. This method is increase the conservation of energy of vehicles by selecting the neighbor nodes based on the queue size and the distance neighbour which has more remaining energy and high queue size. The remaining energy based transmission is to reduce the dead nodes in the network. These conditions were executed by using the fuzzy logic for making the decision system in order to find the relative neighbours. Fuzzy logic is used to improve the efficiency of the output by setting various limitations and conditions. There are multiple verification for the checking the conditions for the output. The output is two types based on the user constraints optimal and sub optimal outputs. The threshold level is fixed for energy and data acceptance rate. The energy level for the node is taken and data acceptance rate is based on the queue size of the node. The queue size is based on the how much of data is to be transmitted through the node. The fuzzy decision system is implemented in this stage based on the energy and data acceptance rate of the distant neighbor nodes. Output of the fuzzy makes the decision through which the node is having that satisfied the fuzzy rule table for energy and the data acceptance rate.

BLOCK DIAGRAM

The block diagram shows that the overall working of the proposed working.

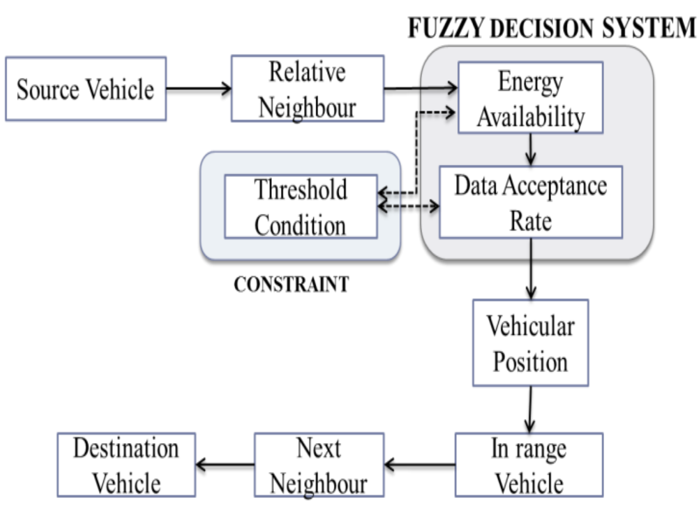

Fig.2: Block Diagram of FOR Routing logic

The source Vehicle selects the relative neighbours by using broadcasts message. Then check the energy availability for the relative neighbours if the energy values are in the threshold condition. Check condition for energy availability were satisfied. Then check the data acceptance rate for those nodes. Data acceptance rate is based on the queue size of the nodes. If the queue size is free for the node then check the vehicular position for the node and if it is in range vehicle then select the vehicle as the next neighbour and disseminate the packet to the destination vehicle.

ALGORITHM

Step 1: initialize the vehicles.

Step 2: Broadcast to find relative neighbors to find optimal path based on the distance.

Step 3: If transmission >1, then compute energy consumed and residual energy.

Step 4: check if residual energy meets threshold

Steps 5: if yes, go to step 2, repeat through, step 3 to step 5.

Step 6: If threshold is not reached, compute data acceptance rate of the forwarder.

Step 7: Update vehicle position.

Step 8: compute distance of the entire vehicle.

Step 9: compute distance between vehicles is less than equal to its communication range then

Next – selection = distance vehicle.

Step 10: repeat through step 6 to 10 until destination vehicle is reached.

Step 11: If end of transmission, go to step 13.

Step 12: repeat through step 2 to 12.

Step 13: end

FLOW DIAGRAM:

The flow diagram shows the detailed working of this system. It checks the energy and data acceptance for the relative neighbours of the vehicular network. The relevant output is taken based on the fuzzy decision system. Source vehicle fetch the energy and data acceptance for the vehicles of nearby neighbours. Then initialize the population of the vehicles, then applies the constraints value to the vehicles and validation to done for the vehicles. The constraints for energy and data acceptance are defined below, the energy and data acceptance of the neighbour vehicle is always greater than the energy and data acceptance of the next neighbour vehicle. If the above condition is satisfied then take for relevant output. The relevant output is check for error factor is true, then check transmission not equal to zero that is transmission is free for the vehicle if it is free and set neighbour vehicle as next neighbour vehicle and transmission to next transmission. The error factor is not true the set as next vehicle and check for destination vehicle. If the error factor of energy and data acceptance of the neighbour vehicle not satisfied then check for similar output with the error factor of the data acceptance of the neighbour vehicle is similar to the data acceptance of next neighbour vehicle and error factor of the energy of the neighbour vehicle is similar to the energy of next neighbour vehicle, the compute the transmission for that vehicle and follow from fetching energy and data acceptance rate. Then the relevant output for the vehicle is true and then goes to next vehicle. If the next vehicle is the destination.

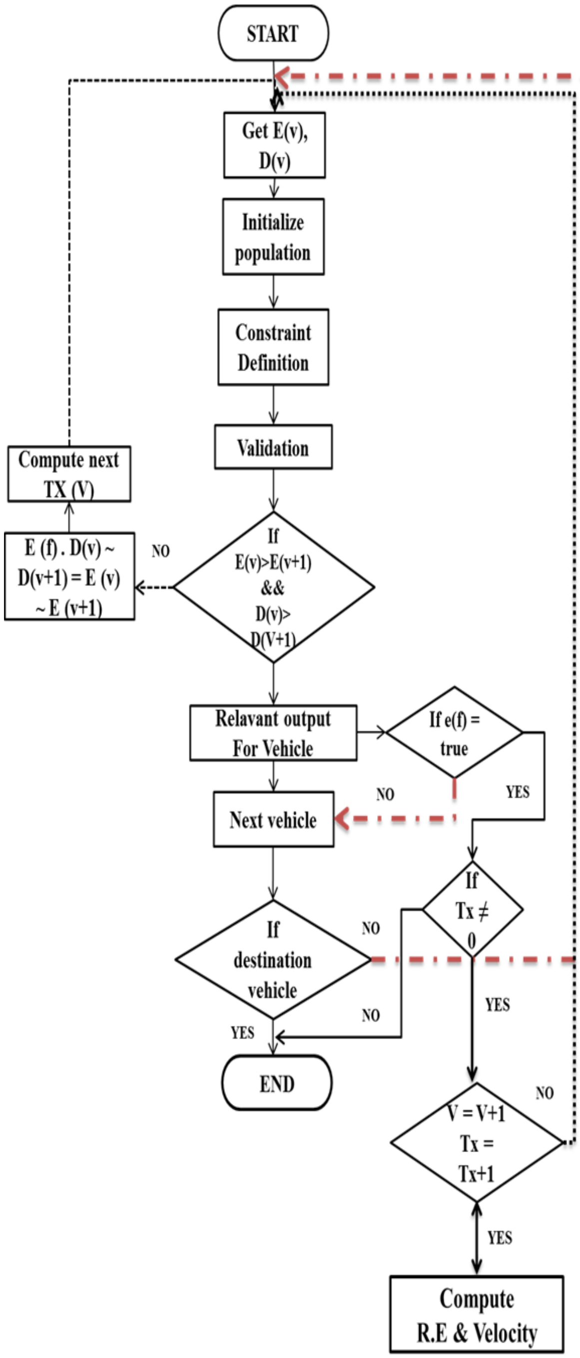

Fig.3: Flow Chart for Proposed Working

IV. FUZZY LOGIC SYSTEM

The fuzzy logic is used to select the optimal node to disseminate the data to the destination vehicle. In the proposed logic fuzzy helps to analyze the metrics of the neighbour nodes that are energy and data acceptance. Based on the metrics energy and data acceptance of neighbour nodes are selected based on high, low, medium. These metrics are inputs that are given to fuzzy logic system. The fuzzy rule table consists of certain rules that are helpful to select the neighbour nodes to destination for transmitting the data until the transmission is too been completed. The fuzzy decision system consists of three grades good, acceptable, bad. If the Grade output set as good it is optimal output for the fuzzy. If it is acceptable then it is sub optimal output that is secondary output to fuzzy. Then bad is rejection. The rule have considered for energy and data acceptance value of nodes. Data acceptance value with high and energy which high and medium are graded as good as the optimal output. And data acceptance value medium and energy value is medium is set to be Acceptable. The low energy and low data acceptance are the bad grade.

TABLE 1: FUZZY RULE

RULE NO.	ENERY	DATA ACCEPTANCE	GRADE
1	HIGH	HIGH	GOOD
2	LOW	HIGH	ACCEPTABLE
3	MEDIUM	HIGH	GOOD
4	HIGH	MEDIUM	ACCEPTABLE
5	MEDIUM	LOW	BAD
6	LOW	LOW	BAD
7	HIGH	LOW	GOOD
8	LOW	MEDIUM	ACCEPTABLE
9	MEDIUM	MEDIUM	GOOD

V. SIMULATION SCENARIO

The Realistic urban environment structure with 2 intersections and 5 two-way streets are distributed in a rectangle area as shown in Fig.4. The initial locations of vehicles are randomly located in the street map and the movement of vehicles is restricted along the street. There are 100 nodes set into simulated area of 2500 m × 1000 m.

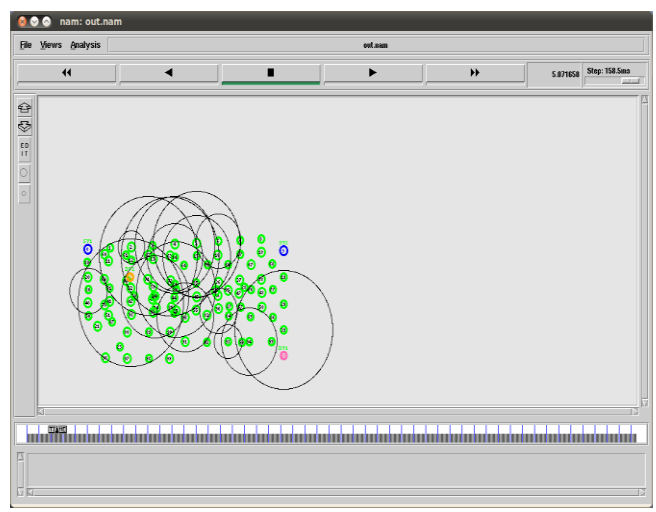

Fig.4 Simulation Scenario

TABLE.2 SIMULAION PARAMETERS

Simulation Parameters	Value
Simulation tool	NS 2 Version - 2.35
Number of nodes	100
MAC type	IEEE 802.11
Packet Size	512 bytes
Traffic type	CBR
Simulation time	100 sec
Min. Speed	30 Km/h
Max. speed	60Km/h
Traffic Flow	Free Flow

VI. PERFORMANCE PARAMETERS

The following performance metrics are considered for our simulation experiments:

A. ENERGY CONSUMPTION

The graph shows that the amount of energy utilizes by nodes for entire transmission. The proposed fuzzy optimization routing consumes lesser energy compared to existing ONS&VL algorithm. The existing ONS&VL algorithm utilizes more energy because it broadcast more control packets in order to find neighbours based on position, mobility, direction are parameters analyzed step by step and send to broadcast to source vehicle. The fuzzy optimization routing selects the vehicles based on energy availability and data acceptance analyzed in single step and broadcast to neighbour. Residual energy based data are transmitted to the nodes so energy consumption is quite higher than existing routing.

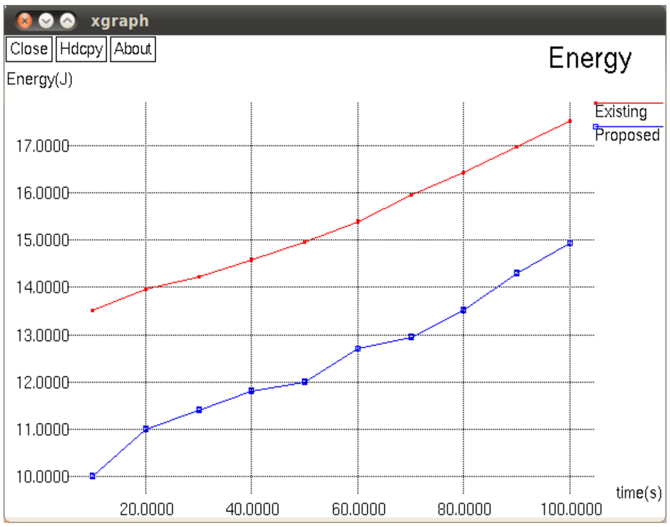

Fig.5: Time Vs. energy

B. OUTAGE

The graph shows the outage for the vehicle count. The outage is defined as the time taken between the reconnection time and disconnection time.

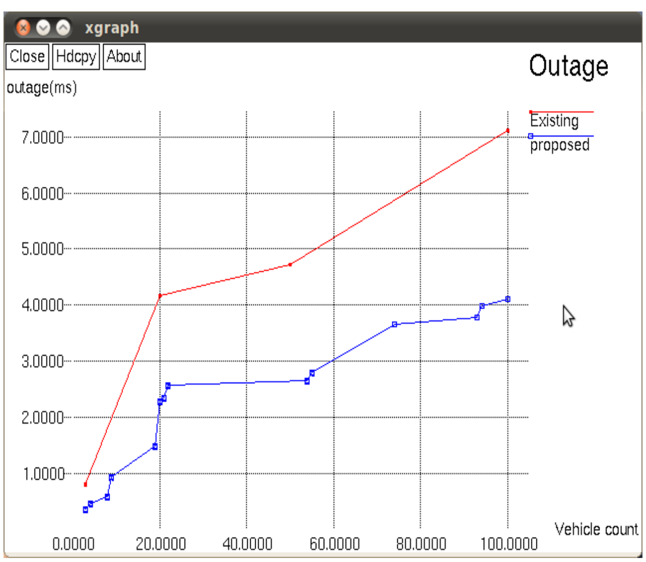

Fig.6: vehicle count vs. outage

The outage percent is lesser than existing ONS&VL routing because it does not considered about energy availability in the vehicle, if the energy gets drains it disconnects the link between neighbour nodes and after checking the parameters of vehicle like distance, direction, position and at it checks link available for the vehicle, if the link is not available it consume more outage time. But in fuzzy optimized routing we simultaneously check the energy, data acceptance so the disconnection of link between the vehicles is less when compared to Existing.

C. ROUTING OVERHEAD

The graph shows that routing overhead on vehicle count for existing ONS&VL and fuzzy optimization routing.

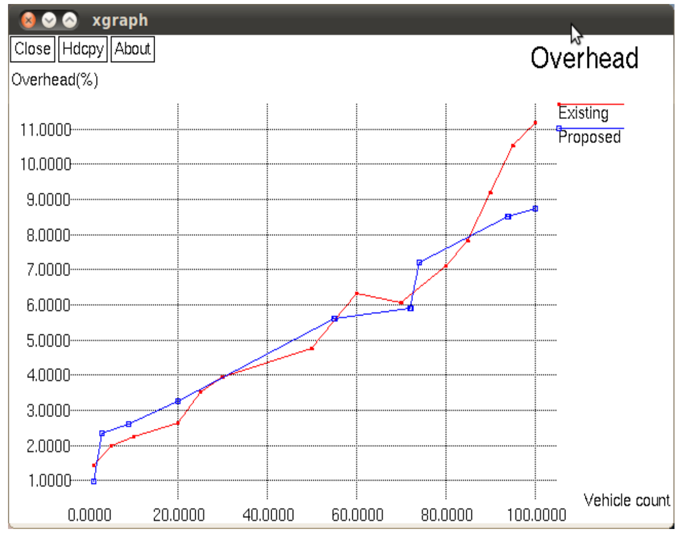

Fig.7: vehicle count Vs. overhead

The routing overhead is quite decreased when compared to existing routing. The proposed routing uses fuzzy decision system for selecting neighbour vehicle on basis having high energy and data acceptance rate. These parameters are checked simultaneously for the vehicles. So the number of control packets is transmitted lesser than existing. In existing control packets are transmitted for every parameter for vehicles is verified. This made increase in routing overhead in existing ONS&VL routing.

D. PACKET DELIVERY RATIO

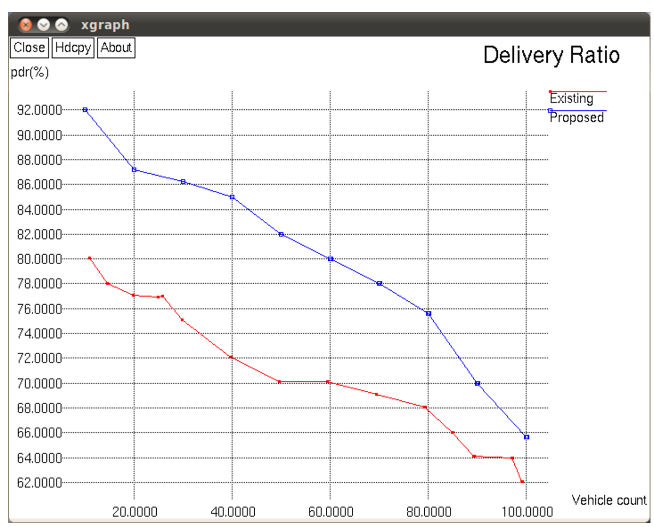

Fig.8: vehicle count Vs PDR

The graph shows the comparison of vehicle count and packet delivery ratio. It is described as the ratio of number of packets received at the destination node to the number of packets transmitted by the source node. The fuzzy optimization routing gives the better performance than the existing ONS&VL routing. The pdr is increased to existing works on the parameters to find neighbours based on position and direction but in proposed fuzzy optimization routing selects the nodes which have higher data acceptance rate for the distant neighbours. In the fuzzy routing delivery ratio is considered by energy of the nodes as the vehicle count increased the drop in energy causes decrease in packet delivery ratio.

E. THROUGHPUT

The graph shows the throughput for existing ONS&VL routing and proposed Fuzzy optimized routing. Throughput refers to the average data rate of successful data that deliver over a specific communications link. Fuzzy optimized routing has improved throughput than existing ONS&VL routing. The fuzzy optimized routing checks the data acceptance rate for the neighbour vehicles. So free queue size available vehicles are selected for the transmission this improved in successful data delivery. But in existing routing it concentrates only on position, direction and mobility parameters only the vehicles with higher queue size cannot handle the data and cause packet drop and this reduces in throughput.

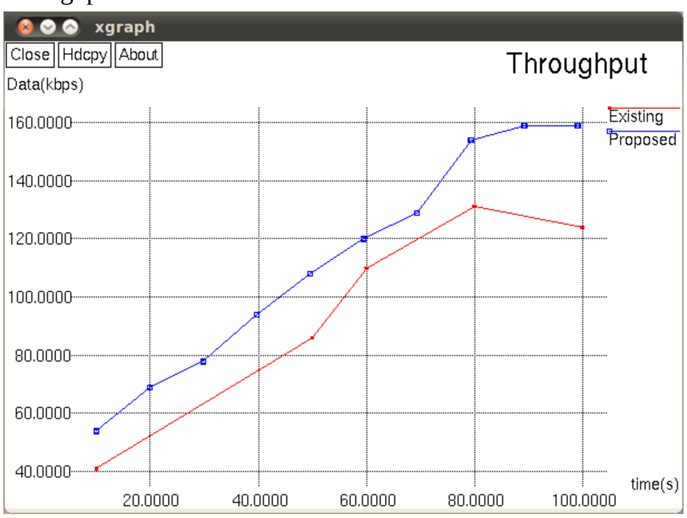

Fig.9: Time vs. DATA

F. COMPARISON PARAMETERS

The table shows that overall comparison of parameters between the existing ONS&VL routing and the proposed FOR routing Logic.

PARAMETERS	ONS & VL ROUTING LOGIC	FOR ROUTING LOGIC
OUTAGE	Increases	6% decreases
THROUGHPUT	Decreases	11% increases
PACKET DELIVERY RATIO	Decreases	5% increases
ENERGY CONSUMPTION	Decreases	5% increases
OVERHEAD	Increases	8% decreases

VII. CONCLUSION

The proposed fuzzy optimization routing logic is to improve energy efficiency for vehicles in an urban VANET scenario. It is used to select the most stable neighbour based on energy values and data acceptance values between source and destination. The node which is having more residual energy and data acceptance rate is selected as neighbour node. Due to this the connectivity between the nodes were stable to transfer the data packets successfully from source to destination with less outage and efficient energy consumption. In the proposed fuzzy optimization routing logic outage is minimized around 6%, routing overhead is decreased about 8% and energy consumption for the nodes is decreased about 5% and throughput is highly improved about 11%. Simulation results are demonstrates between the proposed FOR routing and existing ONS&VL routing logic.

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