PERFORMANCE ENHANCEMENT OF MODIFIED CUCKOO SEARCH OPTIMIZED PATH (MCSOP) FOR CLUSTER HEAD INDENTIFICATION IN URBAN VANET

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ABSTRACT
Vehicular Ad Hoc Networks (VANET) have recently emerged as an effective device to enhance road safety by broadcasting alerts to most vehicles within the network with limitations on approximate capacity to improve the highway. One of the biggest challenges is to transmit the messages to the final destination due to the high movement and dynamic path to the intermittent nodes. The aboveproblems have been solved using grouping mechanisms.Clustering is a mechanism for grouping vehicles based on some predefined metrics such as vehicle density, speed, and topographical positions. The main goal is to select the head of the cluster based on the random search algorithm (RSA) applying parameters such as acceleration and distance. Using the group leader manages the stats conversation between the vehicle nodes and reduces the end-to-end delay. Modified Cuckoo Search Optimized Path (MCSOP) is a cluster- based optimization to select the optimal cluster head based on the fitness function in terms of distance and acceleration. The optimal route between the source and destination for broadcasting the messages is then identified. The simulation result shows that MCSOP outperforms well in terms of delay, number of forwarders, unnecessary broadcast when velocity and transmission range acts as a function when it is compared with Emergency Message Dissemination for Vehicular Environments (EMDV), MultihopVehicularBroadcast(MHVB), IntervehicleGeocast (IVG) and Center Head using RSA methods.
Keywords: Random Search Algorithm(RSA), Cluster, Data dissemination, Cluster Head, Modified Cuckoo Search Optimized Path (MCSOP)-performance analysis.

1. Introduction
Accidents and traffic jams result in a massive waste of time and fuel. The safety and effectiveness of the transportation system can be increased in terms of time, distance, and fuel consumption if the vehicles are provided with convenient and dynamic data related to street traffic conditions, any shocking events, or accidents. Ad hoc networks called VANETs are set up among vehicles that are equipped with correspondence offices. These vehicles are similar to hubs in that each hub can serve as a source of information, an informational target, and a

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switching point for organisations. Through the widespread distribution of cautionary signals about
anticipated roadblocks up ahead among the vehicles in the organisation, Vehicular Ad Hoc Networks (VANET) is a convincing tool for advancing road safety.
In VANETs, data dissemination is challenging due to network disconnections and mobility. Therefore, clustering-based data dissemination avoids this problem by grouping geologically adjacent vehicle nodes into a cluster, which in turn significantly improves the network's adaptability. For effective communication in a dynamic environment, the links' communication is steadier.Therefore, the clustering of vehicles to distribute the data among the vehicles and the development of bio-inspired algorithms to obtain an optimal arrangement sparked to foster a challenged notion and to enforce a bio-motivated solution for conception of clustering in VANET. Existingframeworks are made to meet specific highlights and are not prepared to deal with the spontaneous notion of intellectual vehicle communication. A state-of-the-art is anticipated to carry out a secure and trustworthy explanation to fill the gap found in VANET. Thus, the diffusion of data is another important issue that can be addressed by the use of optimization approaches.

2 Related Works

Data dissemination is a challenging issue since the vehicle network must be used to transmit the most data possible owing to bandwidth restrictions. In order to communicate emergency information to drivers, passengers, and vehicles, VANETs use data-dissemination algorithms. Therefore, it's imperative to keep in mind that information needs to be shared with all cars in the interest area. Numerous academics have suggested numerous strategies for sharing data so that it can be accessed more rapidly. Among them are:
Xu et al. [1] developed a model for providing Quality-of-Service (QoS) for safety messages using the 802.11p standard. This technology enables a high likelihood of receiving warning messages for autos within direct communication range. The amount of time it takes for one message to be delivered defines a time slot, and the number of slots defines a time frame. Since their range is constrained to one-hop neighbours, messages must be sent repeatedly throughout their lifetime to increase the likelihood that they will be successfully received. [2] adopts a similar strategy where cars transmit brief, brief messages that must be quickly repeated in order to achieve high dependability and low delay.

Farnoud and Valaee [3] investigated synchronous fixed retransmission, synchronous p-persistent retransmission, and optical orthogonal codes for one-hop safety message retransmission. They showed how the latter could increase success probability while shortening delay. Since the simulation results were obtained on a three-lane straight road, they are not totally applicable to urban settings where barriers regularly block wireless signals (e.g., buildings).
Viriyasitavat et al. [4] protocol for Urban Vehicular Broadcast (UV-CAST) focuses on data distribution for both dense and sparse VANET environments. There are two modes available

for each vehicle in UV-CAST: broadcast suppression or store-carry-forward (SCF). A transmission strategy that employs a time-barrier method to weed out messages that can interfere with the network was presented by Shah et al. [5]. The goal behind the suggested fix was to fast spread the information via a super node. The time barrier techniques have been adjusted to address the issue and prevent unintended propagation, which could cause the transmission hurricane problem.A modern, efficient clustering simulation versatility (MPECS) system was proposed by

I. T. Abdel-Halim et al. in [6]. The main idea behind MPECS was to partition the entire region into pieces using a Voronoi graph, which would then allow each vehicle to calculate the cost and lifetime of becoming the cluster leader where it is now located. A robust MPECS capability improves clustering design dependability while lowering overhead, as shown by the suggested technique in [7]. This study suggested a CBD- and clustering-based modern data dissemination technique.

Marc Torrent-Moreno et.al. proposed " Emergency Message Dissemination for Vehicular Environments (EMDV).The fundamental benefit of EMDV is that it decreases the end-to-end time by enabling a vehicle (the chosen "preferred" forwarder) to forward a message right away. Note that neither EMDV nor MHVB expressly try to prevent pointless re-broadcasts brought on by connection failures or concealed terminal effects[8].

Mariyasagayam et al proposed "An Enhanced Multihop Vehicular Broadcast". Due to a concealed terminal issue, the MHVB protocol eliminates certain needless re-broadcasts and reduces the number of vehicles in the contention phase by using the angle-based backfire region in the forwarder selection process. By observing nearby traffic, this protocol offers dynamic scheduling for beacon broadcast (e.g. it expands beacon transmission interval in a high vehicle density scenario). These MHVB implementations are used to conserve bandwidth and lessen network collision[9].

A. Bachir and A. Benslimane proposed "A Multicast Protocol in Ad hoc Networks: Inter-Vehicle Geocast".Vehicles do not keep track of their neighbours in this protocol. This frees up more bandwidth for message broadcasting while reducing the traffic generated by the greeting messages sent and received between the cars. Due to a hidden terminal issue, this protocol may result in unwanted rebroadcasts since there is no forwarder selection region in each hop[10]. Another cluster model was proposed and created by B. Ramakrishnan, et al. [11] for effective communication among the VANET nodes on the road. Here, the VANET is illustrated using a Simple Highway. Vehicles can freely travel in any way along a roadside. Each car may have a limited radio range. Vehicles within radio inclusion range can communicate clearly as opposed to the existing model's correspondence through an appropriate side of the road unit.

Liu, L et al. [12] presented a convention on Particle Swarm Optimization Contention based Broadcast (PCBB) has presented for quick and compelling spread of crisis messages within the geological region by using dispute window, position based sending plan, and PSO clever strategy, which help to make more precise examination and execution, and expanding the level of crisis message gathering without influencing the channel impact.

Fogue et al. [13] present better Message Dissemination subject to Roadmaps(e-MDR), another arrangement that is uncommonly expected to extend the level of taught vehicles and decrease notice time; all the while, it mitigates the impart storm issue in genuine urban circumstances. We assess the impact that our arrangement has on execution after being associated with VANET circumstances subject to authentic city maps, and the results show that it outperforms previous plans in all conditions.

3. Proposed Work

3.1. System Model

A VANET combines three different types of parts: servers, Road Side units (RSUs), and cars. The VANET, which consists of 1... N number of vehicles, has as its foremost disciples cars. To keep in mind that every vehicle is equipped with an On Board Unit (OBU), capable of sending and receiving messages via wireless connection [14]. Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication are primarily involved in the correspondence. The RSU is a remote communication facility that was installed by the side of the road. It serves as a middleman between servers and cars. Servers, which deal with the VANET's vehicles and applications, are the third category of unit.

Think about a highway scene where several automobiles are driving in a dynamic speed and direction. Permit us to consider that one vehicle as having a dynamic relationship with itself. This hypothesis contrasts favourably with the claim that each car is moving at a different speed from the others. The prominent features of VANET, such as its high portability and vehicles, have been widely publicised, which has caused variations in the geologies and separations of the association.We suggest a grouping of cars together in order to create a reliable association on it in order to address these concerns. Each group has a cluster leader who is responsible for controlling the transfer of data concerning the group component.

In this research, we propose a cluster-based information transmission technique that takes into account vehicle-to-vehicle (V2V) communication. We anticipate that every car will have a specific feature and be equipped with an On Board Unit (OBU). It is possible to obtain basic information using the GPS system, including the location, speed, and direction of the vehicle. Through signal messages, vehicles exchange information with one another. The beacon messages, which include the vehicle's identifier, current position,vehicle's current status, current speed, direction, and cluster head identification, are transmitted and gathered at every time interval.

3.2 Cluster Head Identification using RSA

In this method, it uses the Random Search Algorithm to choose the cluster head (RSA). Workings of RSA are as follows: Producing and evaluating arbitrary contributions to the objective work are both included in Random Search. It is effective because it makes no assumptions regarding how the objective function is built. This can be helpful for problems where there is a lot of area expertise that could influence or incline the optimization process, allowing for the discovery of counterintuitive conclusions. [15]

To choose the cluster Head in RSA, first chose the car at random based on its position, direction, and speed (CH). Initialize the iteration using the vehicle distance calculations, and then using the probability distribution provided below the equation, generate the new value of the vehicle:

$$\text{If } f(n_{new}(i+1)) < f(n_i),$$

$$\text{Set } n_{(i+1)} = n_{new}(i+1),$$

$$\text{Else } n_{(i+1)} = n_i$$

With reference to the calculation of the above equation, identify the nearest value as Cluster Head (CH) and neighbouring vehicles has to be considered as the cluster member (CM).

Pseudo code for random Search Algorithm for choosing Cluster Head (CH)

1. Randomly choose an initial vehicle (n_0), $n_0 \in N$ where based on the position, direction and velocity.
2. Calculate $f(n_0)$
3. Calculate the distance of each vehicle with others.
4. Set i=0
5. Generate a new value $n_{new}(i+1) \in N$ based on probability distribution
6. Choose the cluster head (CH) based on the below equation
7. If $f(n_{new}(i+1)) < f(n_i)$
   a. Set $n_{(i+1)} = n_{new}(i+1)$
   b. Else $n_{(i+1)} = n_i$
8. Stop if the extreme number of iterations has been reached;
9. Otherwise go to step 1 based on the new i set to the past i+1

Now the RSU as the controller that beacons the transmission of data to the CH and thus CH acknowledges to the RSU. Similarly Cluster Head (CH) beacons the transmission of data to the cluster member (CM) and also to the nearest non cluster member (NCM) based on the same position of vehicle. All the cluster member and non-cluster member (NCM) have been acknowledging to the CH. Thus the broadcasting of data transmission, the cluster member and other intermittent vehicles have been changed their pathway.

3.3 Cluster Head Identification using Modified Cuckoo Search Optimization (MCSO)

3.3.1 Clustering Method:

Cluster head (CH) plays a crucial role in a Cluster's development cycle in VANET Clustering. Depending on the measures used as input, a cluster can be created in a variety of methods. The vehicle component of a cluster is known as a Cluster Member (CM). Cluster Gateways are a few calculations that, in addition to CH and CM, use two CMs to communicate with various groups for the CH (CGs). All members of a group are referred to as CMs, unless they are designated as CG. A group may have one CH, zero, one, or two CGs, and a large number of CMs.[16]

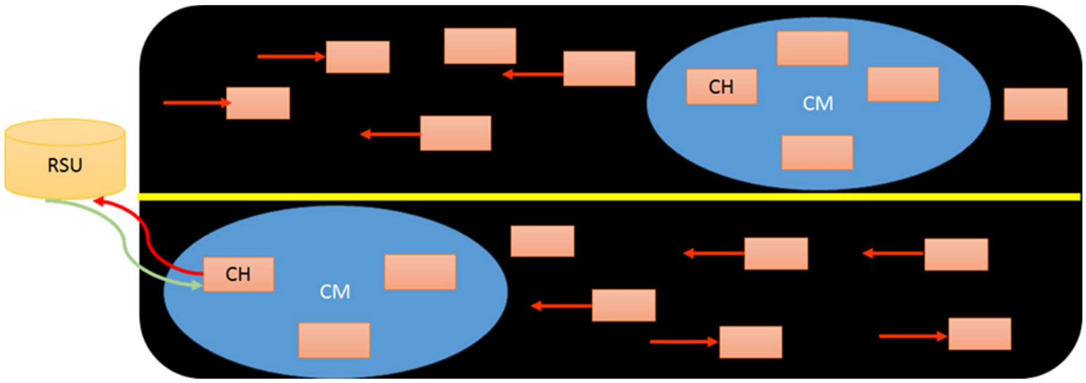


Fig. 1. Clustering Method

To select the cluster head, the proposed method modifies fuzzy cuckoo search optimization and calls it modified cuckoo search optimization path (MCSOP).

Cuckoo Search (CS), one of the newest bio-inspired algorithms, was created by Yang and Deb [17]. The Lévy flights improve the CS technique, which rely on the brood parasitism of particular cuckoo species [18]. According to recent research, CS is likely more efficient than PSO and GA [19].Eggs laid in the nests of other host birds are the typical method used by cuckoo birds to carry out their fostering parasitism [20]. The host bird will expel the eggs if it realises they are not its own, abandoning the nest and making another one somewhere [21]. Since the process starts with distinct nests, each egg in the nest contributes to the final result. The Lévy flight technique is employed to produce innovative findings [22]. Newer, better replies are substituted for the worst ones in the nest. The best nest, which produces eggs of exceptional quality, will be passed down to the following generation.

The examination is approved out by Lévy flights for creating a novel result using the solution as shown in Equation (1):

(1)

The L´evy flight essentially provides a random walk while the random step length is drawn from an L´evy distribution in equation (2)

(2)

In VANET, the vehicle is initially identified as a node based on its position (P), direction (D), and velocity (V) (V). Each cuckoo is a vehicle node selected at random. By computing a membership matrix for each nest and calculating the fitness for each nest using the fuzzy K-Means' objective function, the fuzzy notion is integrated into the cuckoo search. Let X = x 1,

x 2,..., x n be a set of nodes (Vehicles) to be clustered, with v i as its centroid, C as the cluster's number, and r as a parameter for choosing the cluster Head (CH).

The objective function of the MCSOP algorithm is in Equation (3):

(3)

Where F is the sum of squared error for the set of fuzzy clusters and the associated set of cluster centers V. Here, is the distance between the data and the cluster center . The centroids and cluster member for each cluster can be evaluated using Equations (4) and (5)

(4)

(5)

Only the finest solutions are retained once a portion of nests are terminated. Following, the next generation inherits the current best cluster solution, and so on until a maximum number of generations or a stopping requirement is reached. The closest value should be designated as Cluster Head (CH) in the calculation of the aforementioned equation, and nearby cars should be regarded as Cluster Members (CM).

Pseudo code of MCSOP for choosing Cluster Head (CH) in VANET

10. Initial population of n nodes of cluster having its position, direction and velocity
11. While t < (Max Iteration) or Stopping Criterion
12. Choose a cuckoo set of cluster node randomly and also applying Lévy flights using Equation (1)
13. The fitness function of each nest is computed using Equation (3) and the cluster centroid are identified using Equation (4)
14. To calculate the cluster member of each nest using Equation (5)
15. Choose a nest randomly.
16. if (Fi <Fj)

    Replace j by new solution by implementing Lévy flight and update the centroids end if
17. if > Ai (UpperApproximate)

    Remove node from the cluster.

    end if
18. Retain the best cluster node and chose it as cluster head.
19. This best cluster act as a cluster head and passed to the next iteration.

20. end while

Currently, the RSU serves as the regulator that directs data transfer to the CH, and CH consequently acknowledges the RSU. Similar to a vehicle's location, the Cluster Head (CH) indicates the transmission of data to the closest Cluster Member (CM) as well as to the nearest non-Cluster Member (NCM). The CH has recognised every cluster member and non- cluster member (NCM). As a result, the cluster member and other irregular vehicles have adjusted their course and the broadcasting of data transmission.

4 RESULTS & DISCLOSURE:

4.1 SIMULATION ENVIRONMENT

Test model have been accomplished by utilizing the system Veins 5.1 of the OMNeT++ 5.6.2. Veins give the convention heap of the IEEE 802.11p norm for V2V correspondence and an obstruction model for signal constriction. For the test of vehicle traffic and motion, we thought about SUMO (Simulation of Urban MObility) , which is an open source traffic test system to demonstrate and to control objects in the street situation. This permits us to recreate the ideal vehicle developments with arbitrary journey speed and V2V communications as indicated by exact information. We considered an area of 3 km2 from the Saravanampatti to Kalapatti of Coimbatore city, Tamilnadu and from Raja street to around Town Hall of Coimbatore city, Tamilnadu which was acquired through the OpenStreetMap and imported by SUMO to produce the move records of vehicles.

4.2 SIMULATION ANALYSIS

In this section, the effectiveness and dependability of MCSO with those of EMDV, MHVB, IVG and CH_RSA are compared. The end-to-end delay, the number of forwarders, and the number of unnecessary re-broadcasts can all be used to evaluate the effectiveness of these protocols. Reliability is determined by the ability to spread a message throughout the full target area. When a communication finally reaches the target region, it has experienced an end-to-end delay. The number of forwarders is the total amount of forwarders required to spread a message inside the intended area. These metrics are produced by simulating averages of more than 100 warning messages, and they are examined in situations with different densities of vehicles, transmission ranges, and warning message lifetimes.

Each simulation ran for 500 seconds (simulation time) and vehicles are simply filling the simulation playfield during the initial 400 seconds. During this initial interval, no messages are exchanged between vehicles. Vehicles start to exchange beaconing messages after 400 seconds at the rate of 10 Hz. The simulator generates WMs at 1 Hz rate and offers each WM to a randomly selected vehicle to disseminate.

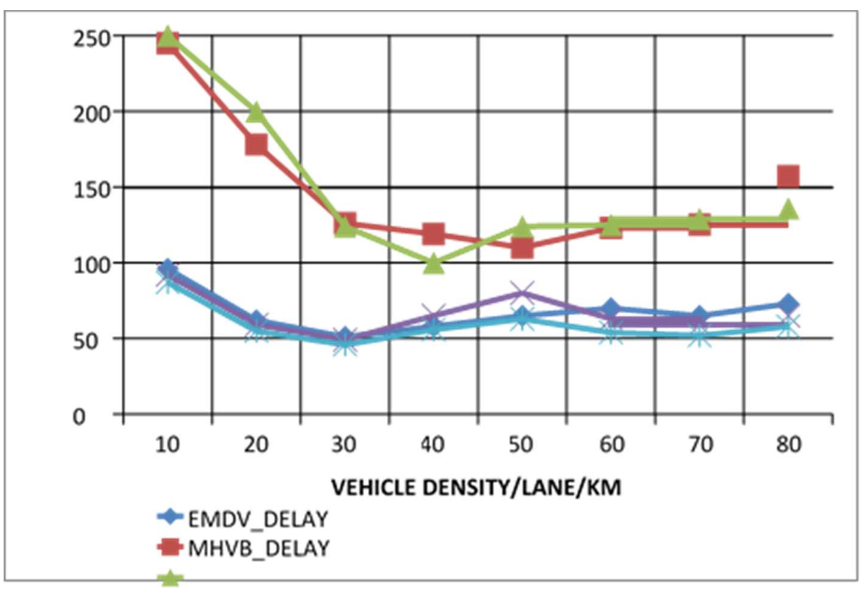
Table - 1 Additional Simulation parameters.

Parameter	Value of Parameter
Environment	Omnetpp 5.6.2,Veins5.1 and Sumo
Channel required	Wireless
Algorithm Used	RSA for identification of Cluster Head
Size of Networks	Dynamics
Type of Road	Highway with Multiple Lanes
Road Length	8 km
Vehicle Density	15 ~50 vehicles/km.Lane

Simulation Area	3Km²
Simulation Time	500 sec
No. of Nodes	3000 Nodes
Frequency	5.850 GHz
Data rate	6 Mbps
Packet Size	270 bytes
Transmission Range (m)	250 -700
Transmission length (m)	1000 -7000
Warning Message interval	1s
Beaconing interval	1/10s

4.3 The effects of the vehicle density

In this section, the effects of the vehicle density by varying it between 10 and 80 vehicles per lane per km were studied. The transmission range and the length of a target region are fixed at 300 m and 3000 m, respectively. The other simulation parameters are as mentioned in Table - 1.



IVG_DELAY CH_MSCASO

Fig 2. Function of Vehicle Density – Average Delay

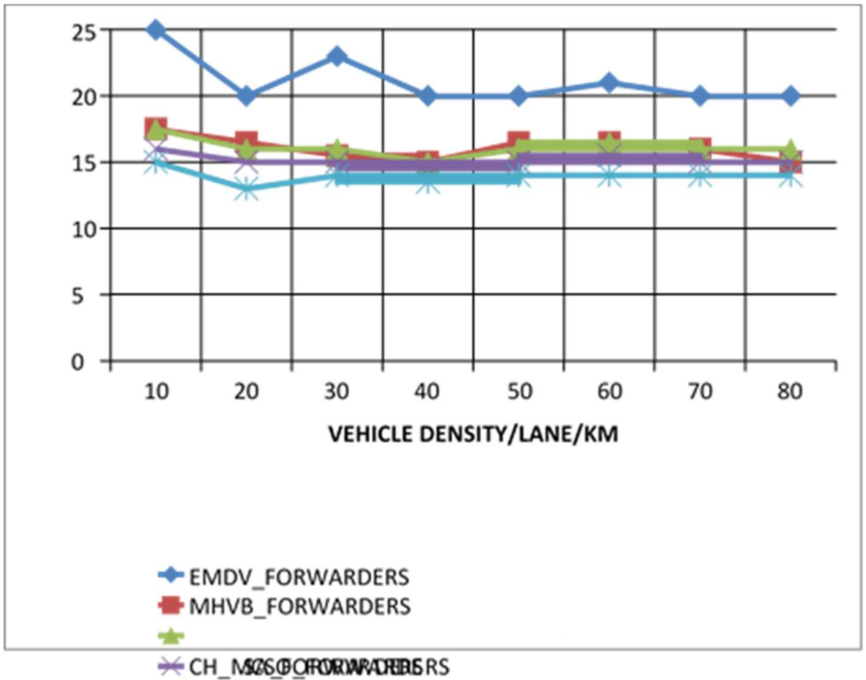
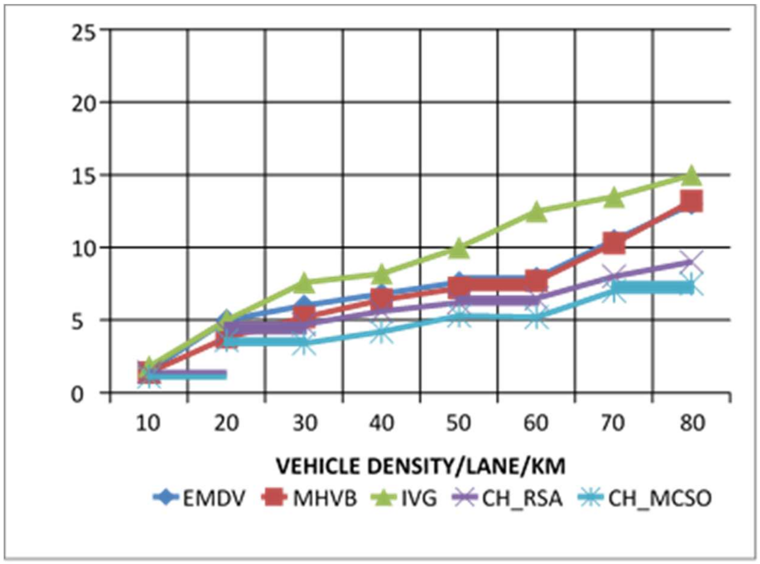


Fig 3. Function of Vehicle Density – Number of forwarders

The average delay and the number of forwarders are shown as a function of vehicle density in Figures 2 and 3, respectively. In terms of delay with low vehicle densities, CH_MCSO,CH_RSA and EMDV clearly surpass IVG and MHVB (below 40). This is due to the fact that low vehicle densities may result in a lack of vehicles near a sender's transmission range, which, in accordance with the distance-based system, results in waiting periods that are somewhat longer than ideal. By contrast, re-broadcasting always occurs instantly in CH_MCSO, CH_RSA and EMDV when employing the preferred forwarder selection strategy. Due to the potential of finding a forwarder at the sender's transmission range's edge in high vehicle densities, the end-to-end delay for MHVB and IVG starts to decrease as the vehicle density rises. Since the transmission range and the length of the target zone are constant and all protocols (try to) pick the farthest vehicle as a forwarder, it should be noted that the average number of potential forwarders is about 16 in all circumstances, with the exception of EMDV. However, EMDV employs a forwarding area that is only as large as the sender's communication range, therefore it takes more hops than the other protocols to reach the complete target zone.



Function of Vehicle Density – Unnecessary Re-broadcast

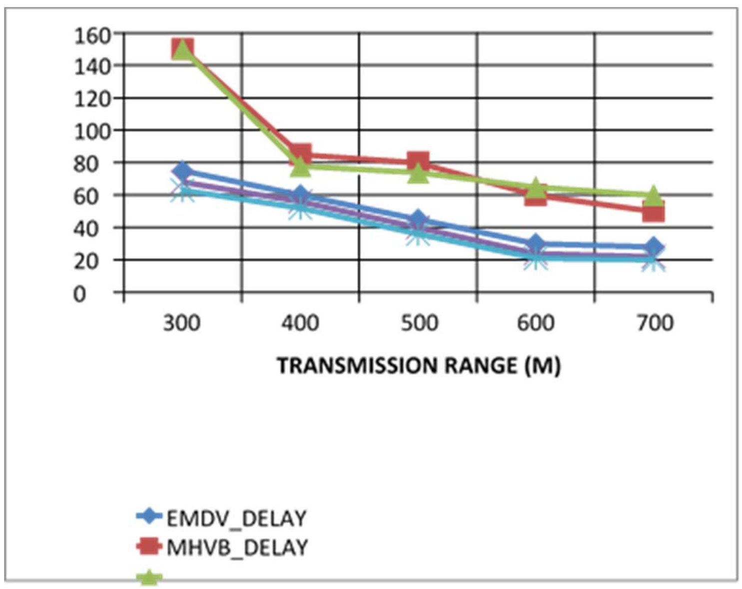


Fig 4. Function of Transmission Range – Unnecessary Re-broadcast

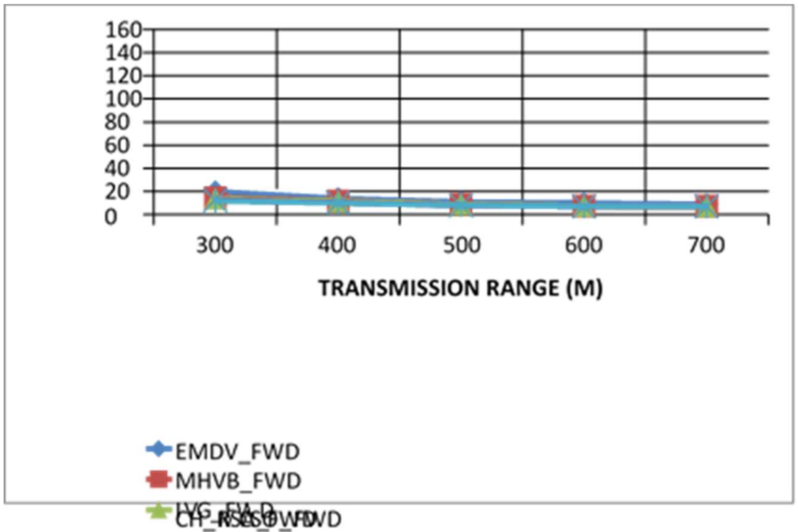


Fig 5. Function of Transmission Range – Number of Forwarders

Fig 3 displays the typical amount of unnecessary retransmissions, and once more, CH_MCHO surpasses the other protocols. Each sender or forwarder is permitted a maximum of three re-broadcasts in the event that it does not hear the transmission of its (preferred or other) forwarder, as this might result in extra broadcasts. However, in CH_MCSO, the possible forwarder notifies the following forwarding vehicles with notification messages (ACK). At higher vehicle concentrations, this strategy is clearly profitable.

To experiment with the transmission range. in this section, altering it between 250 and 700 metres. The target region's length is fixed at 3000m, and the vehicle density is set to a medium value of 30 vehicles per lane per kilometre.
Fig 4 shows that, in terms of end-to-end latency, CH_MCSO, CH_RSA and EMDV once again perform better than the other protocols. By extending the transmission range, the average end-to- end latency of all chosen protocols start to come down. Recall from Fig 5 that the number of prospective forwarders decreases as the transmission range increases and that, except from EMDV, all protocols taken into consideration have nearly the same number of (intended) forwarders in this case.

5 CONCLUSIONS AND FUTURE WORK

In this paper, we have analysed the performance of the CH_MCSO, CH_RSA, EMDV, MHVB and IVG methods as functions of vehicle density in terms of delay, number of forwarders and unnecessary broadcast and as function of transmission range in terms of unnecessary broadcast and number of forwarders.From the results, it is observed CH_MCSO outperforms well compared to the CH_RSA, EMDV, MHVB and IVG methods. In future, more parameters such as length of target region, life time of the message etc, be considered for better understanding the performance of the proposed work.

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