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DISSEMINATION OF DATA IN THE EMERGENCY APPLICATION FOR THE CLUSTER-BASED INTERNET OF VEHICLES IN NETWORK

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ABSTRACT

Internet of Vehicle is the improved technology of VANET, which is used for the communication among the vehicles to vehicles, vehicle to infrastructure, vehicle to the sensor. Due to the mobility nature of the vehicle, the network's topology frequently changes, which may cause scalability problems, reliability problems, and also frequent path failure. Clustering is one of the solutions which is proposed to overcome the problem in the IoV environment. In this paper, an algorithm for clustering on the Internet of Vehicles based on the evolutionary algorithm clustering technique is proposed to solve the routing problems. This algorithm provides the optimal solution for reliable communication among the network. The proposed technique is used to maximize the coverage of the vehicular nodes with a minimum number of clusters. The parameters considered for the study are the grid size of the network, load balance factor (LBF), speed of the vehicular network, the direction of the vehicle, and the transmission range. The experiments are performed by varying the parameters and compared with the various optimization algorithms proposed for the vehicular network. The evaluation of the proposed algorithm is evaluated based on the number of nodes with transmission range, number of nodes, and the number of vehicular nodes. The analysis indicates the proposed algorithm outperforms the existing methodologies.

Keywords: *Internet of vehicles, Routing, topology, clustering, Optimization.*

1. INTRODUCTION

Internet of vehicles will improve the communication between the vehicular nodes by using the infrastructure developed to provide safety to the passengers and comfort to the drivers as well as the passengers. Communication among the vehicular nodes is enabled using cloud services, devices with the internet, and the advancement in the field of internet networks. The main focus of the IoV is to provide timely safety applications, control the traffic flow, infotainment services.

According to scientists, by the year 2025, there will be over 30 billion objects connected to the Internet. According to the present study, there will be more than 380 million cars that will be connected to the internet by the year 2021. The Internet of Vehicles (IoV) is renovating into a renewed study region while trusting on Intelligent transport and evolving from the Adhoc Vehicle Network (VANET). IoV is made up of Internet-connected cars and other heterogeneous networks that include a Worldwide Wireless Access Technology (WAT) network.

IoV has incorporated large-scale apps in Intelligent Transportation System (ITS) due to the reliability of solid communication facilities. IoV is the main ITS structure to provide various new functionalities to the transportation system. ITS is suggested to design vehicle (drones, underwater vehicles) activities, and help drivers collect the necessary data for security and entertainment which could be infotainment services, traffic management which may be controlling the traffic signals, and as a comfort source for tourists. Examples of automatic toll collection and driving aid systems can be quoted, and ITS apps usually involve the transfer of countless emails from source to destination via various hops between cars. The QoS is also another compulsory consideration for transmitting information efficiently. In the circumstances such as security and surveillance apps, a delay can become very dangerous.

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1.1 IoV components

IoV allows data exchange between various vehicles, sensors, Roadside units (RSU), and on-board units (OBU), which are the main characteristic of Intelligent Transportation Systems [1]. IoV has incorporated large-scale apps in ITS due to the reliability of solid communication facilities. As a result, IoV transmission mode is being updated to anything in the environment (V2X) from vehicle to vehicle (V2V). V2X (Vehicle to anything) mode is used for communication with roadside units (RSU's) and other 4G and the new latest technology 5G network. The composition of an IoV consists of access points and vehicles, and the main components in the vehicles are the (i)Application Unit and (ii) On-Board Unit (OBU), a device used to provide driver services, and the application can be located on the OBU or Road -Side Units (RSU). In the IoV network, RSUs are used as fixed architecture [2].

Every Vehicle in IoV's acts as a router and also as a mobile node, as well as the WAP. To form a network, vehicles are linked to one another. This connectivity enables communication to be conducted within a restricted range. The communication between the vehicles is restricted within a range of distance provided by various available technology. There is also a limitation of vehicle mobility and density in the region. IoV's also have a few other constraints, such as big towns, tall buildings, street maps, jams in the road network, complicated road infrastructure, and much more. The IoVs have a very restricted range and work in the local region due to these limitations. IoV offers many features, such as manageability, credibility, and capacity to operate. IoV network makes it possible to merge with various networks and enhances the extensibility, scalability, computability, and management facilities of big networks.

IoV's primary concept is to provide human service for their vehicles to the point of fulfilment. It also supports the provision of transportation facilities that are efficient for the order to improve the quality of services (QoS) which includes various parameters in the vehicular network. Vehicle telematics is one of the solutions for complicated techniques in automobiles. IoV's initial implementation is the Intelligent Transportation System (ITS). This technology is improving and increasing day by day to revolution the automobile industry. In various techniques, the notion of ad-hoc is being introduced and used in the autonomous vehicle network to enhance various features. As the use of this technique increases, the demand for new gadgets is also increasing.

1.2 Need for the research

All this ongoing use and demand makes the scientists think about fresh concepts for improved productivity in the autonomous vehicle industry. Research work is currently underway in the IoV setting to improve protocols, models of communication, and many others. However, it is compulsory to look for an appropriate routing system in urban regions that offers efficient data transmission and also tends to be sufficiently appropriate for ITS apps with polished end-to-end service Quality (QoS), vehicle (V2V), and vehicle infrastructure(V2I) air communication facilities. The goal is to provide mobile consumers with worldwide and ubiquitous connectivity as they travel on the road. The IoV is now considering increasing both in execution and research because, for the ITS, there are still many projects going on worldwide. There are additional streams such as (i) V2V, (ii) I2V, or (iii) V2I in IoV, and the last strategy is an amalgam, (hybrid methodologies) which is the mixture of the two algorithms listed. Their apps result in more comfortable handling of traffic jams and many other aspects and other problems in the IoV network.

It is also a prospective nucleus of ITS that contributes to enhancing the road safety of travellers and promoting the efficiency of transportation by using traffic management. Also, their network architecture layout should be taken into account when mapping IoV routing protocols. Nodes move inconsistently in the IoV network, resulting in structural deviations resulting in separation of the network, and as a consequence, there might be an expiry in the network. Network lifetime could be improved by anticipating vehicle mobility patterns, and This will lead to significant business use of apps, emergency, security, multimedia, infotainment application, traffic applications management. While IoV scalability is one of the most significant problems for network developers, a clustering-based model is one of the finest alternatives for the network developers.

The communication of the network is made available with a set of communication tools. In IoV, separate systems are interconnected so that devices can readily communicate or transmit information to each other. Networks are generally implemented for specific purposes in distinct domains. One of the network environments is to create a temporary basis network. It is called the type of network as an Adhoc network. These can be less infrastructure than infrastructure networks. There are many subdivisions in Ad-hoc networks, which include vehicle ad-hoc networks which are abbreviated as (VANETs), and mobile ad hoc networks which are abbreviated as (MANETS).

The IoV with a network of heterogeneous architectures consists of 5 different kinds of communications. These include the (i) Vehicle-to-vehicle infrastructure(V2I), (ii) Vehicle-to-vehicle(V2V), (iii) Vehicle-to-Road-side unit(V2R), (iv) Vehicle-to-sensors(V2S). This communication architecture can be categorized into three classifications: Adhoc, hybrid, and wifi-based wireless access in-vehicle environments (WAVE). With the use of unique WAT, each IoV communication vehicle is allowed. The WAT consists of IEEEWAVE for V2V, V2R is 4G /LTE, and Wi-Fi for V2I. Mostly Wi-Fi is used for V2S, CarPaly/NCF for V2P.

IoV follows the principles governing the MANET network and contains a network that is a wireless network providing vehicle information/ communication using Dedicated Short Range Communication (DSRC). IoV primarily used conventional short-range communication (DSRC) spectrum of 75 MHZ created by the federal communication Commission of the United States for V2V communication only. The DSRC is now available in parallel variants for Japan, Europe, and also the USA. V2X mode is allowed by the next design in-vehicle wireless access (WAVE) IEEE 802.11 p with a maximum transmission range of 1000 m. The IEEE 802.11a standard is used in IEEE 802.11p for low overhead operation.

1.3 Why clustering?

The clustering technique, which is used in IoV's, is considered to be a difficult task as the IoV network is in the form of ad hoc networks (MANETs). Clustering algorithms are taken into consideration for the study of a heterogeneous network. They are contributing to the Transport department which is sustainable and smart Cities through the measurement and analysis of the results of these three IoV routing protocols. Clustering is the primary technique to address the problem of scalability in IoV. This algorithm's primary input is to optimize the process of clustering. Use the algorithm to optimize the use of assets for the IoV network. This method is finished by optimizing and minimizing the number of clusters for distinct situations with the assistance of multiple parameters. Finally, a comparative analysis is used to demonstrate the algorithm outcomes and current systems.

Clustering allows the development of dynamically virtual backbones in a network, thereby helping to maintain the quality of service in such networks. Various reviews have been written based on clustering routing protocols [4],[5],[6]. To organize the network to provide reliable and efficient communication among the nodes in the autonomous vehicles. Clustering is one of the solutions to overcome the problems in the communication network of autonomous vehicles. The scalability, stability, and reliability of the Internet of Vehicles is the main focus of this work.

1.4 Need for the Routing protocol

Due to the increase in the demand for the introduction of new services in the IoV network, there is a chance the network becomes complex. A network becomes complex when the vehicle moves out of the range of the communication network which leads to delay in the response, packet drop, disconnections in the network, and also provides some old information/outdated information which might mislead the network to take wrong decisions. The topology of the network changes when the vehicular nodes move in high mobility, and due to the high speed of the vehicles, the nodes might often leave and joins the network. The node mobility decreases the lifetime of the network which might lead to the link failure and also to the delay in the data delivery. The main challenge in the IoV network is to provide reliable and timely communication for the very high dynamic vehicular network. The challenge also includes routing the packets among the vehicles in a timely and effective manner with low latency.

Therefore, there is the need for more appropriate routing protocols to handle all the failures in the unpredicted Vanet environment which includes high mobility, scalability, dynamic topology changing problems. The routing protocol should be designed to adapt the (i) quick change of VANET topology (ii) frequently disconnected networks (iii) large volume of data to be processed (Big-data processing tools to be introduced) (iv) storage problem in the IoV network (v) heterogeneous vehicles (which includes hardware and software from different companies and also cars, bikes, trains, and airplanes) (vi) scalability problem (vii) to improve the Quality Of Service (QoS) (viii) high data rate (ix) fragmentation problem (x) node density (xii) network partitioning (xiii) security.

Routing technology is a well-known essence of standard network studies. While routing remains an essential element of an inter-vehicle network, it is equally essential for IoVs to deliver control messages [3]. The architecture of communication is not restricted to RSUs and Vehicles (drones, underwater vehicles); however, other communication systems may be included. The architecture's complexity is the consequence of device ranges being included as opposed to VANET. Routing in IoV is a kind of network comprising heterogeneous, complicated, homogeneous networks. Since the study is done in the IoV network, it is a mixture of the network, which is heterogeneous.

IoV model is developed and analyzed for the highway scenario where the vehicles move with the high-speed on the road where fewer RSUs are installed. The developed model is analyzed for the metropolitan regions. Routing protocols are proposed based on various optimization algorithms such as ACO [7]. There are various reviews and surveys [4,5,6, 14] analyses and written for the IoT network [8,9,10]. IoT applications [11,12,13] for various applications based on smart homes, automobiles, agriculture, and healthcare have been discussed in the above papers.

The heterogeneous network vehicle structure of the IoV has excellent potential to oversee and guide vehicles, enabling them to deliver a communication platform that is trustworthy for plentiful multimedia, infotainment, and mobile internet apps. Besides, the Intelligent Transportation System (ITS) community agrees those vehicle communications-exclusively IoV- have a beneficial effect on traffic management and road security effectiveness improvements, such as collision avoidance, accident detection/avoidance in the road infrastructure. Therefore, to create secure and sustainable mobility, numerous challenges such as safety and connectivity should be addressed and considered for the introduction of efficient V2X technologies, including standardizations, deployment plans, technical difficulties.

The difficulties of the VANET and IoV network transition stage are largely dependant on the security of the communication network and stability among the communication network in the congestion of the traffic network. Therefore, it is necessary to evaluate the amount of IoV network connectivity wisely before deploying real-world implementation. The diversity of IoV characteristics influences the connectivity level of the vehicular network. These features can be described as the spectrum of the vehicular communication node, the density of the vehicles, traffic load among the vehicles, traffic lights, and RSUs, and market penetration of equipment in the network infrastructure. It is studies that more vehicles fitted with communicating radios which includes the OBU will increase the likelihood of vehicle communication, which leads straight to greater penetration of the market, and the outcome is an improvement in the level of IoV connectivity.

2. RELATED WORK

VANET's experiences include limited bandwidth problems and continual topology adjustments, Cluster formation is, therefore, one of the alternatives for the efficient management of a network. Since optimal clustering is one of the challenging issues in IoV and is also one of the NP-hard issues, optimization based on swarm intelligence can be used to discover near-optimal alternatives. A swarm-based route clustering is produced by pursuing the values inspired by nature, bird conduct, genes, and insect behavior, which can be used to deduce such values. In this context, some well-known VANET clustering algorithm approaches such as Ant colony optimization based, Artificial immune systems, Grey wolf optimizer, and particle swarm optimization can be mentioned. To be accurate, the most study is conducted based on a single objective issue, learning weights, and static transmission ranges, with the expectation of the DragonFly Algorithm.

The range of the transmission of the node is not similar in real-world applications, and the clustering of nodes in the IoV network is considered multi-objective. In the field of computer science, Artificial Intelligence machine learning, well-known metaheuristics algorithms such as Genetic Algorithm (GA), Particle swarm optimization (PSO), firefly optimization, fruitfly optimization, and ant colony optimization are presently in demand. Metaheuristics are particularly inventive in computer science and other fields, and due to heavy consumption, there are few questions as to why metaheuristics techniques are presently in demand when the comparison is created with other methods. A few of them include affordability, a process independent of deviation, simplicity, and local minimal prevention. Because meta-heuristics algorithms are available to solve such problems in clustering, these methods are well-liked and have contrasting natures to solve the issues. These techniques are also lenient and are easy to use.

Vehicle connectivity is referred to as connectivity of vehicles to other things around, whereas intelligence is deemed to combine vehicle and drive operations by using any of the techniques such as computational intelligence, profound learning, swarm intelligence, or anti-scientific intelligence. IoV is therefore designed to integrate human intelligence into the car by taking environmental variables into account. Clustering allows the development of dynamically virtual backbones in a network, thereby helping to maintain the quality of service in such networks. IoV's experiences include limited bandwidth problems and continual topology adjustments, Cluster formation is, therefore, one of the alternatives for the efficient management of a network. Since optimal clustering is a challenging issue in IoV and is also an NP-hard issue, optimization based on swarm intelligence can be used to discover near-optimal alternatives.

The establishment of the VANET of suitable clustering-based nature-inspired algorithms has shown excellent results. In mobile ad hoc network algorithms based on nature inspiration, such as swarm intelligence and insect-based bio-inspiration, provides better results in case of clustering problems. These available methods could be feasible for successfully developing more efficient routing algorithms. This research focuses on answering some essential routing questions that are motivated below in a wireless mesh network.

2.1 Cluster Based Routing Protocols

Chatterjee et al. [15] proposed a weighted clustering algorithm (WCA) where large CH is elected based on the node weight. The node weight is calculated based on the factors which include mobility, scalability, transmission range, and energy. Clustering algorithms for MANET were previously suggested in the literature. As with MANET's weighted clustering algorithm (WCA), the weights are recorded as a weighted sum of factors that depend on the neighbors, neighborhood distance, velocity, and time limitations. Throughout the entire communication session in which the author is proposed the car as a CH [15]. Secondly, an expansion of the WCA- based VANET weight-based clustering algorithm (VWCA) expanded about a few distinct VANET- based weights however, static weights are used as the WCA [16] suggested by Daeinabi et al.

Clustering time and nodes per cluster are the main parameters for an effective energy-conscious predictive clustering strategy for IoV's. Communication delay is decreased for better results, depending upon the two characteristics and node positions. Efficient communication is also beneficial in terms of energy nodes as well as the network bandwidth for resource usage. This method worked better than VWCA [16] but is lagging in providing the optimal cluster amount for each situation. The most significant connectivity problem is solved in Gerla's [17] proposal, and Tsai was built on the genetic algorithm as well as optimized the number of clusters.

SDN (software define network) based methodology was suggested by He et al. [23] in heterogeneous SDVN. In this model, IoV's cost-effectiveness in a heterogeneous setting is aimed. SDVN could be agreed as a greedy algorithm that could be compared with an approach that provides the best- effort and is outperformed in many cases. Dua et al. [24] suggested the quality of service (QoS)- conscious dissemination of information for dense urban regions in VANETs. QoS- based clustering is performed in this system to provide the shortest path of communication. The reward-punishment based on single weight is used for fitness calculation and smart forwarding (IF), which could be better conducted than sender-designated broadcast (SOBP) and destination-oriented-based routing protocols. A big problem with this method is the calculation of a single weight that stays static during the entire session. Zhang's newly suggested method is another Binary Artificial Bee Colony (BABC) algorithm that is designed for the VANETs [30].

Wang [33] et al. suggested the energy-efficient clustering algorithm for the sink node. This algorithm showed a better lead than the other proposed algorithms based on the coordinated priority. The novel clustering-based algorithm is created as an energy-efficient cluster-based Road Adjustment (EECDRA). This algorithm lowers the route setting cost to maintain ideal paths. This system has improved the lifetime of the network and also provides energy efficiency.

Shankar et al. [35] proposed a new modified K-mean clustering algorithm to improve the lifetime of the network by minimizing the energy consumption in WSN nodes. Modified K-means cluster algorithm (MK-means) select three CH's for each cluster at the same moment of time. The load sharing technique is used in the load transfer within the nodes in the network. This algorithm provides energy efficiency and extends the lifetime of the network. This also helps to reduce the impact of reclustering, which eventually improves network performance.

2.2 Clustering Algorithms based on Optimization Algorithms

Shahzad et al. [18] suggested most popular dynamic method for MANET based on metaheuristic CLPSO. On fundamental network factors which include ideal degree, battery power, and also transmission power, this algorithm calculated an optimal amount of clusters. Adaptive mobility density linked clustering algorithm (MADCCA), built only in distinct situations for cluster stability. Based on the top of the cluster of traffic density, switching is made to maintain the average density of nodes for each CH. Key parameters used in MADCCA are the speed and velocity of the vehicle. [19], [20].

In the context-aware computing field and 5G communication network, high-efficiency urban-traffic management was suggested by Liu [21]. This method is also based on 5G, communication among the VANET's, and mobile edge/fog computing SDNs, which substantially enhanced rescue time and response time in case of emergency cases. The architecture may also include factors which include car location, traffic forecast processes for traffic management, which were conducted similarly in the various case study when compared to the prevalent solution for arrival time. Optimization of the dynamic path using the nature-inspired IoV is an algorithm built by Chowdhary and Kaur [22], proposed two commonly nature-inspired ACO as well as the PSO algorithms for IoV optimization of the path, where the performance of ACO is better than PSO by offering the shortest paths requiring less travel time.

Sahar et al. [25] proposed cluster based enhanced AODV for IoV called as AODV-CD to ensure the Quality of Service (QoS) in the IoV network.

Nadjet et al. [26] proposed new dissemination scheme and proposed the cluster selection algorithm to avoid the brain storm problem. The latency, packet delivery ratio and data throughout are improved

Mumataz et al. [27] proposed a 5G communication model for the VANET network which is D2D communication. It uses an algorithm called, Transmission parameter sensing algorithm which is ideal for connectivity, taking into account resources which is the D2D spectrum, that could be a sensing parameter interference of the network, transmission energy is concentrated by sensing algorithm for effective D2D environment connectivity. Construction is only centered in this tree-spanning methodology, and a minimum spanning tree is beneficial by the uninterrupted communication of the network. The spanning tree's role is to link nodes that are without loops. The simulation is considered with the 16 number of nodes which is the maximum value, where only one parameter is considered to be used as the maximum hit prediction. This proposed BABC algorithm is compared and conducted better with the Kruskal algorithm owing to its vibrant conduct and developmental capacities. The only car to roadside scenario (V2I) could be used in performance assessment testing. ACO- based VANET (CACONET) clustering algorithm assessed the efficiency of the same well-known metaheuristics.

Aadil et al.[28] proposed the clustering-based algorithm based on the density of nodes. In an ACO, another algorithm called CLPSO, and multi-objective swarm optimization (MOPSO) comparative analysis [28] by Farhan et al., The algorithm increased the cost of packet routing and reduced the total amount of clusters. The algorithm is designed to solve effectively performed multi-objective issues (MOP), by weights that are not dynamic. Most communication factors which include transmission range, scalability, stability mobility pattern, and topology, are regarded in this method but are presumed to be uniform for all nodes. All nodes in the network will probably have the same transmission variety in the event of transmission range.

Aadil et al. [28] also suggested the algorithm or the local area network create the communication network to be more optimized. The higher-degree node will be nominated as CH for the network. MOBIC, which is a clustering algorithm, operated effectively to pick CH in the MANETs. Network capacity is also measured based on the stability of clusters that can be assumed in terms of parameters such as the proportion of CH actuations and the radio of cluster nodes to CH modification. A previous version of this method offers the only solution and is inadequate for issues of optimization, such as clustering.

The two algorithms CACONET and CAVDO suggested by Aadil et al. [28] are also the techniques used for clustering in VANETs. The optimization of the colony of Ant and the Dragonfly algorithm conceptualizes these methods. By using ACONET, VANETs measure LBF and complexity, there is an enhancement gap to optimize the number of created clusters in VANETs to get more optimized results.

Fahad et al. [29] recently suggested one of the optimization algorithms for optimizing the number of clusters called the grey wolf optimization algorithm. It also utilizes the same parameters for communication. Finally, evolutionary methods can find alternatives from even more prominent and non-uniform parametric networks owing to their dynamic nature. Therefore, swarm intelligence-based techniques are documented literature to solve MOPs, but the problem is that these algorithms use static weights, and all objectives are listed in accordance with the predefined order of meaning.

Fahad et al.[29] later also suggested for the VANETs the CLPSO and MOPSO. As a consequence of this algorithm, more than one alternative is given, depending on the parameters nominated by the customer The Fahad et al. [29] solves the same issue, but there is still a study gap that can be enhanced through the use of the other meta-heuristics. Tan [31] et al. presented a clustering algorithm called TSDEGA. This algorithm is used for the health monitoring of the network. The main objective of this algorithm is used to increase the lifetime of the network. This algorithm uses battery energy as the metric. The suggested methodology has enhanced the time synchronization of structural health. Yao [32] et al. proposed the two-level programming-based vehicle route for the emergency. The methodology for the two-level programming is based on the Genetic Algorithm. It contains different priority-based levels so that the resources can be allocated. The simulation is conducted for the no-signal, priority control strategy, coordinated priority strategy.

Wang [34] et al. proposed a new methodology for solving the hot spot issue. The clustering system is based on the well-known Particle Swarm Optimization (PSO) meta-heuristics algorithm. IN the routing phase, clustering is based on the remaining energy and the node position of the network. The suggested technique improved the lifetime of the network, thereby the performance of the network is increased. The other advantages include reducing transmission delay and energy consumption. Shankar et al. [36] suggested a clustering method for energy balancing to improve energy efficiency in WSNs. Combining HSA and PSO, the algorithm is intended to provide high dynamic capabilities. It improves the lifetime of the network by decreasing residual energy consumption. Potthuri et al. [37] suggested the hybrid differential evolution and simulated annealing (DESA) algorithm for the energy use clustering algorithm in WSN. This system also focuses on the correct choice of CH to prevent network separation and node expiry. Compared to other current techniques, the suggested framework decreased the node death rate.

Oranj et al. [38] disagree that although these parameters may be influenced by environmental parameters, they generally ignored, affecting the output owing to the performance. Baker and Ephrimides [39] proposed the idea of the identity of each node, in which each node contains a unique ID. A node with the lowest ID is selected as CH. Kavisha and Zhanjie Wang [40] propose a CH selection-based routing protocol for the vehicle network. Only better selection/ election of CH focuses on the use of bully algorithms and time stamps. The methods suggested are contrasted for the assessment with the AODV protocol and the Dynamic Source Routing (DSR). In many situations, this technique is conducted better, but network parameters are not used about its transmission features.

The adroit algorithm [41] is suggested for effective routing in the 5G-cloud-VMesh network(5CVN). The efficient use of resources is addressed on the 5G access layer by closing optimum gateway cars and aggregator nodes. In many situations, the adroit algorithm conducted well concerning other techniques, but this algorithm is only used for three parameters. Balaji et al. [42] proposed the use of ACO in cluster architecture is more suitable for the VANET environment. The algorithm is proposed for the effectiveness of urban routing operations. Shahzad et al. [43] presented a new clustering algorithm based on particle swarm optimization. This algorithm is mainly proposed for the MANET environment. The mobility metric is based on the various parameters, which include optimal degree, cluster frequency, transmission range, and energy. The weights are assigned to each parameter based on the user requirements and the application. Shahzad and Ali et al. proposed MOPSO for the MANET environment.

Hafeez et al. [44] are proposing a distributed multichannel and also mobility-conscious cluster-based (DMMAC) protocol in IoV's. Using a fuzzy logic-based scheme (FIS), the hidden terminal, and also a media access issue, is aimed at this method. Since DSRC a limited amount of communication among the channels, there are higher chances of using the same channel with any node. Use of FIS Service Channel subchannels for this problem. Gerla and Tsai [45] expected the procedure for choosing CH but using topology-based clustering, for several neighbors are computed together, called node grades.

Tan et al. [46] suggested the structural health monitoring clustering algorithm TSDEGA. The novel method's primary objective is to increase the lifetime of the network by using battery energy as a metric. The suggested strategy has also enhanced the precision of meeting time synchronization in the surveillance of structural health. These types of communication are used for communication among the vehicles for safety and infotainment applications. Safety applications could be used to prevent accidents. Infotainment applications could be used for the safety and comfort of drivers and passengers. End-to-end connections in the IoV environment could not be guaranteed in the IoV environment. The IoV environment is highly mobile, thus differing from various multi-hop networks. In the highway scenario, there is more chance for network partitions. The traffic safety in the vehicular network is influenced by intermittent connectivity. The intermittent connection in the vehicular network may lead to severe packet loss, which may affect the reliability of the safety applications. The communication range in the vehicular network is limited for this type of extensive scale network. The flat network topology fails in the case of a vehicular network. To overcome this clustering approach, which is also called the hierarchical topology, was proposed for the vehicular environment.

The main issues addressed in this paper include optimal route delivery by improving the end-to-end connectivity and also providing minimal overhead. The performance metrics used for the comparison include node density, size of the grid, and the transmission range of the network. Table 1 represents the comparison of various clustering algorithms based on the machine learning algorithms. The grouping of several nodes having similar characteristics into a virtual group is named clustering. Based on specific rules, vehicles are grouped into different groups. Among the grouped nodes, the cluster head is selected based on specific characteristics. The selected serves as the central management, and it is used for data dissemination.

To provide cluster stability, the following properties need to be considered.

(i) Transmission overhead should be low

(ii) Prolonged cluster head lifetime

(iii) Prolonged cluster member lifetime

(iv) To minimize the times the cluster head change

(v) To minimize the state change of the vehicle

Based on the topology of the cluster the clustering is divided into

(i) Single hop cluster

(ii) Multi-hop cluster

In the single-hop cluster, the cluster head is one hop away from the cluster members within the transmission range. In the multi-hop cluster, the cluster members are 2- hop or 3- hop away from the cluster members.

The study of the related works gives us the limitations to be addressed:

(i) the convergence time is more in the existing algorithm during the process of the CH selection.

(ii) Maintenance of the clusters in the IoV environment

(iii) Most of the algorithms available in the literature could support only the small-scale network and not the large-scale network

(iv) There are issues in the IoV network to prolong the lifespan of the network can be improved.

3. PROPOSED WORK

The proposed method is novel according to our best understanding. The novelty is based on the following:

(i) algorithm novelty,

(ii) dynamic algorithm for tuning weights

(iii) dynamic network parameters in which the (transmission range is considered to be dynamic)

(iv) 5G interface.

Also, the suggested technique is designed to deal with the multi-objective problem to find the optimization, and each goal has dynamic weights which are used to provide a more predictive solution. Finally, each section of the predicted method is modeled mathematically for comparative assessment and better description. In contrast, the latest optimization techniques are compared to improve its importance.

Multi-objective strategy based on swarm rather than conventional cluster algorithms in IoV. The algorithm recently suggested mobility-conscious channel model and the proposed algorithm is considered for the dynamic nature by considering the transmission range to be dynamic. 5G existing model interface to further enhance current outcomes, proposed conceptual model based on the location of GPS using 5G interface.

Cluster-based VANET communication is impacted by the choice of the most suitable cluster head (CH). The step to select the CH is necessary to consider the distance and speed of the vehicle to increase the stability and efficient communication or messages in intra and inter clusters. To maintain the connectivity among the bodes of the IoVs, the range of transmission of the network is highly essential. The network's connectivity is affected based on various factors which include when the transmission range is not assumed static when there is a non-uniform vehicle distribution, and also when there is a change in the road infrastructure rapidly. Therefore, the excellent connectivity in non-uniform networks requires a vibrant transmission variety. This problem encouraged us to consider dynamic transmission variety in the IoV network for each vehicle moving in the network. To this end, we suggest a new algorithm for allocating a dynamic range of transmission to each node/ vehicle depending on local traffic density.

The proposed framework includes various properties

(1) A novelty of the algorithms which is proposed

(2) Network parameters are considered dynamic

(3) 5G technology

For greater emphasis, the suggested technique is designed to have one of the multi-objective optimization capabilities to have a more predictable solution. Our research goal is to provide a model of routing to improve vehicle route discovery and preserve network stability in an IoV network among the nodes. Our research contributions are defined as follows:

- The main issues addressed in this paper include optimal route delivery by improving the end-to-end connectivity and also providing minimal overhead.

- The performance metrics used for the comparison include node density, size of the grid, and the transmission range of the network.

3.1 Proposed Algorithm

The following questions have to be answered before proposing the algorithm

3.1.1 Clustering concepts

The clustering structure involved in the study are Cluster Head (CH), Cluster Member (CM), Cluster gateway (CG), The cluster heads selection criteria include the destination metrics that are based on mobility information of the vehicular node which includes the destination object such as relative velocity, direction, and the current location.

3.1.2 Cluster formation strategy

The cluster formation strategy includes the centralized strategy where a central node takes the responsibility for the cluster formation and also the affiliations of the cluster members to the appropriate clusters. In the VANET environment, RSU acts as the central node. RSU sends the beacon message to the nearby nodes in the network. Then the vehicular nodes send affiliation requests to the RSU node. The RSU node initiates the process of cluster formation among the vehicular nodes.

3.1.3 Cluster radius

The number of hops the Cluster Head (CH) away from the Cluster Member (CM). Here the cluster members (CM's) are 1-hop away from the cluster heads (CH's).

3.1.4 Clustering Flow

The clustering process includes the following phase

1. Neighborhood discovery
2. Cluster Head Selection
3. Announcement
4. Affiliation
5. Maintenance

3.2 Locust Optimization Algorithm

Initialization process

1. The decision variables are represented
2. Integer variables should be included
3. The continuous variable T
4. The operating variables length
5. Initial position and velocity (searching locust)
6. The solution for the individual locus is represented

Step 1: The vehicles of different velocities in each particle positions are given. The total no. of Vehicles (or the population size) is given.

Step 2: The position of the vehicles is generated with the corresponding velocities of the vehicles of the particles are randomly generated.

Step 3: The fitness function of each vehicle (Locust) is calculated.

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The minimum fitness among the vehicles and the corresponding vehicle is the output as the
Pbest and the pbest=gbest
Vehicle searching is performed
Updating the discrete integer-valued positions from binary-valued velocities of the vehicles
The searching step size is improved by using the conventional velocity updating formulation
For K_iS the bellow equation is used

$$v_{ij}^{t+1} = round\left(\omega . v_{ij}^{t} + \bar{c}_1 r_1 \left(pbest_i^t - \chi_{ij}^t\right) + \bar{c}_2 r_2 \left(gbest_i^t - \chi_{ij}^t\right)\right) \quad (1)$$

Updated position of the particle is given by

$$\chi_{ij}^{t+1} = \chi_{ij}^{t} + v_{ij}^{t+1} \quad (2)$$

Round() is the only function applied to round the value if and only if $1 \leq \vec{j} \leq \vec{J} - 1$
Round () rakes no effect
W is the inertia weight
$c\bar{1} and c\bar{2}$ are the two c constants between 0 and 1 such that $c\bar{1} + c\bar{2} \leq 1$
For the fine search of T ($T \leq 1$)
For the coarse search of K_iS to represent the cognitive and social-behavioral factors of the vehicles, r1 and r2 are two random numbers in (0,1)
To illustrate the processes of updating the present best and global best vehicles eliminating illegal vehicles
Step 4: velocity is updated using equation 1.
and the former four elements are rounded
step 5: Two vectors are predefined as the upper bound 'upb' and lower bound 'lob' of each decision variable
step 6: The old particle is updated according to equation 2.
illegal elements in the newly updated vehicle are eliminated with the corresponding bounds
step 7: New fitness is computed with the newly updated positions of each vehicle and pbest
the corresponding vehicle information is output
if the new minimum fitness (nmf) is smaller than the current global minimum fitness (gmf)
fnf is replaced by nmf
gbest is updated with the new position of the vehicle
if gmf <nmf < the present fitness pmf of the former pbest
pbest is updated with the new position of the particle
step 4 to 7 is repeated till the present maximum iteration number is reached then the procedure is finished
results are taken as the output
The Locust swarm optimization algorithm is the swarm of locusts. The Locust optimization algorithm considers the search space to be a plantation area, where all the available locusts in the plantation area interact with each other. The solution obtained within the available search space provided the position of the locust in the plantation area. The locust gets the food quality index based on the fitness value of the solution obtained.
Two behaviors include

1. Solitary
2. Social

Locust operation

Population: L^k { $l_1^k, l_2^k, \ldots, l_N^k$ } of N locusts (individuals}

Initial point (k=0) to a l_i^k
Total gen number iterations (k=gen)

3.2.1 Pseudocode

Initialize/set the position of the vehicles on the highway (randomly)
Set the direction of the vehicles moving randomly
Initialize/ set the speed/ velocity/acceleration/jerk of each node of the vehicle
Create the mesh topology considering dynamic transmission range
Calculate the distance between the vehicles
Initialize the Max iteration MR, initial positions, and velocities of particles w, c1, c2
For (iteration=1) to total iteration =10
    While (node! =empty)
        Node availability to be clustered= ALL node
    End while
Compute fitness and output (pbest and gbest) and current best fitness pmf,gmf
Generate new velocities of S based on obtained pbest, gbest
Update position of S particles based on newly obtained velocities
Compute new fitness nmf based on new velocities and position
If (nfm<gmf)
{
Update gmf as nfm and corresponding position)
Else
{If(gmf<nfm<pfm)
{ update pmf as nfm

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The corresponding position of the particle{
}
Update Best cost
If iteration=MAX
{ return best found fitness and gbest}
BEST COST

In figure 1, various steps involved in the proposed methodology are represented. The initialization of the process begins with the random solution. Then the process of clustering takes place based on the fact that the cluster is assigned with one CH, and the CM is assigned from the vehicular nodes available in the network. The next step is to construct the weight function. The weight function can be used to construct the objective function with the weights assigned to the defined objective functions. According to the number of iterations, the value of weight c is updated. The position update is done based on the weight obtained in the previous step. The step is repeated to get the maximum number of iterations. At the end of the process, the efficient CH will be returned by the main loop.

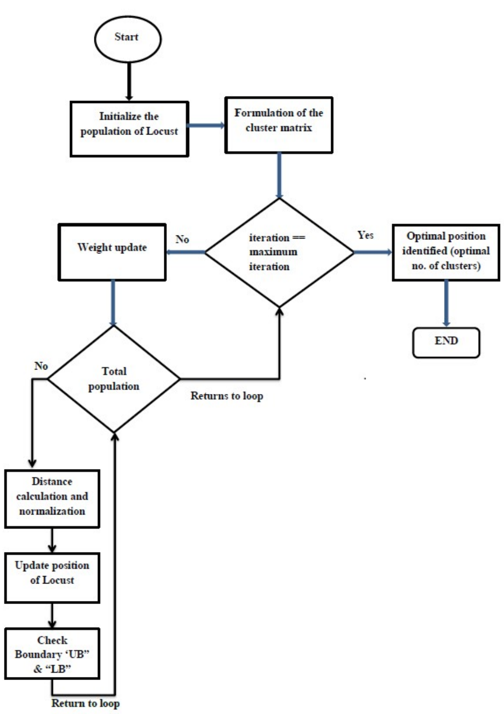

Figure 1: Flow chart of the proposed methodology

EXPERIMENTAL AND SIMULATION STUDY:

To measure the efficiency of the proposed algorithm with MFO (moth Flame Optimization), MOPSO (Multiple Objective Particle Swarm Optimization), CLPSO (Comprehensive Learning Optimization), GWO (Grey wolf Optimization), ACO (Ant Colony Optimization), CAVDO (Dragonfly Optimization), GOA (Grasshopper Optimization) many experiments have been performed. The performance of the compared algorithms is shown in the various figures. The efficiency of the proposed methodology is checked based on the transmission range of the nodes and the node density in the grid. The proposed methodology showed a consistent performance compared to the existing algorithms. LoIoV algorithms performed comparatively well in the increasing number of nodes ranging from the number of nodes from 10 to 100 which are the node density. The experiments are performed for the transmission ranges from 100m to 500m. The transmission range is varied to check the consistency of the new proposed methodology.

The figure shows node density ranging from 30,40,50,60 with the transmission range from 100m to 500m. The studies show that if the transmission range is increased the number of the cluster formed will be less. From the results, we found that the algorithm LoIoV outperformed the other algorithms. The proposed algorithm formed a minimum number of clusters for the specific grid size. Table 2 contains the various simulation parameters needed for the analysis. The results obtained from the primary phase of analysis of the grid size of the network which includes 1000m x 1000m states are shown in

Figure 2. From the figure, it is found that the minimum number of clusters is formed by the LoIoV algorithm for the maximum transmission range and the minimum number of nodes. When the number of nodes is increased for the maximum transmission range CACONET performs better when compared to the other optimization algorithms.

Figure 3 compares the correlation among the various clustering protocols based on optimization algorithms. The parameters compared include the grid size which is also called the network area, the transmission range of the vehicular nodes, network area, the total number of clusters formed. The number of node densities is directly proportional to the number of clusters. When there is an increase in

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the node density there is an increase in the number of clusters and vice versa. From the graph, it is observed when there is the minimum number of nodes with the transmission range is 100 m LoIoV performs better. When the transmission range of the coverage of the network is increased, there will be a drastic decrease in the number of clusters formed. In most of the cases, our proposed algorithm provided the minimum number of clusters. But when there is an increase in transmission range with the increase in the number of nodes then the CACONET performs better

Table 1: Comparison of various clustering algorithms based on machine learning

Author/Algorithm	Performance parameter	Techniques	Initial consideration	Inference
Bansal [47] Taherkhani [48]	Packet delivery ratio and throughput improved Routing overhead increased compared to the base k-means algorithm	K means clustering	Position of the vehicles (x, y, z)	Divide the vehicles into clusters Maintenance phase not required Fixed number of clusters is a problem
Chai [49]	Packet delivery ratio, throughput	K harmonic means	Relative distance and centroids The velocity of the vehicles along with the centroids	Fixed number of clusters is a problem
Bhosale [50]	Packet delivery ratio, throughput	Agglomerative hierarchical clustering	Direction and speed of the vehicles	Do not require fix number of clusters Proximity matrix calculation is needed Change in cluster member is not possible
Arkian [51]	Resource management is improved	Reinforcement learning(Q-Learning)	Speed, degree. RSU link quality	Calculate fit factor Acceleration, the direction is ignored
Wn [52]	Throughput, stability, and bandwidth is improved	Q-learning	Vehicle velocity, degree of a node, and channel condition	Sloe vehicles are chosen as the cluster head still it is a drawback as the faster vehicles will moves faster without joining the network
Bhanja [53]	Traffic congestion in the dynamic vehicle environment	K means clustering algorithm along with Fuzzy	Vehicle speed, fog, rain, and brake frequency	K means always use the centroid as the CH, so if there is any change in the network there will be a change in the CH
Sharma [54]	Optimal clusters	Hybrid fuzzy multi-criteria decision making (HF-MCDM),	Velocity, social contact, integrity, availability	The efficiency of the cluster and stability of the cluster is not studied

		dolphin swarm		
Machine learning system for RDM [6]	Packet delivery ratio, end-to-end delay	Unsupervised learning methods	Movement of the vehicles, the capability of transmission	to select the best route path the vehicle movement is predicted
QGrid [6]	Delivery ratio, hop count, delay	Reinforcement learning,	-	Message delivery is improved Routing decision
FQLAODV [6]	Bandwidth, signal strength, no of hops	Fuzzy logic, Q-learning	-	To find the best multi-hop route for data transmission Do not work in Fading channel Best route selection
EQ-AODV [55]	Average delivery ratio, end-to end-delay and time is taken for half energy depletion	Reinforcement learning(Q-Learning)	-	Good packet delivery ratio and energy consumption Performance of End-to-delay is weak Message dissemination
TIDE [6]	Delivery ratio, transmission delay	Reinforcement learning	-	In the dynamic topology routing optimization For routing decision Traffic noise is increased to make accurate decisions
Deep learning-based algorithm [6]	Average of the packet delivery time, energy consumption, travel time	Deep reinforcement learning	-	Routing of packets in heterogeneous networks To make routing decisions
CAVDO [28]	Time is taken for cluster formation, delay in the re-clustering, dynamic transmission range,	Clustering algorithm MA-DTR	Direction, scalability speed	To improve the stability of the topology in the dynamic environment Performance depends on the node density of the vehicular network, transmission range, depends on the cluster number and the size of the grid Dissemination of message in the dynamic(speed/velocity/acceleration) environment)
Nature-inspired algorithm [28]	Average travel time	ACO and PSO	Vehicle speed, frequency band	Managing the traffic, Routing decision in the network
Nature-inspired algorithm	No result for PDR, end to end delay,	Moth flame optimization (MFO)	Speed, direction, grid size, the degree of a node, the	Optimize the cluster

	hop count, throughput		transmission range of the vehicles	

Table 2: Parameters for the various algorithms for the study

Parameters	LoIoV	GWOCNET	MOPSO/CLPSO	CACONET	GOA/MFO
Population-size/ particles	100	100	100	100	100
Maximum Iterations	150	150	150	150	150
Inertia-weight (W)	0.649	0.649	0.649	0.649	-
C1	2	2	2	2	2
C2	2	2	2	2	2
Simulation area	100x100, 200x200, 300x300, 400x400	100x100, 200x200, 300x300, 400x400	100x100, 200x200, 300x300, 400x400	100x100, 200x200, 300x300, 400x400	100x100, 200x200, 300x300, 400x400
Lower Bound (lb)	-	0	-	-	
Upper-Bound (up)	-	100	-	-	
Dimensions (Dim)	-	3	-	-	
Transmission-range	100 to 600 m	100 to 600 m	100 to 600 m	100 to 600 m	Dynamic
Mobility models	Freeway mobility model	Freeway mobility model	Freeway mobility model	Freeway mobility model	Freeway mobility model
Simulation runs	10	10	10	10	10
W1	0.5	0.5	0.5	0.5	0.5
W2	0.5	0.5	0.5	0.5	0.5
Nodes	30,40,50,60	30,40,50,60	30,40,50,60	30,40,50,60	
Vehicles Velocity Range	22 m/s-30m/s	22 m/s-30m/s	22 m/s-30m/s	22 m/s-30m/s	22 m/s-30m/s
Maximum Acceleration	1.5 m/s2	1.5 m/s2	1.5 m/s2	1.5 m/s2	1.5 m/s2
The minimum distance in vehicles	2m	-	2m	2m	2m
Maximum Distance in vehicles	5m	--	5m	5m	5m
Width of Lane	50m		50m	50m	50m
Number of Lanes	8	8	8	8	8
Evaporation Rate	-	-	-	0.05	0.05

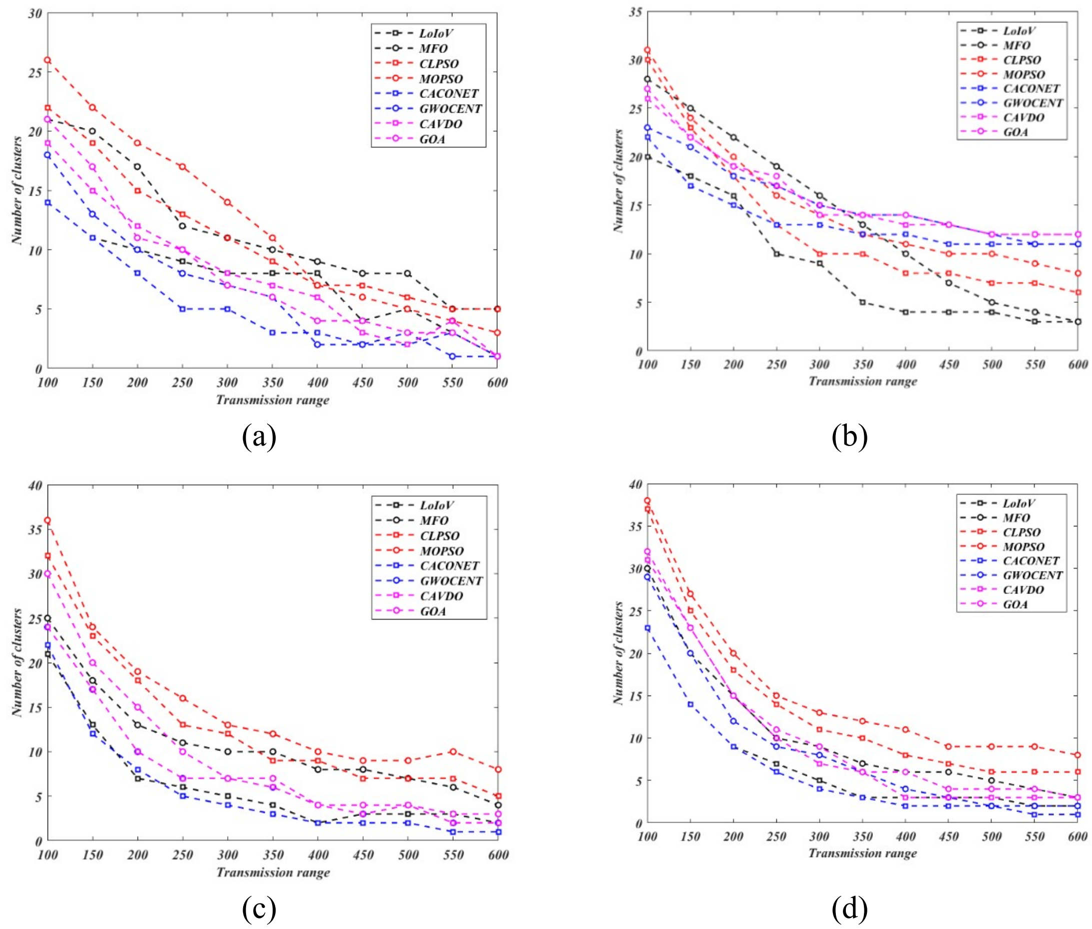
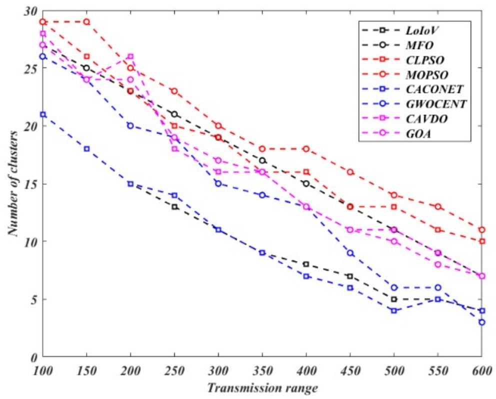
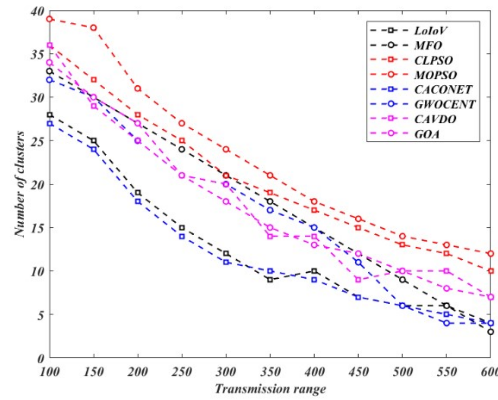


Figure 2: Transmission range Vs Node density (Number of nodes) Vs Grid size 1000m (1km x 1km)



(a)



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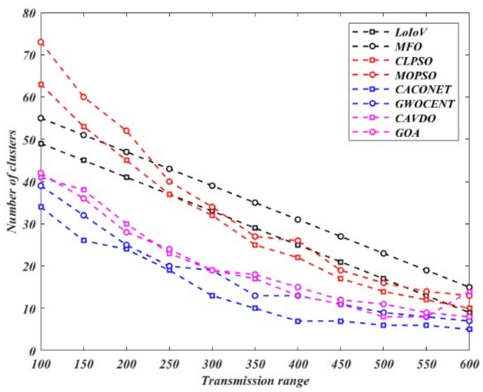
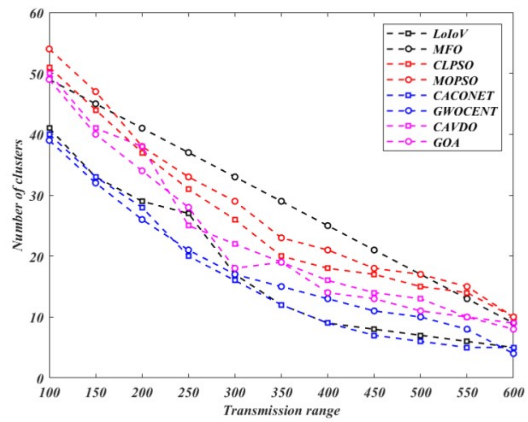


(c)



(d)

Figure 3: Transmission range Vs Node density (Number of nodes) Vs Grid size 2000m (2km x 2km)

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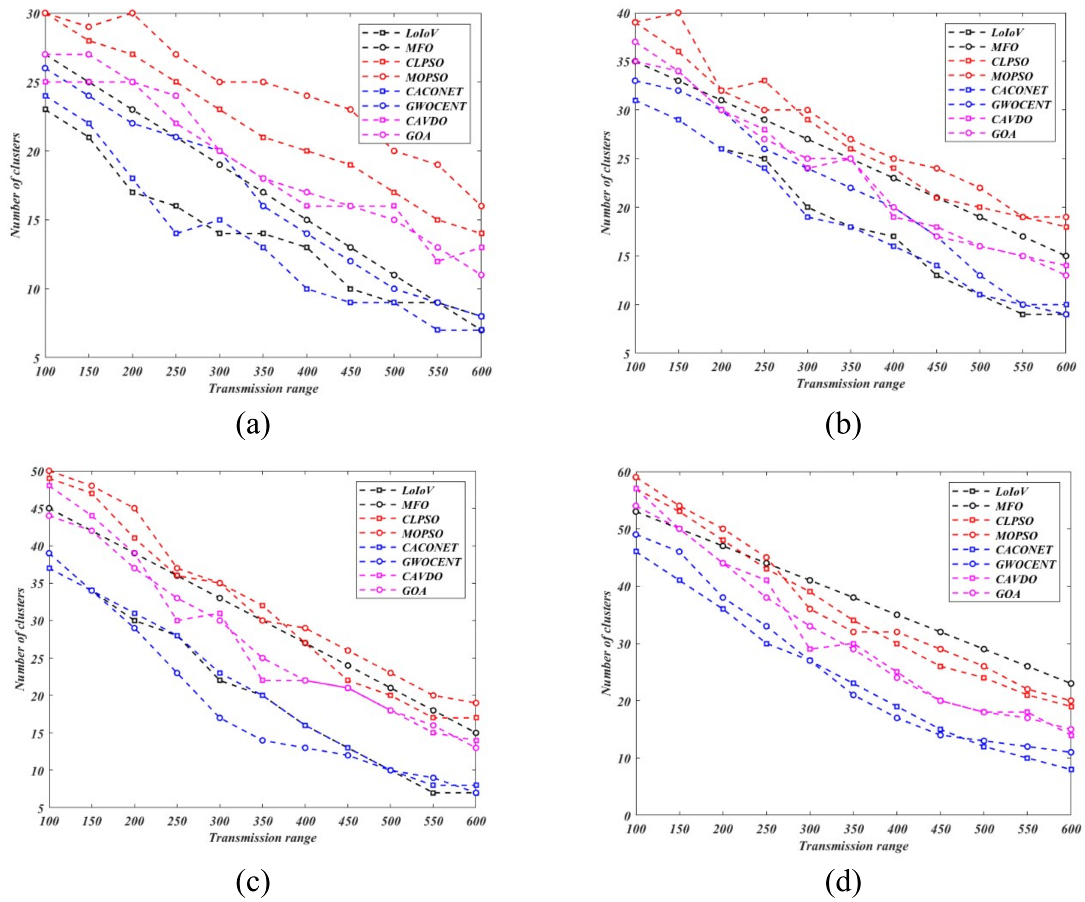

Figure 4: Transmission range Vs Node density (Number of nodes) Vs Grid size 3000m (3km x 3km)

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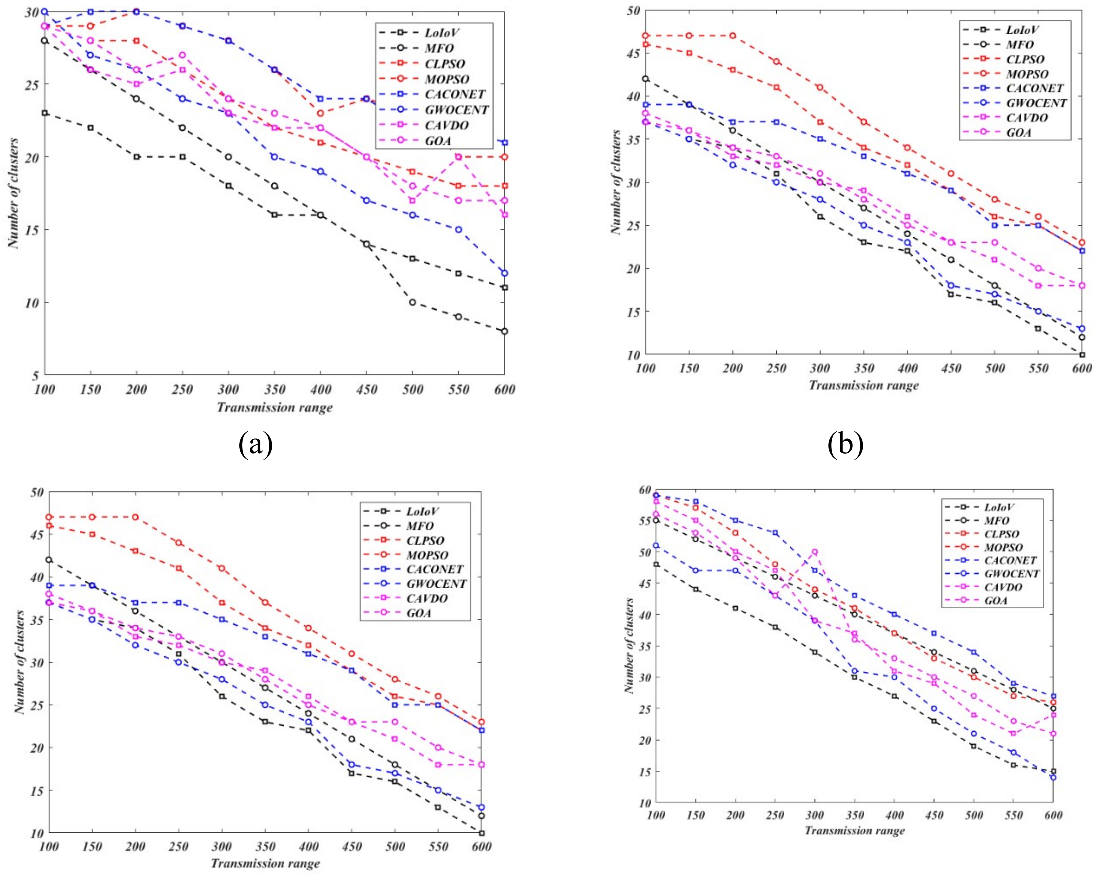

(a) (b)

(c) (d)

Figure 5: Transmission range Vs Node density (Number of nodes) Vs Grid size 4000m (4km x 4km)

Figure 4 the values from the graph generated for the 3Km x 3Km we observed that there is an increase in the values of the minimum and the maximum number of clusters formed compared to the little smaller grid size 1km x 1km & 2km x 2km. when the distance among the vehicular nodes increases this will affect the number of clusters formed. As observed, there is a degradation in the performance of the various algorithm when there is an increase in the node density and also an increase in the simulation area. Figure 5 the number of the cluster formed for the various optimization algorithms are plotted in the graph. The analysis is performed for nodes ranging from 30, 40, 50, and 60 with the simulation area 4Km x 4Km with the transmission range value between 100 to 600 m. It is observed from the graphical representation that the proposed algorithm provides the optimal value. There is one more observation that when there is an increase in the transmission range the number of clusters is increased.

Throughput :

Throughput is the metric which is calculated by using the below formula,

Throughput (T)= ∑(Traffic received- Traffic sent)/ Total data packets received.

It is defined as the average number of packets transmitted successfully. From the analysis it is concluded that LoIoV performed better throughput compared to the other algorithms. From the experimental study it is concluded that the throughput will decrease if the number of vehicles is increased.

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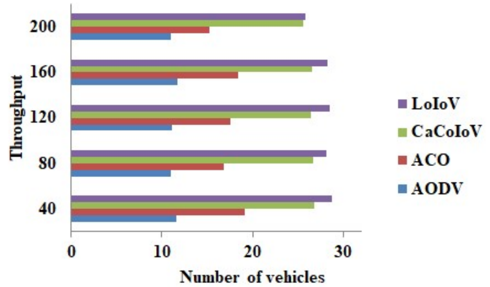

Figure 6: Throughput Vs Number of Vehicles

DPDR (Data Packet Delivery Ratio):

Packet delivery ratio is given by the formula:
PDR=(∑ Number of packets received/∑ Number of packets sent)*100. From the simulation study it is concluded that the data packet delivery ratio is high for the proposed algorithm. But the challenging factor is when there is the increase in the number of vehicles there is a decrease in the data packet delivery ratio.

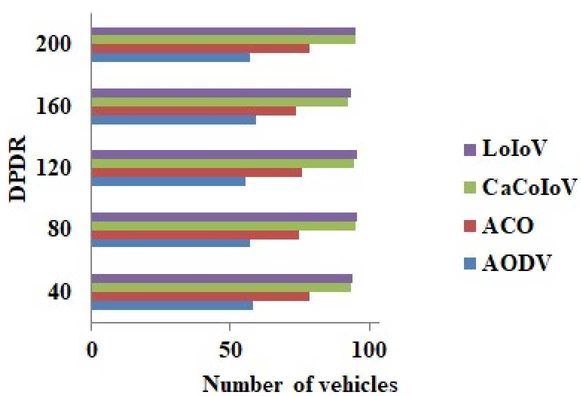

Figure 7: Data Packet Delivery Ratio Vs Number of Vehicles

PDR (Packet Drop Ratio):

It is the ratio of packets that are not received in the destination to the packets which is send from the source. The study make us a understanding that the algorithm of LoIoV provides much less in the packet drop ration compared to the other algorithms. There is a huge difference in the packet drop ratio compared to all the other algorithms.

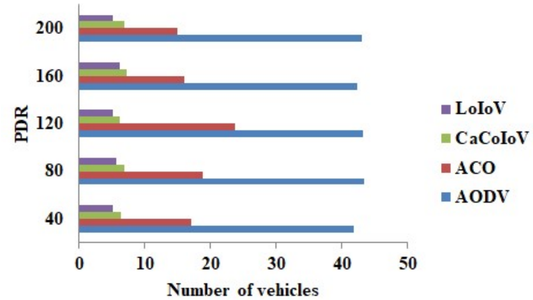

Figure 8: Packet Drop Ratio Vs Number of Vehicles

AED (Average End to End delay):

This is the time taken by the packet to be transmitted between the source and the destination. This metrics partially depends also on the ratio of packet delivery ratio. From the experimental study for the proposed algorithm LoIoV it is concluded that the average end to end delay decreased is increased when the number of vehicles is increased.

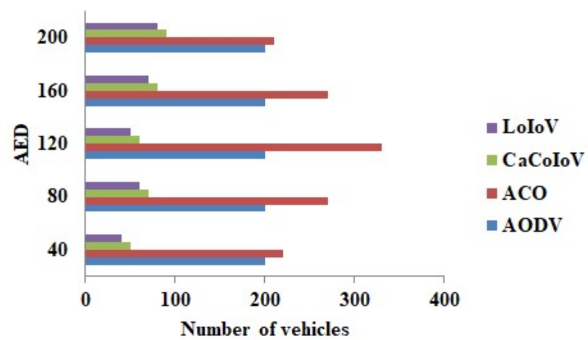

Figure 9: Average End to End Delay Vs Number of Vehicles

Load Balance Factor (LBF)

Load Balance factor (LBF) is the method to find the load assigned in each of the cluster heads. It is very difficult to assign an equal number of CNs among each cluster. LBF factor is used for the balanced allocation of load among the clusters. Choubey defined the LDF as below

n is the number of the clusters
the cardinality of the cluster i
the average number of neighbors of a CH (the total number of nodes in the network)

When the transmission range is increased the number of clusters decreased. From the study, it is observed that the number of the cluster formed is inversely proportional to the transmission range. If the size of the network is increased, the number of clusters is also increased. Another observation from the results is based on the distance among the nodes and the network size (grid size). The distance between the vehicular nodes is directly proportional to the grid size. The proposed algorithm performs in various sizes of the network and varying transmission ranges, which could be integrated with the routing algorithm to choose the best path.

In most of the scenarios, the cluster head might have a maximum number of clusters in comparison with the cluster with less number of clusters. There are two types of communication among the cluster head and the cluster members which include intercluster communication and intracluster communication. In the intracluster communication, the data is sent among the sender and receiver among the same cluster. In the intracluster communication, the cluster members and the cluster members do not belong to the same clusters. In the traditional network, the sender sends the request message to the CH and the CH broadcasts the message to the entire topology of the network. The problem in the intercluster communication of unnecessary broadcast overhead could be overcome by keeping the constant hop count. Thus, the efficiency of the mobility vehicular network is improved. Thus, clustering provides a minimal number of clusters and thus the broadcast problem is minimized.

5. ANALYSIS

The proposed LoIoV is provides a good result by improving the packet delivery ratio and reducing the end-to-end delay. The simulation is performed by changing the size of the network and the grid size. We found that the number of the clusters increases when the size of the grid increases. The time taken for the CH selection is and the recluster formation is less than that of the other compared algorithms. As the number of vehicles increases the end-to-end latency increases.

6. CONCLUSION AND FUTURE WORK

The scalability problems, reliability problems, and also frequent path failure due to the mobility nature of the Internet of Vehicles environment is addressed by using Clustering This paper proposed an algorithm for to increase the lifespan of the network and to reduce the delay (latency) of the vehicles. The LoIoV protocol includes the CH formation and the CH selection. The distance between the vehicles are calculated using the Euclidean Distance and the CH is elected using the LOA. The CH collects the data from the vehicles and forwards it to the RSU. The performance of the LoIoV protocol is compared with the various other optimization algorithms and concluded that the packet delivery ratio is improved and the latency is delayed. Future work can be done with various other swarm intelligence algorithms. The algorithm can be extended for FANET (Flying Adhoc), SONET(Sonar), etc. The proposed LoIoV algorithm could be implemented in real time in the urban areas. The performance can be compared with the other ACO, CAVDO, and other optimization algorithms and the performance of the algorithm is evaluated based on the performance metrics such as end to end delay and packet delivery ratio.

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