



CLUSTERING ADAPTIVE ELEPHANT HERD OPTIMIZATION APPROACH-BASED DATA DISSEMINATION PROTOCOL FOR VEHICULAR AD HOC NETWORKS

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Abstract

The wirelessly connected networks of vehicular nodes are Vehicular Ad Hoc Networks (VANET). According to the limited bandwidth of the wireless interface, dynamic topology, and frequently disconnected networks with a vital role in vehicular communication is the best path. To address this problem, this research proposes a Clustering-based Adaptive Elephant Herd Optimization (CAEHO) for VANETs. The proposed CAEHONET protocol is used to form optimized clusters for robust communication. in CAEHONET is utilized to control the overhead can be efficient. The main objective of the paper is to analyse energy efficiency and provide the security analysis in VANET. By calculating an enhanced fitness function, it works intelligently to select the optimal route and most stable route among known routes. The aim of the paper is to maintain the stability in the system of polar coordinate and the obstacles as the objective of the probability of occurrence. The NS2 platform is used to implement the proposed work then it is contrasted with previous techniques such as the Ant Colony Optimization algorithm (ACO) and Improved Whale Optimization algorithm (IWOA) respectively. Especially, the CAEHONET enhances the packet delivery, network throughput, packet loss ratio and ratio end-to-end delay than other routing protocols and the entire simulation works are handled in NS2 tool.

Keywords: CAEHONET protocol, EHO, Improved whale optimization algorithm, energy, clustering, ACO and NS2 platform

I. Introduction

Recently, the Intelligent Transportation Systems (ITSs) is fed to the infrastructure to transfer information between them and vehicles also, which enhances and minimizes the productivity, safety and traffic congestion. The services connected to traffic and transport management is provided by the advanced applications of ITSs. Based on the transport networks uses, make a safer, more coordinated and permits the users become superior knowledgeable. One of the vital mechanisms of ITSs is Vehicular Ad hoc Networks (VANETs) [XIV], [XXI].

In the research community, the great interest attracts recently is vehicular networks and number of useful applications are proposed [XXVI]. The vehicle collision avoidance is this range from safety applications. For media content sharing, trip planning and information retrieval with the means of transport crash evasion, to other expensive requests. The environmental conditions and other monitor roads are established by a mobile sensor network in vehicles. The vehicular networks are the “delivery networks” that transfer data from remote sensor nets to Internet servers [XII], [XVII], [VI], [III], [XXV], [XXIV].

The communication among vehicles toward send data from a source to a node destination are maintained by the main challenge in VANETs. The multi-hop and wireless mode data transmission is occurred. From many studies, the most common issues are solved by an efficient data transmission in VANETs protocol [V], [VI], [VIII], [IX]. This problem is never yet provided while despite the different approaches proposed so far [XVI].

The road-safety as well as comfort applications such as weather information, Internet access and so on are provided by emerging field of several useful applications. A lot of study related to the protocols of communication verifies the robust data packets delivering and applications rely on a reliable [XXVII], [XVIII], [XI]. The Vehicle-to-Vehicle (V2V) and Vehicle-to-Road-Side-Unit (V2R) are both kinds of message on a just vehicular network then it provided better data packets transmission. The road users used robustly and rapidly data provides VANET information, also the support the requirements convinces routing protocols [XX].

Due to some link breakdown on the routing paths previously introduced, the random way modifications of vehicles and high mobility are the unique characteristics of VANETs. Because of high-rise buildings, from time to time through communications among few vehicles are not possible in addition smaller distance than the transmission range. The wireless links instability and frequent disconnections problem addressed to major proposed routing protocols dedicated. The performance of routing is affected by previous protocols never totally think the express effect of current obstructions through connectivity. For transmitting the data packets, the option of the most excellent linked trails combines the traffic density and accuracy of the connectivity [X], [XX].

The data transfer in VANETs discussed many studies, Artificial Intelligence (AI) techniques, clustering algorithms, Glow worm swarm optimization routing algorithm and Ant colony optimization algorithm.

The proposed the protocol of CAEHONE via a data dissemination of VANET is analyzed. Section 2 explains the newest investigate reviews. The detailed

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explanation CAEHONET model is illustrated in the section 3. Section 4 discusses the result and section 5 concludes the paper.

II. Literature Review

The excellent data dissemination protocol for VANETs protocols presented in the existing studies is analyzed in this section.

The mechanize the proposal of cluster heads and clustering of nodes based Evolutionary Game Theoretic (EGT) framework was proposed by Ammara Anjum Khan *et al.* [I] that accomplishes the VANETs with cluster stability. The Lyapunov function has been used to test the stability and the equilibrium point was established systematically. By using static and mobile scenarios to different cost functions by their projected evolutionary sport performance is typically examined. For different populations and speeds, the heftiness of EGT method and the simulation results demonstrate the effectiveness.

The optimal dropbox deployment algorithm (ODDA) was advocated by Jianping He *et al.* [XIII] and the hypothetical structure for accurate release time computation. For a given m , polynomial computational complexity is ODDA and deployment for the number of dropboxes. The benchmark methods were used to analyze the performance evaluation and the simulation results demonstrates the superior performance than existing algorithms.

In VCPS environment, the efficient data dissemination between different devices for secure clustering was advocated by Rasmeet S. Balia *et al.* [XIX]. For trust computation among the different devices, the varying transmission characteristic of vehicles defines according to a different trust metric then the global and local levels are evaluated. For creating secure clusters, the key parameter with current security level of vehicles is established by the trust metric. This method designs the secure clustering for trust establishment. Based on various network scenarios, the different evaluation metrics is to evaluate the performance of their proposed scheme.

According to vehicular FoG computing and congestion avoidance scenario in VANET based emergency message dissemination schemes was presented by Ata Ullah *et al.* [IV]. The message congestion scenarios managed the FoG-assisted VANET architecture in the similar vein. The address message congestion avoidance by them presented taxonomy of schemes. The strengths and weaknesses are highlighted by the comparison of congestion avoidance. For all big data repositories with linkage requests, the overcrowding as contrasted to in a straight line similar to cloud and the accessibility delays reduced by the FoG servers.

The multiple worth of Discrete Particle Swarm Optimization (DPSO) was carried out by Manisha Chahal *et al.* [XV] for the identification of an optimal path in VANETs. The possibility of obstructions incidence as purpose and the polar coordinate system are calculated by the Euclidean distance based their projected method involving link stability. The performance metrics like routing overhead, packet delivery ratio and average throughput is to analyze the effectiveness of their proposed method by extensive simulations.

In partially connected VANETs, connectivity-aware data dissemination (CADD) approach was proposed by Zhiyuan Li *et al.* [XXVIII] then the data transmission capacity is enhanced. The node forwarding capability estimation

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introduces a different metric in the CADD protocol. The estimation of association delay is activated and throughput purposes are the metrics. The various metric plans the high efficiency protocol of data dissemination.

The existing solutions with CADD protocol results has shown better outcome in case of protocol overhead, the transmission delay and the packet release ratio.

Recently, many investigation works are talk about VANETs data dissemination. Because of the dynamic characteristics by the network transmission efficiency is poor. The very challenging problem can prove the efficient routes discovery and maintenance for data dissemination in VANETs. The information-centric VANETs obtained from Content Centric Networks (CCN) into VANETs forming information-centric VANETs were proposed by many studies to improve transmission performance. For assisting the data dissemination, the drop boxes are extremely useful in vehicular networks. It minimizes the data delivery delay that increases the contact probabilities between vehicles. For data dissemination, the efficient and stable routes provided by control protocols are clustering. The frequent cluster reformation is created by quick network topology variations in VANETs that provides stability routes. In VANETs, the QoS-aware data dissemination and reliable are enabled by assumed as a category of discrete optimization. According to dynamic topology, disconnected network and incomplete wireless interface bandwidth with the most favourable path is the huge significance in vehicular communication, also the data transfer in VANETs is discussed by many studies. Moreover, the unicast protocols and broadcast protocols are the most popular existing approaches. One receiver node and the transfer of data between single sender node are conducted by unicast protocols. The data disseminate in the direction of multi future receivers by the broadcast protocols. In VANETs, the most popular protocol is unicast protocol for data storing. In contrast, the broadcast scheme provides efficient modulation and coding system. Next to that, more heuristic methods including particle swarm optimization algorithm, Glowworm Swarm Optimization (GSO) and ant colony algorithm. For the problem to solve, this is approximate to generate suitable solutions and it create optimal solution. The routing algorithm of ituation-Aware Multi-constrained QoS (SAMQ) is introduced for VANETs. The QoS parameters set are improved via optimal path between two nodes. The NP-hard and optimization issues are solved. In VANET, the data dissemination is analyzed with the usage of CAEHONET protocol. The deficiency error is minimized and it measures the reliability according to the multiple criteria. The main contribution of the paper is described as below,

Contribution of the Research:

- In the paper, the clustering concept is utilized and selected the cluster head (CH).
- To find the best path and measure the distances between the vehicles.
- To improve the life time of the path withbearing in mind stability issuelinkedamong the vehicles.
- By using Network Simulator (NS2) with the proposed CAEHONET protocol performance is analyzed.

III. Proposed Methodology

The proposed CAEHONET is the optimal method in high speed VANET for efficient multimedia dissemination. Against density of vehicles and high speed, the recognizing most favourable connection in discovery of route with the path lifetime or reliability improvement is the most important endeavour of the proposed method. Through wireless links with the decentralized dynamic network connects the vehicles are self-configured by the Vehicular ad-hoc network (VANET). With less delay for data packets networking between huge speed vehicles with the efficient routing mechanism are demanded by the VANET knowledge recurrent connection breaks throughout the vehicles lifetime.

This paper depends on the clustering process with CAEHONET protocol for the data disseminative process in VANETs. For better multimedia data dissemination, the link breaks are decreased to enhance the lifetime of routing path with the main purpose is to put up steady clusters. The relative distances between it to finding reliable relay vehicles to the destination, which is accomplished via bring in clustering idea. The previous method IWOA and ACO method comparison with network simulator-2 for dissimilar velocities of vehicle by proposed scheme performance is evaluated. For dissimilar vehicle density and velocity with the in general time is minimized to 60% due to improved reliability.

Clustering process

The sequential vehicles into clusters set groups the topology. The designated cluster head (CH) links the members of each cluster at the intra-cluster level. The multi-hop link is used to connect the cluster heads at the inter-cluster level. The access to a time bounded with each cluster member providing the input purpose, which to send its message on contention-free channel. The protocol of multi-hop inter-cluster communication is used to adjacent cluster heads exchange their status of cluster. Finally, all their cluster members' aggregates the information by cluster heads broadcast by the dissemination protocol of intra-cluster. To obtain the same proximity map of vehicle its surroundings by broadcast transmission by each cluster member successfully receiving this as the chart is broadcasted as of a solitary basis. Under the high data load of beacon transmissions by use contention-free MAC in order to reach dependability. The synchronization of both inter-cluster and intra-cluster channel are combined by contention-free MAC. Fed the wide inter-cluster bandwidth use again, the high bandwidth efficiency is provided by intra-cluster aggregation protocol. In all clusters that takes place simultaneously based on the aggregation process. For adjacent cluster heads' communication and more reliable map dissemination in the aggregation stage creates the channel in an efficient bandwidth use again.

For more reliable map dissemination in the aggregation stage creates the channel available by this efficient bandwidth reuse and cluster heads' communication adjacent. It never only the transmitter's cluster, we utilizes come together colouring to attain highly reliable transmission other than also both adjacent clusters member. The clusters are formed as various ways represented in the Fig.1.

CH Selection

The initialization of CH selection procedure is the next step. Each node's Clusterhead Level (CHL) is evaluated and broadcasted. Based on CH selection, the highest CHL weight with node and fuzzy logic are the important method. The linking with other CH in different clusters and various roles routing are performed by CH. The other cluster member to join in the cluster is the investigation of CH. For any node within that cluster radius to join, the CH and broadcast and invite it automatically becomes the CH if there in only one node.

Affiliation and Invite

The broadcast of CH invite message for all the nodes within the vicinity to join and participates in the cluster. The members on joining rest contain turn out to be members of clusters.

Maintenance

Based on continuous link to its cluster CH to ensure by all members evaluates their link which is carried out by periodically to confirm its status in terms of cluster affiliation. The reclustering procedure is initiated which may take us back to step 2 above while the CMs fail to receive communication from CH.

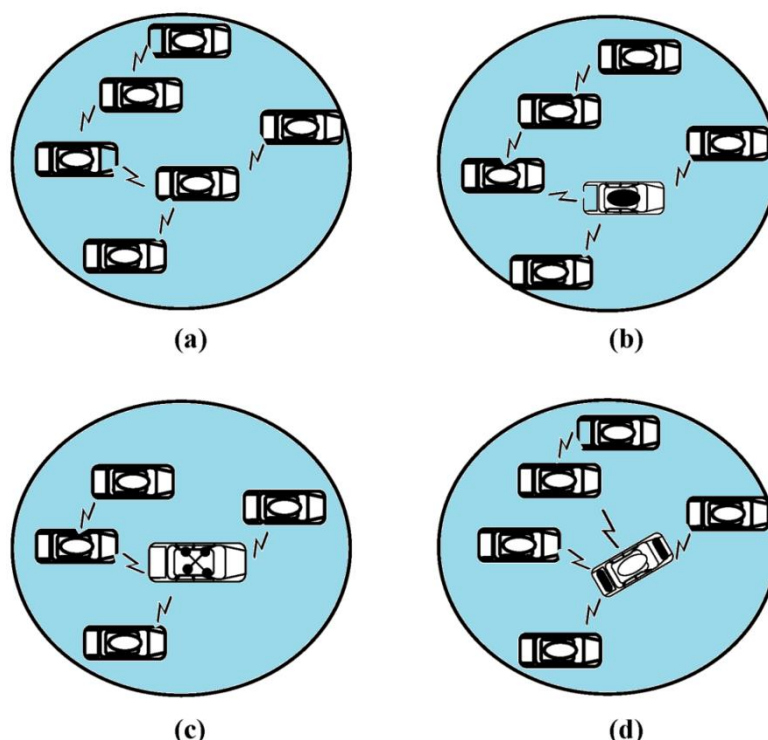


Fig.1: Various types of Clustering Process

CH Selection Process

When considering the criterion of a CH selection with top priority is the Cluster stability. To consider the CH selection depends upon the fuzzy logic method by the parameters like connectivity levels, lane weighting, direction and speed are utilized, which are explained as follows:

Lane Weight

In urban environment, the vehicular traffic splits at each intersection into three as;

Left Turn (LT) – Takes the left turn on the left most lane

Right Turn (RT) – Takes the right turn on the right most lane.

No Turn (NT) – The middle one never takes a turn in traffic in this lane but goes straight. The vehicle's lane of travel is determined by lane weighting aids [II]. The general lane weighing (LW), the entire amount of lanes on the road (TNL) and the number of lanes of each traffic flow (NLTF) are explained as follows:

$$LW_k = \frac{1}{TNL} \times NLTF_k \quad (1)$$

In this work, it is proposed that the CH is the node, which is in the middle lane as much as probable. This necessitates the varying of lane weight. While outer lanes, the half the total weights allocates the middle lane by evenly the residual not whole Eq. 1.

$$LW_k = \begin{cases} \frac{1}{TNL} \times NLTF_k & , \text{for } TNL \leq 2 \\ \frac{2}{TNL} \times NLTF_k & , \text{for } TNL > 2 \\ \frac{1}{2TNL} \times NLTF_k & , \text{for } TNL > 2 \end{cases} \quad (2)$$

Where , $TF = NT$ for $TNL > 2$ and $TF = RT = LT$ $TNL > 2$

For each traffic flow, one LT, RT, and NT with if we have a road of three lanes as follows:

$$LWLT = LWRT = 0.167$$

$$LWNT = 0.667$$

Based on every traffic flow (TF), the Network Connectivity Level (NCL) then initially calculates the overall NCL. Based on the overall NCL, the i refers the connected to node/vehicle by maximum number of nodes/vehicles.

$$\alpha_i(t) = \sum_j A(i, j, t) \quad (3)$$

For the TF of vehicle, the potential connected neighboring vehicle is 'j' and connectivity level (CL) β .

$$\beta_i(t) = \sum_j A(i, j_{TF}, t) TF \quad (4)$$

$$NCL_i(t) = \beta_i(t) + (\alpha_i(t) \times LWTF) \quad (5)$$

The below equation explains the level of normalized network connectivity

$$NCL_{inorm} = \frac{NCL_i}{\max(NCL_x)} \quad (6)$$

The overall average absolute distance δ_i is the distance between the directly connected vehicles to vehicle i as explained follows:

$$\delta_i = \frac{\sum_j \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}}{NV} \quad (7)$$

The other vehicles in the same TF denoted as χ_i and the average absolute distance, between vehicles i .

$$X_i = \frac{\sum_{jTF} \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}}{NV_{TF}} \quad (8)$$

The below equation explains the ADL for vehicle i in TF

$$ADL_i = X_i + (\delta_i \times LW_{TF}) \quad (9)$$

$$AD_{inorm} = \frac{ADL_i}{\max(ADL_x)} \quad (10)$$

Based on CH candidate is to calculate the average difference velocities of all vehicles. The overall Average Velocity Level (AVL), σ_i .

$$\sigma_i = \frac{\sum_{NV} |vel_i - vel_j|}{NV} \quad (11)$$

$$\rho_i = \frac{\sum_{NVTF} |vel_{iTF} - vel_{jTF}|}{NV_{TF}} \quad (12)$$

$$AVL_i = \rho_i + (\sigma_i \times LW_{TF}) \quad (13)$$

The AVL is calculated for vehicle i in TF.

$$AVL_{inorm} = \frac{AVL_i}{\max(AVL_x)} \quad (14)$$

Based on their neighbors Clusterhead Candidacy Level (CHL) weights between other parameters such as position, velocity and so on are broadcasted and computed. The equation (15) explains the highest weighted CHL vehicle is chosen by CH.

$$CHL_i = w_1 * NCL_{inorm}(t) + w_2 * ADL_{inorm} + w_3 * AVL_{inorm} \quad (15)$$

The full description of the proposed algorithm is described in the following part.

Adaptive Elephant herd optimization algorithm

The recently established swarm intelligence algorithms is Elephant herding optimization algorithm, which is based on the performance of elephant herding. The clans are the categorization of Elephant population by each position of the elephant's denotes on solution. Under the leadership of a matriarch is the natural living

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behaviour of elephants in one clan (Called as optimal fitness). The worst fitness function values with the solutions are identified by a number of male elephants in each generation. In two years ago, EHO algorithm was presented and it is applied in many optimization issues. The three tank system with level control to tune most favourable proportional integral-derivative (PID) controller in EHO algorithm. In home energy management system, the unmanned aerial vehicle path planning are used for neighbourhood discovery in multifaceted social networks. Next to population of N solutions initialization then the solution is categorized into n m clusters (clans). If one is done randomly then the clusters are about the similar dimension. Based on the cluster's most excellent solution, every solution j of the cluster i alter and it is shown in the below equation.

$$x_{new}, c_i, j = x_{ci}, j + \alpha * (x_{best}, c_i - x_{ci}, j) * r, \quad (16)$$

Hence, a new solution j in cluster i is x_{new}, c_i, j is i and x_{ci}, j denotes the existing solution. The best clan solution is denoted as x_{best}, c_i . The parameter denotes the influence of the matriarch is $c_i, \alpha \in [0,1]$. The population diversity is enhanced using the random interval is $r \in [0,1]$. The i, x_{best}, c_i , is the best solution in the cluster [12].

$$x_{new}, c_i = \beta * x_{center}, c_i, \quad (17)$$

Therefore, the parameter of the algorithm is $\beta \in [0,1]$ and manage the pressure of the x_{center}, c_i .

$$x_{center}, c_i, d = \frac{1}{n_{ci}} \times \sum_{i=1}^{n_{ci}} x_{ci}, l, d \quad (18)$$

Hence, d^{th} dimension (problem dimension is D) is $1 \leq d \leq D$ and the clan i with the number of elephants are n_{ci} .

In each cluster, by generating random solutions with the exploration was implemented and substituting the worst solutions. The below equation explains the new solutions as:

$$x_{worst}, c_i = x_{min} + (x_{max} - x_{min} + 1) * rand, \quad (19)$$

From the equations, inferior and superior boundaries of the search space are x_{min} and x_{max} . The random digit chosen from uniform allocation is $rand \in [0,1]$.

The algorithm of EHO joint with k-means is introduced in this paper. The EHO algorithm searches the optimal positions of the cancrroids. The number of attributes $N_{attributes}$ is equivalent to the problem dimension, number of clusters k is described by instances multiplied. The equation (17) explains the fitness function. There before each fitness functions evaluation by improving K-means algorithm. In one iteration of the k-means algorithm with each generated solution is adjusted. The EHO algorithm generates the instances are clustered by the cancrroids. The equation (16) shows the solution upadation by computing the instances. For data clustering, the suggested AEHO method pseudocode with k-means is summarized in following and the flow chart is illustrated in the Fig.2.

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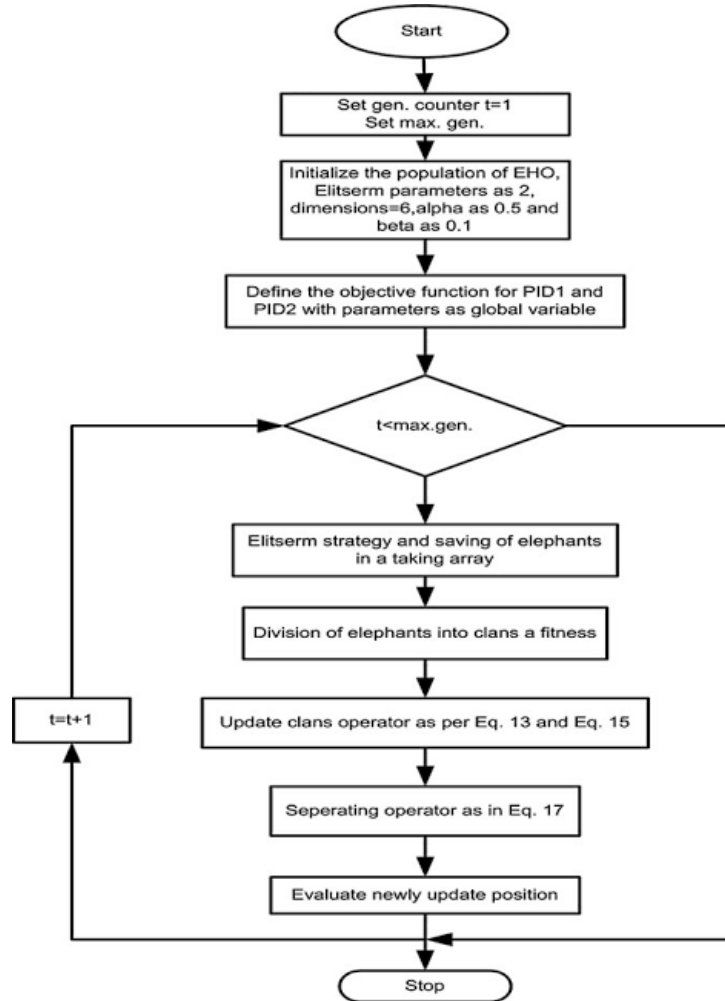


Fig.2: Flowchart of EHO algorithm

Pseudo code:

Start

Initialization of Set generation counters $t = 1$ and set maximum generation $MaxGen$

Population initialization

The clusters by dividing data instances

Use k-means algorithm to update the population

Repeat

According to their fitness to sort all the elephants

For

The population in all cluster c_i

do

For

The cluster c_i with all solutions j

do

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Update $x_{ci,j}$ and generate $x_{new,c_{i,j}}$ by Eq. (18)

If

$$x_{ci,j} = x_{best}, c_i$$

then

Update $x_{ci,j}$ and generate $x_{new,c_{i,j}}$ by Eq. (19)

The clusters with cancroids from $x_{ci,j}$ divide data instances

Use the k-means algorithm to update solution $x_{ci,j}$

End if

End for

End for

For

In the population with all clans c_i

do

By using Eq. (17) to replace the worst elephant in clan c_i

The clusters are divided by data instances

By the k-means algorithm to update generated solution

End for

By the newly updated positions to evaluate population

Until $t < \text{MaxGen}$

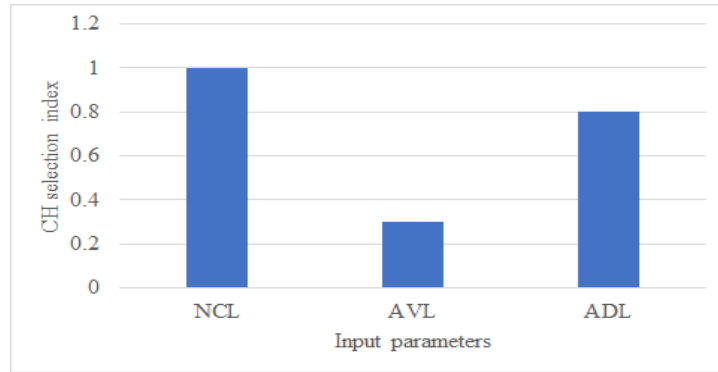
Return the optimal solution

IV. Results and discussions

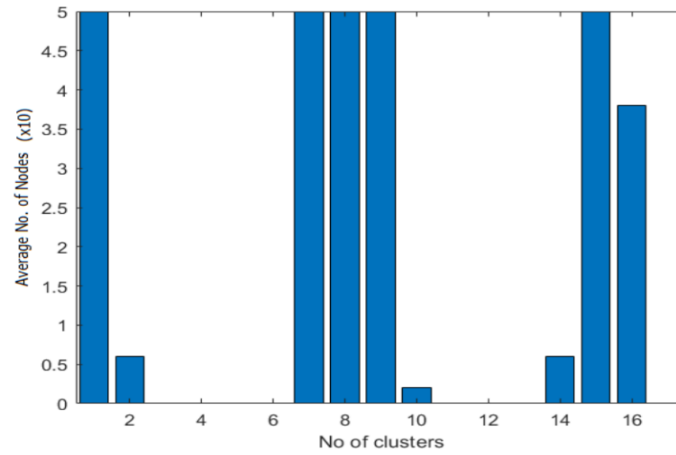
The performance metrics such as average cluster lifetime, CM duration, CH duration and cluster size and others are achieved by VANET structure by proposed system was simulated on the platform of NS2. Every exposure 1000 m radius, the two RSUs with 1500m length and 24 m width (each direction in 12 m) by the road highway network second-hand by a two-way lane. Every imitation life form replicated 1000 s real time, the permitted utmost vehicle speed of 50 km/h (13.89 m/s) and presumptuous the chance nature of vehicular speeds are utilized. This let the means of transport to know their positions on the road segment by all the vehicles in the system are up to with global positioning system (GPS) and OBU. Approximately 250 m radius used by communication range of a vehicle thereby using QPSK modulation frequency 5.9GHz. The communication with vehicle heading on different directions by an RSU second-hand is not incomplete to single method vehicles.

One of the important vehicle synchronization is RSU with the grouping of vehicles dependent on it movement of direction. From 2 RSUs has been received, if there is not communication from a ping and CH. Thereafter, lower distance with the vehicle aligns itself with an RSU. The fuzzy logics initiate the after that stage of CH assortment following receiving message with other means of transports. The CH nomination with the crucial component is NCL. From together info is in a straight line proportional to the NCL ADL and AVL with the output of a CHL system.

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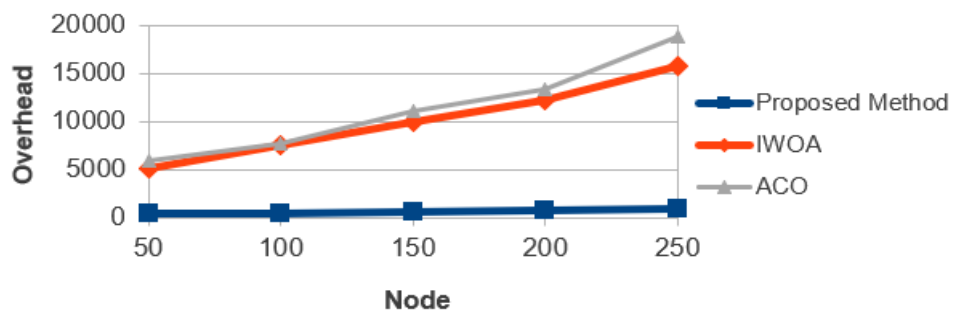


(a)

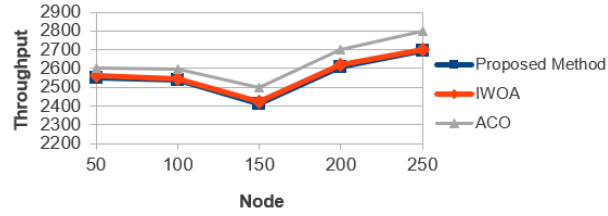


(b)

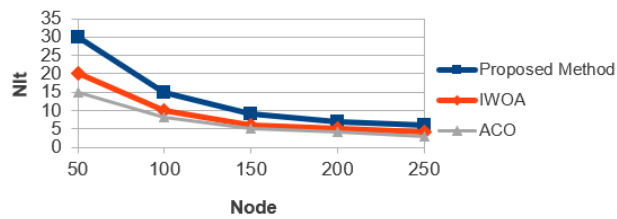
Fig.3: Analysis of (a) CH selection index and (b) number of nodes in a cluster



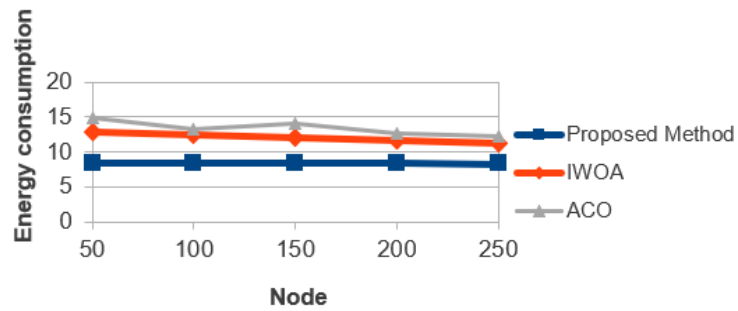
(a)



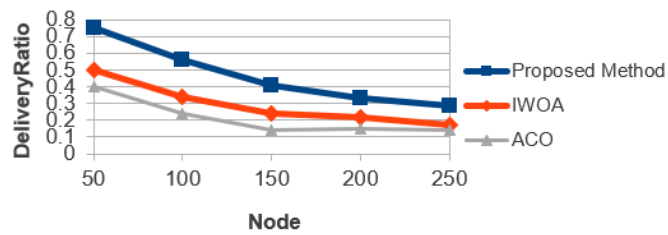
(b)



(c)

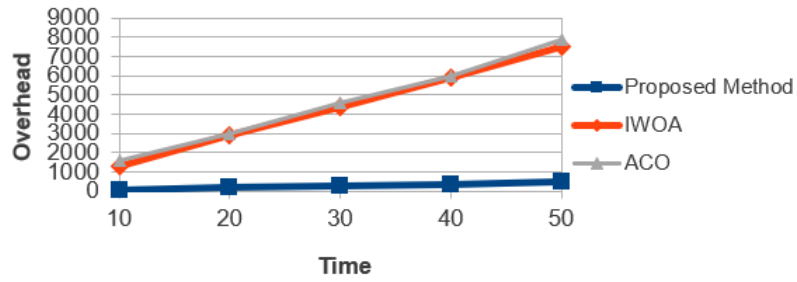


(d)

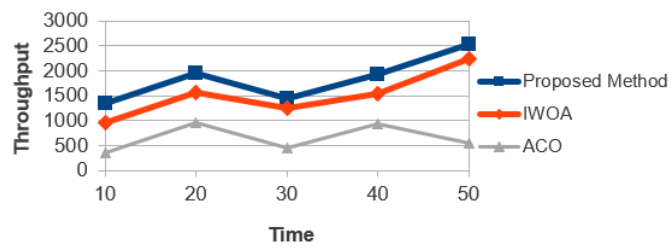


(e)

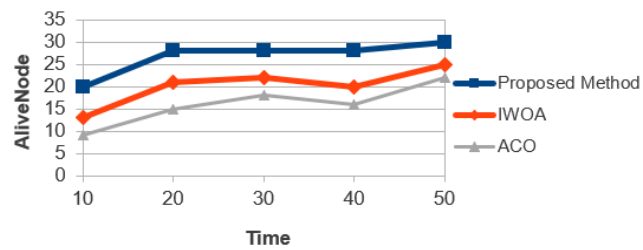
Fig.4: Comparison analysis of (a) Overhead (b) Throughput (c) network lifetime (d) energy consumption and (e) delivery ratio



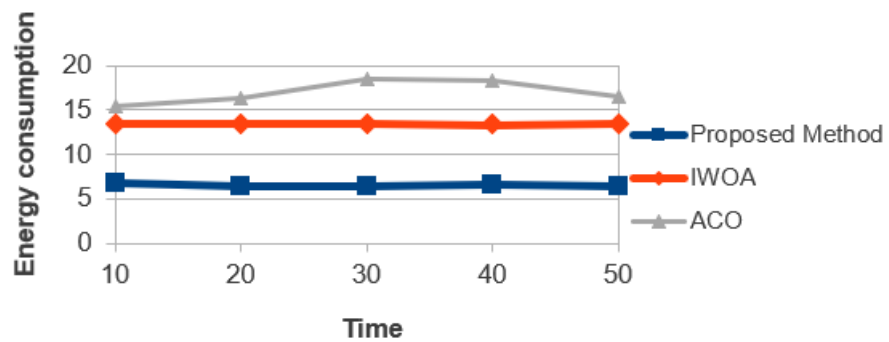
(a)



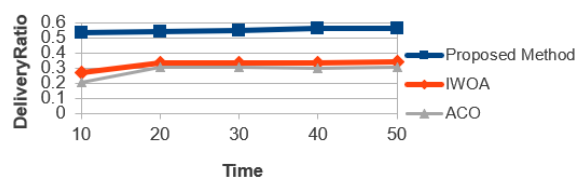
(b)



(c)



(d)



(e)

Fig.5: Comparison analysis of (a) Overhead (b) Throughput (c) network lifetime (d) energy consumption and (e) delivery ratio

The similar vehicular scenario comparison by means of and with no lane weighting was carried out to evaluate the result of path weighting on CH constancy. Figure 3 shows two scenarios such as cluster single as vehicle by means of ID no. 3 and vehicle by means of ID no. 1 is particular as the CH. For the simulation period, the node 4 was after that elected as the new CH and node 3 CH devoid of the employ of path weighting was shorter. The coordination operation of the cluster over taken another CH must be selected and the re-selection of CH is done at what time a CH leaves the cluster and one more CH. The CH selection with the impact of various input parameters are shown in Figure 3. As much as possible number of directly connected vehicles important of a CH to have the highest NCL is a crucial parameter in selection. The second most important parameter is average distance level due to vehicle that is exterior the range of cluster or at the cluster furthest point never turn out to be a CH. Nevertheless, the favourite is for the node at the centre of the cluster as a great deal as likely. In the VANET network, the average number of nodes in each cluster is indicated in Figure 4-5.

Here, the VANETs are tested with the rectangular and circular path, increases the vehicle speed with the matching increase the routing overhead routing. The 500 vehicles are utilized to analyze the routing overhead of the VANETs by the PDR, routing overhead and speed. Fig 4 to 5 illustrates the throughput, Routing overhead, PDR under speed of the VANETs changes. The analysis of overhead reduces the packets loss while the proposed method. It determines overhead by the analysis of transferring messages. It evaluates the packet loss for packet into node routing. The stability is maintained under the density of high velocity.

V. Conclusion

The dynamic characteristic of VANETs is analyzed by a CAEHONET protocol. From ad-hoc networks, the varying movement is with the network architecture dynamic characteristics. The commonly used protocol is the clustering-based routing protocol for VANET. It creates the unused routes among the destination node and source nodes. Based on the deliver the optimal outcomes with the AODV protocol are changed. In the local search schemes, assuming the deficiency of AEHO method, routing procedures and clustering is carried out. The augmented number of clusters creates the efficient communication by the proposed framework because is termed as intelligent method. It determines the efficiency, stability, data delivery, route delivery distribution with the utilization of proposed

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algorithm. When compared with existing algorithms, the QoS parameters including routing overhead, throughput and PD. The suggested method improves the data transmission ability. The NS2 platform implements the propose method when contrasted to the ACO and IWOA method.

Conflict of Interest :

No conflict of interest regarding this article

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