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Optimal Route Selection Using Hill Climbing Based Red Deer Algorithm in Vehicular Ad-Hoc Networks to Improve Energy Efficiency

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Abstract – One of the effective technologies that have been found useful in a number of real-time applications to increase the safety of roadways is called a vehicular ad hoc network, or VANET for short. In spite of the many advantages of the VANET, one of the most difficult aspects of this network is still the creation of an efficient routing protocol. The fact that VANET involves dynamic factors in its routing process makes it a difficult task to do successfully. It is possible to build a wide variety of route selection strategies in order to make efficient use of the available networking resources and to improve the efficacy of the routing. To achieve a higher level of resource utilization within VANET, the development of an efficient routing protocol is an absolute necessity. As a result of this impetus, the purpose of this research is to present an energy efficient hill climbing based red deer algorithm known as EEHC-RDA for use as an optimal route selection technique in VANET. In order to increase both the system's lifetime and its energy efficiency, the EEHC-RDA technique that has been presented prioritizes the selection of the most effective routes to the final destination. In addition, the EEHC-RDA method improves the convergence rate since it combines the mating behaviour of red deer with the hill climbing (HC) ideas. In addition to this, the EEHC-RDA method computes a fitness function for selecting the best possible routes, which takes into account a variety of input factors. In order to show that the EEHC-RDA approach offers a higher level of performance, a broad range of simulations are carried out. The outcomes of these simulations show that the suggested model has an enhanced performance in contrast to the existing methods in terms of a wide variety of different metrics, which demonstrates that the present state of approaches is not optimal.

Index Terms – VANET, Communication, Energy Efficiency, Multihop Routing, Reed Deer algorithm, Fitness Function.

1. INTRODUCTION

The most recent advancements in wireless technologies and embedded systems have enabled communication to be used in previously unexplored fields. With the help of this development in technology, equipment and vehicle manufacturers have recognized the possibility of enhancing surface transportation by means of the transmission capabilities of Vehicular Ad hoc Network (VANET) in order to provide the driver with an Intelligent Transportation System (ITS) [1]. The primary purpose is to improve driver safety by alerting them to potential threats and circumstances that they may not have been able to see themselves. In addition, it is used to assist other services, such as broadcasting traffic or informational entertainment or weather conditions, with the goal of making a journey as comfortable as possible for the passenger [2]. Because the more relevant application has been investigated, and the primary technological challenge has been identified, it has become clear that the most significant change should be made in each layer of the Open System Interconnection (OSI) model [3]. In order to facilitate this kind of service, Intelligent Transportation Systems (ITS) provide transmission between roadway infrastructure and vehicles, transmission among vehicles and from wireless devices, and transmission from wireless devices to vehicles, which

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includes transportation by pedestrians, cyclists, and drivers. The architecture of VANET is illustrated in Figure 1.

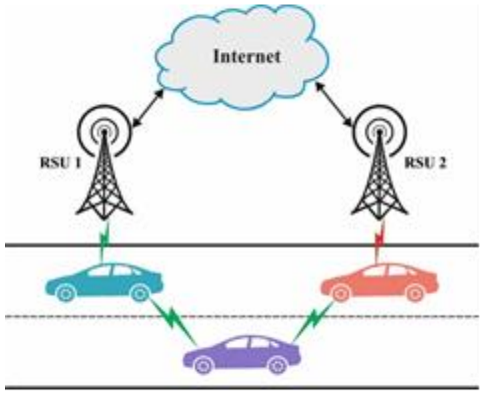

Figure 1 VANET Structure

In comparison to the mobile Adhoc network, VANET has exclusive features [4]. The major features of the VANET are given in the following: time varying vehicle density, heterogeneous communication range, geographically constrained topology, mobility of the vehicles, the vehicle being the component that builds the network, dynamic topology, and frequently disconnected network [5]. The VANET routing protocol should be developed which consider the factor that includes scalability, security, and mobility of vehicle transmission [6]. The objective of VANET is to enable connections among vehicles or fixed roadside units and vehicles. The V2V transmission is the wireless communication of information among motor vehicles [7]. The major objective of V2V transmission is to prevent accidents by enabling vehicles to transfer position and speed information to each other through an Adhoc mesh network. Based on the technique is executed, the vehicles themselves might take preemptive measures namely braking to slow down or the vehicle drivers might receive a caution more simply must be at the possibility of an accident [8].

V2V is significant in the developing republics due to the low internet & networks capacity, poor infrastructure, spread of theft of public properties, and large areas of uninhabited places resulting in not installing Road site unit (RSU) on the high way road. The message routing in vehicular Adhoc networks (VANET) is a promising and attractive field for study. This network doesn't have centralized coordination, the topology is extremely dynamic, making the routing procedure a serious problem, and the node is mobile because it is accountable to ensure message delivery with smaller delay and overhead. In addition to being responsible for other allocations, the network layer is the one in charge of setting the rules that govern how packets are routed [9]. The routing protocol is responsible for controlling the service as well as the packet routing technique, which is the service that is responsible for maintaining and finding the pathways between the source and destination nodes. The operating mode and type of architecture are both classifications that are applied to the routing protocol. The operating mode includes the many forms of routing, and it may be further subdivided into the dissemination, geographic, topological, and opportunistic categories [10].

High vehicle mobility creates a dynamic topology that causes packet loss and network decentralization. Accordingly, a lot of work is being put into developing effective routing protocols and providing new medium-access controls. It was investigated on how to modify routing protocols for V2V communications to satisfy various Quality of Service (QoS) requirements in applications. Several factors, such as constrained link bandwidth and transmission range coverage, force the vehicular system's usual characteristics. These restrictions result in decreased routing efficiency and increased overhead. Since no single node is responsible for determining and guiding the paths between the nodes in this type of network, routing is a challenging operation.

1.1. Problem Statement

This paper introduces an energy efficient hill climbing based red deer algorithm (EEHC-RDA) for optimal route selection technique in VANET. The proposed EEHC-RDA technique aims to accomplish the selection of optimal paths to the destination in order to accomplish improved lifetime and energy efficiency.

1.2. Structure of the Article

The rest of the paper is organized such a way that, section 2 offers research works done in optimal route selection for the past two decades, section 3 offers materials and methodology used in the proposed research work, section 4 offers experimental outcomes of the proposed research, the final section 5offers conclusion with future findings.

2. RELATED WORKS

Chandren Muniyandi et al. [11] introduced a process for optimization that is carried out by the EHSO approach-based embedding two common selection methodologies in its memory, such as tournament selection and roulette wheel selection, was presented as an enhanced harmony search optimization (EHSO) method. This method takes into consideration the configurations of the OLSR parameter by connecting the two phases. In [12], proposed a Moth Whale Optimization Algorithm (MWOA) for determining the optimum multi-path for transmitting the videos from one vehicle to another vehicle in the VANET network. The presented method is designed with the incorporation of Whale Optimization Algorithm (WOA) and Moth Search (MS) algorithm. At first, the VANET is simulated and the optimum selection of the multi-path can be performed by adaptive geographic routing system-based fitness measures.

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Vafaei et al. [13] provided a routing method based adoptive junction with QoS supports with respect to delay, packet delivery ratio (PDR), and connectivity probability. In order to determine the optimal QoS paths, the corresponding routing problems are considered as the optimization issues and later presented a method based ACO to solve them. Furthermore, a fuzzy logic-based approach has been applied for selecting optimal next-hop vehicles. In [14], provided a novel routing method-based glowworm swarm optimization method. The glowworm approach is used in the proposed method to determine the best route across junctions and three-way intersections. After then, the route selection is used to determine how the packet will be delivered. The technique that has been provided with the glowworm swarm optimization approach is a distributed heuristic method that assigns a value to all of the possible paths that go from a source to a destination.

Kittusamy et al. [15] provided an approach for the process of constructing a cluster head (CH) election and cluster structure that is appropriate for VANET. This strategy can be found in their paper. Approach was provided in the form of this technique. The adaptive weighted clustering protocol (AWCP) that has been developed clusters the random nodes, and then, after the optimization of the network parameters, the optimal CH may be discovered. The EWOA is a cutting-edge strategy that was developed with the intention of achieving the highest levels of productivity possible in everything that it does. Vehicle network mobility routing protocols make use of the cars' known position and speed in order to do motion analysis on each of the vehicles that are a part of a trusted clustering approach. This allows the motion of each vehicle to be analysed. Hossain et al. [16] provide a two-hop routing method that is coupled to the multi-objective Harris Hawks Optimization (2HMO-HHO) model. This model selects the transmitters that are the most efficient out of the cars that are moving in the direction that connects the origin and the destination. It is possible to increase the stability of the defined route and guarantee that information is efficiently transferred by opting for a route that has only two hops rather than one that has multiple hops or the whole route.

Ishtiaq Wahid et al. [17] develop a novel ML technique for improving the efficiency of ITS by utilizing RF and a posterior detection based corset to increase detection efficiency and enhance detection accuracy. The experiment result shows that our presented technique could considerably improve the recognition performance than traditional applications of ML methods.

QMM-VANET is a clustered routing strategy that was introduced by Fatemidokht and Rafsanjani [18]. This technique takes into account QoS demand mobility limits as well as the mistrust value parameter. This approach improves the connection as well as the cluster's stability while it is being transmitted. It also helps define the dependable and stable cluster.

An Effective Clustering V2V Routing Based PSO in VANET was suggested by Bao et al. [19]. (CRBP). In the beginning, a vehicle node that has a movement direction that is comparable s identified, and then the CHs are selected. K-Means Clustering is a technique that was introduced by Elhoseny and Shankar [20] for the purpose of clustering the vehicle node. After that, the most energy efficient node was found for compelling transmission. Manickam et al. [21] introduced one of the most appropriate and thorough approaches is to classify the cars into clusters and then to organise the networks via the clusters. This approach offers a solution to the problem of regulating assaults made against the security of the VANET.

Cheng et al. [22] introduced, a connectivity prediction model (CP) that is based on the properties of individual vehicle nodes and the relative features of individual vehicle nodes should be proposed. Kolandaisamy et al., [23] proposed a technique known as Stream Position Performance Analysis (SPPA). This technique keeps track of the precise position of the field station that is delivering the data in order to carry out DDoS assaults.

Despite the exciting promise of VANET, designing reliable communication routing models for route optimization remains a significant challenge. Building a comprehensive metric that can ensure reliable routing in VANET is an important research topic since there are so many dynamic factors working against good routing in VANET. The approach suggested in this work was motivated by the fact that these requirements (which include creating reliable route communication metrics and efficient routing algorithms) provide non-trivial challenges for VANET developers.

3. PORPOSED EEHC-RDA METHODOLOGY

In this study, a new Energy Efficient Hill Climbing based Red Deer Algorithm (EEHC-RDA) technique has been developed for the optimal selection of routes to destination in the VANET, to attain enhanced lifetime and energy efficiency. The following assumptions are based on presented routing methods:

- All the vehicles in the VANET are equipped with Global Positioning System (GPS) devices to be aware of their corresponding positions.
- All the vehicles have a transceiver for communicating.
- All the vehicles could evaluate their instant velocity through their speedometer at any time and transfer this data through its transceiver to a vehicle or infrastructure.
- A vehicle transfer road surface data only if it breaks down, or slows down below a predetermined velocity.

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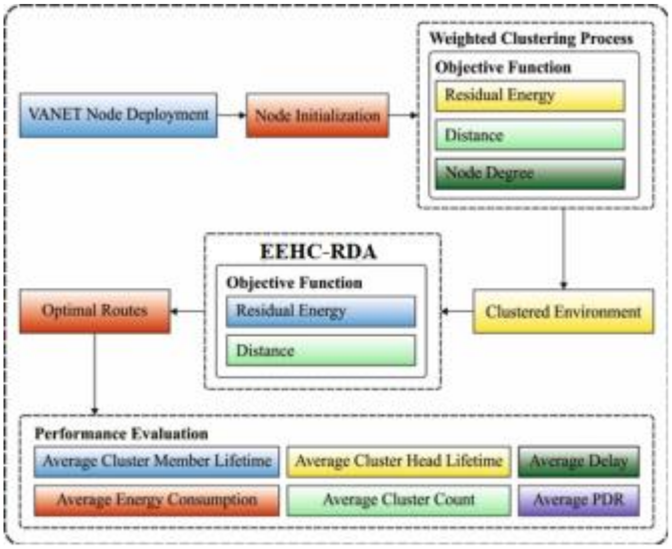

Figure 2 Proposed Model Architecture Diagram

3.1. Design of HC-RDA Technique

The RDA is derived based on the mating characteristics of red deers (RDs) [24]. Comparable to other metaheuristic algorithms, the RDA initiates with fixation of initial population of RDs. It operations mainly in two stages namely intensification and diversification. At the time of intensification, a pair of MRDs are found to appoint the winner indicating the generation of optimum MRD. In addition, the MRD mates with the nearby nodes in the close terrain. At the time of diversification process, the roaring MRD also mates with the MRDs and some hinds in the harem in a random way. In addition, the MRDs mated with the harem at the time of intensification and diversification. To intend of the optimizing process is to determine effective solutions for an optimization problem. Therefore, the RD is equal to the solution. At N_{var}-dimension optimization problem, the RD is considered as $1 \times N_{\text{var}}$ array which can be computed by Eq. (1):

$$RD = [X_1, X_2, X_3, \dots, X_{N_{var}}]. \quad (1)$$

Additionally, the functional value of the RDs can be estimated using Eq. (2).

$$Value = f(RD) = f(X_1, X_2, X_3, \dots, X_{N_{var}}). \quad (2)$$

Primarily, the population initialization of size N_{pop} take place and it is needed to select optimum RDs [18] for N_{male} and the remaining ones in the hind. At the time of roaring MRDs, the MRD has tried to improve the simplicity through the roaring. If the MRDs are optimum to the existing one, the objective function can be used for replacing it. In general, it enables every MRD to vary its position. The roaring MRD forms a basis to attract female RDs.

The MRDs can be divided into two parts namely male commanders and stags, therefore commander male count can be related to γ, it can be represented in Eq. (3) as follows:

$$N.male.Com = round\{\gamma . N_{male}\} \quad (3)$$

Where $N.male.Com$ indicates the male count to seize the harem. This MRD can be chosen as an optimal one and the residual MRDs are called stages. The stag count can be determined using Eq. (4):

$$N.stag = N_{male} - N.male.Com \quad (4)$$

Where $N.stag$ indicates the stag count in the MRD population. It is considered that every commander male fights with the stag randomly. Then, they are chosen when the objective function is superior to the earlier one. Then, harems are formed. Figure 3 illustrates the steps involved in RDA.

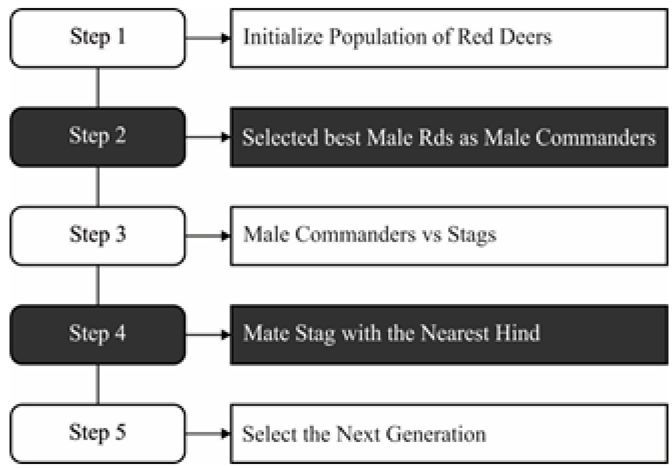

Figure 3 Steps in RDA

The term "harem" refers to a gathering of hinds that are under the control of a male leader. The number of female concubines in harems, which was determined by the male commander's level of power (their capabilities: fighting and roaring). In order to establish the harem, we first distributed the hinds among the male commanders in the following manner as computed in Eq. (5):

$$V_n = v_n - \max_i\{v_i\} \quad (5)$$

Whereas v_n indicate that the number has been normalised and reflect the value of the nth male commander. Using the normalised values of each male commander, it is possible to calculate the normalised strength of all the male commanders using the following Eq. (6):

$$P_n = \left| \frac{V_n}{\sum_{i=1}^{N.male.Com} V_i} \right| \quad (6)$$

If one looks at things from a different angle, the normalised strength of the male commander is the portion of the hind that

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has to be controlled by the male. Following that, the total number of harems may be calculated in Eq. (7):

$$N.harem_n = round\{P_n.N_{hind}\} \quad (7)$$

While $N.harem_n$ indicates the hind number of nth harem and N_{hind} shows each hind number. To split the hinds to all the male commanders, we arbitrarily elect $N.harem_n$ of the hind. This hind and male form nth harem.

F. Mate male commander of harem with ∝ percent hinds in his harem

The act of mating first takes place during stage. In GA, we make use of a model called the crossover. The male commander and the females in his harem are the children's biological parents. The spawn is the creative answer to the problem.

The hind number in harem are mating with the male commander related to ∝, as shown in Eq. (8):

$$N.harem_n^{mate} = round\{\propto .N.harem_n\} \quad (8)$$

In which $N.harem_n^{mate}$ denotes the hind number of nth harem i.e., ready to mate with this MRD. They arbitrarily select $N.harem_n^{mate}$ of the $N.harem_n$..

A harem gets arbitrarily chosen and consider mating process of male commander to $\beta\%$ hinds of the harems. Generally, the MRD lies in waiting for other harems for promoting the terrain. The hind count in the harem can be mated to a MRD and can be defined in Eq. (9).

$$N.harem_n^{mate} = round\{\beta.N.harem_n\} \quad (9)$$

where $N.harem_n^{mate}$ indicates the hind count of the nth harem which are active to mate with a MRD.

During the mating process of every stay, they undergo mating with their neighboring ones. At the time of breeding period, the MRDs desire to trail the handy hind, and it might become the preferred hind amongst others. Consider every individual stag mated with the neighboring hind. Therefore, it is possible for every MRD for mating with least number of hinds, indicating the mate of one hind in poor scenarios. For determining the closer hind, it is needed to determine the distance of all stages and hind. The distance among the MRDs and every hind in the J-dimension space can be determined using Eq. (10):

$$d_i = \left(\sum_{j\in J}\left(stag_j - hind_j^i\right)^2\right)^{\frac{1}{2}} \quad (10)$$

The subsequent round of the MRDs is considered as the optimal ones and to select the hind for succeeding round with tournament/roulette wheel selection with fitness. The termination criteria are predefined as the maximum number of iterations or the optimal solutions obtained.

In order to improve the performance of the RDA, the HC-RDA technique is derived. The HC approach is named as local searching process which is a simpler kind of local development model. It generally initializes with an arbitrary initial solution (x), repetitively proceeding with the movement from the present to nearby solutions until the local optima are reached, indicating that the local optimum solution does not offer improved nearby solutions with no enhancement in the fitness function [25]. It performs the downhill progress in which the fitness function of an adjacent solution is superior to the present solution. As a result, it gets converted into the local optimum quickly and abruptly. Once the initial solution x is generated and using the iterative enhancement procedure, a set of nearby solutions gets produced by the use of $Improve(N(x))$. It helps to explore the improved neighboring solutions from the set of neighboring ones by the use of any utilized acceptance rule like initial enhancement, optimal enhancement, sidewalk, and random walk. The process involved in the HC technique is offered in Algorithm 1.

The initial solution x

$x_i = LB_i + (UB_i - LB)$ ∗U(O,I), $\forall_i = (1,2,N)$

Calculate fitness function $F(x)$

while (End condition is not satisfied) do

$x' = Improve((N(x))$

if $F(x') \leq F(x)$ then

$x = x'$

end if

end while

return x

Algorithm 1 Hill Climbing Technique

3.2. Steps Involved in EEHC-RDA Technique for Routing Process

In energy utilization, the formation of clusters performs an important role. This study utilizes a powerful clustering method for the formation of clusters. The FF is utilized for the cluster construction method as per Eq. (11).

$$k = \sqrt{\frac{n}{2\pi}}\sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}\frac{D}{x_{BS^2}}, \quad (11)$$

Whereas n denotes vehicle count, D indicates the dimension of network, and average distance of each vehicle to the BS is represented as x_{BS}. By utilizing Euclidean distance, the

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distance between every vehicle to the cluster center is developed by the following eq. (12).

$$X_{n2CC}=\sqrt{\sum_{j=1}^{N}(X_j - X_{CC})}, \quad (12)$$

In which X_{n2CC} represent the distance of node to cluster center, X_j denotes the coordinate of vehicle j, and X_{cc} is the coordinate of cluster center.

The route selection problem is solved by the EEHC-RDA technique, by considering it as a multi-objective minimization issue in VANET. In the study, two objectives are taken into account the data delivery reliability. The objective is to reduce the cost of intra-and inter-cluster transmission. A group of distinct optimization methods is utilized for achieving data reliability. The intra- and inter-cluster transmission costs are enhanced by Eq. (13) and Eq. (14).

$$\sum_{k=1}^{|V|}\sum_{m=1}^{|C_k|} w_{cm_{m,k}\rightarrow CH_k} \quad (13)$$

$$\sum_{k=1}^{|V|} w_{CH_k\rightarrow NextHop_{CH_k}}, \quad (14)$$

While $CH_k \rightarrow$ CH number $k; k \rightarrow$ Overall amount of CH selection; $NextHop_{CH_k} \rightarrow$ Next hop for CH_k; $cm_{m,k} \rightarrow$ Cluster member m of cluster k; $V \rightarrow$ The vector comprises the CH selection; $C_k \rightarrow$ The vector covers the cluster member in the cluster that corresponding to CH_k.

4. RESULTS AND DISCUSSION

4.1. Simulation Environment

The Network Simulator 3 is used to test the performance of the supplied model (NS3). The first step involves changes to the pause time (mobility), while the second stage involves changes to the pace. Table 1 shows the parameter settings used during experimentation.

Table 1 Parameter Settings

Parameter	**Values**
Node count	100
Deployment Dimension	1000*1000m
Simulation Time	100-250s
Hold time	5-25s
Max speed	2-10mps
Protocol	EEHC-RDA
Queue Size	35
Connection Type	Random

4.2. Average Lifetime of Cluster Head (ALCH) Analysis

Figure 4 illustrates the comparative ALCH analysis of the EEHC-RDA technique with recent methods under distinct velocities. For enhanced outcomes, the values of ALCH should be as high as possible. The experimental values indicated that the CACONET model has failed to showcase improved outcomes with the minimal values of ALCH. Followed by, the ICMFO and FA-OLSR techniques have reached moderately ALCH values. However, the EEHC-RDA technique has resulted in superior performance with the higher values of ALCH.

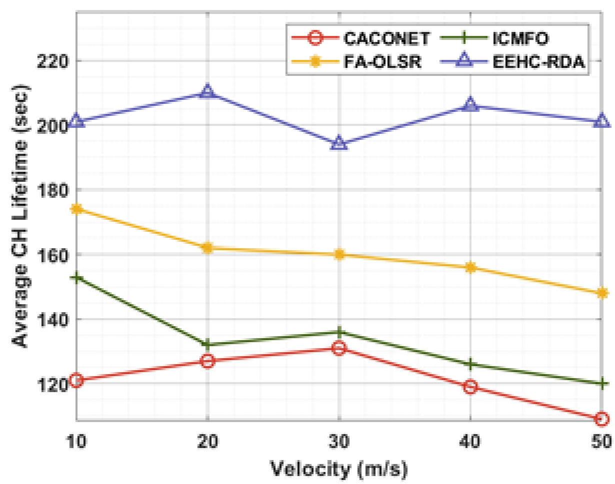

Figure 4 ALCH Analysis of EEHC-RDA Technique with Recent Algorithms

4.3. Average CM Lifetime (ALCM) Analysis

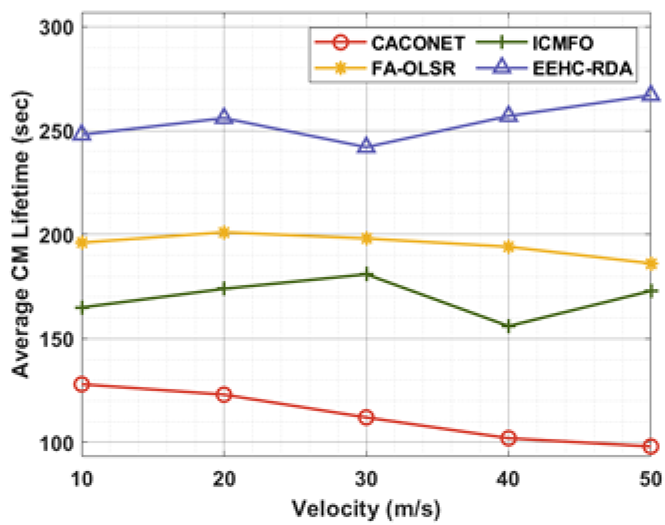

Figure 5 ALCM Analysis of EEHC-RDA Technique with Recent Algorithms

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Figure 5 depicts the comparative ALCM analysis of the EEHC-RDA approach with recent techniques under different velocities. For improved outcomes, the values of ALCM should be as high as possible. The experimental values indicated that the CACONET technique has failed to showcase improved outcomes with the minimal values of ALCM. Afterward, the ICMFO and FA-OLSR methods have reached moderately ALCM values. However, the EEHC-RDA system has resulted in superior performance with the higher values of ALCM.

4.4. Average Cluster Count (ACC) Analysis

An ACC analysis of the EEHC-RDA technique with recent approaches is made in Figure 6. The lower value of ACC implies effective outcome on the VANET communication process. From the figure, it is apparent that the CACONET and ICMFO models have resulted in ineffective outcomes with the higher values of ACC. Followed by, the FA-OLSR technique has obtained certainly enhanced outcomes with the moderate values of ACC. But the supremacy of the EEHC-RDA technique is ensured by the minimum values of ACC.

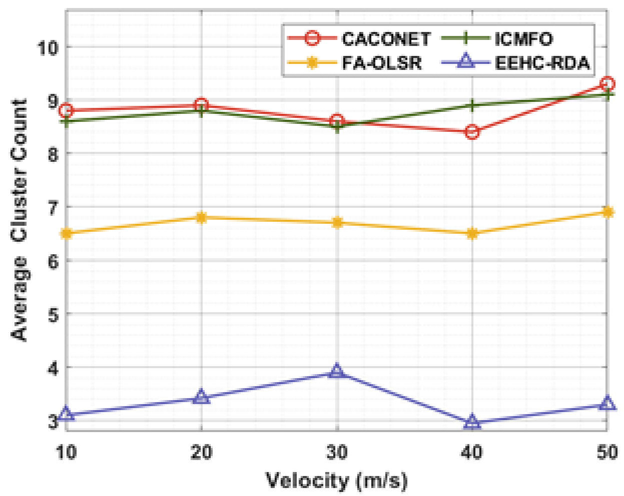

Figure 6 ACC Analysis of EEHC-RDA Technique with Recent Algorithms

Table 2 offers a comprehensive comparison study of the EEHC-RDA technique with existing techniques under varying velocity and count of vehicles [26-28].

4.5. Average Energy Consumption (AECM) Analysis

An AECM analysis of the EEHC-RDA technique with recent approaches is made in Figure 7. The lower value of AECM implies effectual outcome on the VANET communication process. From the figure, it can be apparent that the CACONET and ICMFO systems have resulted in ineffective outcomes with the superior values of AECM. Afterward, the FA-OLSR technique has gained certainly maximal outcome with the moderate values of AECM. However, the supremacy of the EEHC-RDA methodology is ensured by the decreased values of AECM.

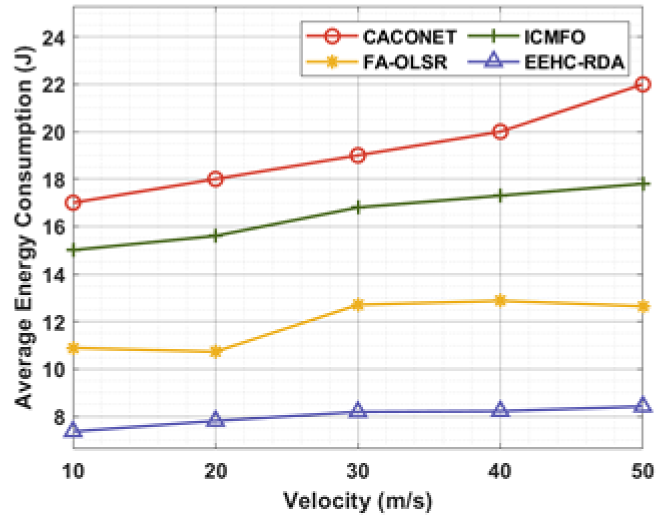

Figure 7 AECM Analysis of EEHC-RDA Technique with Different Velocity

4.6. Average Delay (ADL) Analysis

An ADL analysis of the EEHC-RDA system with state-of-the-art algorithms is made in Figure 8. The lesser value of ADL implies effective outcome on the VANET communication process. From the figure, it can be obvious that the CACONET and ICMFO models have resulted in ineffective outcomes with the higher values of ADL. Afterward, the FA-OLSR technique has gained certainly maximum outcome with the reasonable values of ADL. Then, the supremacy of the EEHC-RDA approach is ensured by the minimum values of ADL.

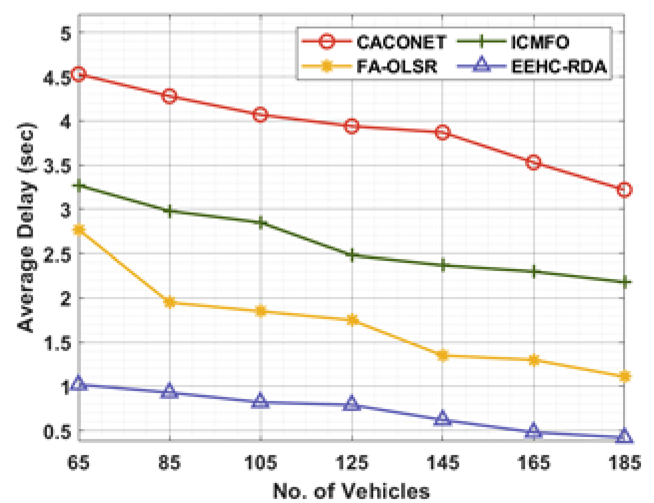

Figure 8 ADL Analysis of EEHC-RDA Technique with Count of Vehicles

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4.7. Average Packet Delivery Ratio (APDR) Analysis

Figure 9 demonstrates the comparative APDR analysis of the EEHC-RDA method with recent algorithms undercount of vehicles. For improved outcomes, the values of APDR should be as high as feasible. The experimental values referred that the CACONET technique has failed to illustrate enhanced outcome with the reduced values of APDR. Likewise, the ICMFO and FA-OLSR approaches have gained moderately APDR values. Afterward, the EEHC-RDA technique has resulted in superior performance with the superior values of APDR.

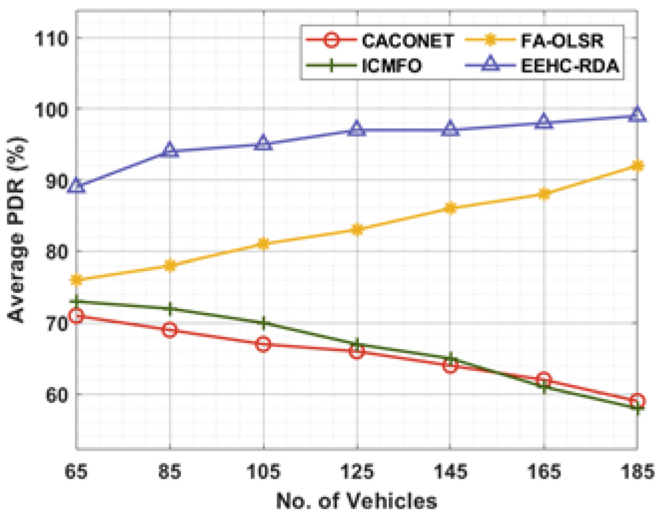

Figure 9 APDR Analysis of EEHC-RDA Technique with Count of Vehicles

Table 2 Result Analysis of Existing with Proposed EEHC-RDA Method in terms of AECM, Average Delay and APDR

Average Energy Consumption versus Velocity				
Velocity (m/s)	**CACONET**	**ICMFO**	**FA-OLSR**	**EEHC-RDA**
10	16.95	14.95	10.79	7.36
20	17.95	15.55	10.64	7.81
30	18.95	16.75	12.69	8.19
40	19.95	17.25	12.78	8.22
50	21.95	17.75	12.55	8.42
Average Delay (sec) vs Number of Vehicles				
No. of Vehicles	**CACONET**	**ICMFO**	**FA-OLSR**	**EEHC-RDA**
65	4.53	3.27	2.77	1.02
85	4.28	2.98	1.95	0.93
105	4.07	2.85	1.85	0.82
125	3.94	2.48	1.75	0.79
145	3.87	2.37	1.35	0.62
165	3.53	2.30	1.30	0.48
185	3.22	2.18	1.11	0.42
Average Packet Delivery Ratio (%) vs Number of Vehicles				
No. of Vehicles	**CACONET**	**ICMFO**	**FA-OLSR**	**EEHC-RDA**
65	71.00	73.00	76.00	89.00
85	69.00	72.00	78.00	94.00
105	67.00	70.00	81.00	95.00
125	66.00	67.00	83.00	97.00
145	64.00	65.00	86.00	97.00
165	62.00	61.00	88.00	98.00
185	59.00	58.00	92.00	99.00

5. CONCLUSION

In the course of the investigation, a novel EEHC-RDA method for the optimum selection of routes to destination in the VANET has been established. The goal of this method is to achieve increased lifespan and energy efficiency. The EEHC-RDA approach is mainly designed to be an improved version of the HC-RDA technique by embracing the ideas of HC as well as the mating behaviour of red deer. In addition to this, the EEHC-RDA method computes a fitness function for selecting the best possible routes, which takes into account a variety of input factors. A diverse selection of simulations are carried out in order to demonstrate the EEHC-RDA method's capacity for producing superior results. The comparison findings show that the suggested model has a superior performance to the current state of methods in terms of a variety of various metrics. As a result, the EEHC-RDA method may be used in the VANET as a useful instrument for increasing the amount of energy efficiency that is achieved. In the not too distant future, a clustering model for VANET that is based on hybrid metaheuristics may be proposed.

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