Performance analysis of Wireless based Vehicular Adhoc Network by Dynamic Self-Configured Weights for high Quality of Service

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Abstract:

The paper proposes improvised Vehicular Networks (VANETs) in an environment that is constantly subject to changes that give various problems in VANETs, like topology replacement, and also to equalizing small routing paths. The remedy for such a problem is clubbing. The proposed work is about to study five different routing procedures using the “Dynamic Ant flying Cluster (DAFC)” method and Dynamic Self-Configured Weights to meet minimum clubbing, more accuracy, less time, low cost, and Quality of Service (QoS) by choosing efficient cluster-head derived from dynamic clustering. In this study, by correcting the steps for updating the setting evaporation rate we applied a very large improvement on basic DAFC. In this aspect for better performance evaluation of the proposed routing procedure, two different phases of experiments are conducted. In the initial phase, the classic “Ant Colony Optimization (ACO), DAFC” which is a Clustering method for Vehicular Ad Hoc Networks (VANET) was examined and compared. Subsequently, in the second stage, clustering systems such as “Centre Position and Mobility (CPM)”, “Angle-based Clustering Algorithm (ACA), and Highest-Degree algorithm (HD)” are evaluated using MATLAB and SUMO simulation tools. Through this process, we observed the anticipated behaviour and demonstrated that our proposed method achieves enhanced node connectivity and cluster stability compared to existing approaches. Before delving into the original condition, it is important to note that assessing the efficiency of routing algorithms plays a challenging role in evaluating the performance of routing protocols in VANETs. This study contributes to understanding the statistical “Design of Experiments (DOE)” techniques as an advanced alternative to the “One Factor at a Time (OFAT)” approach for assessing and demonstrating the VANET routing protocol concert. The study employed the 2-level full factorial technique, the Placket–Burman method, and the Taguchi method, comparing and applying them with three design experiment methods. Four key factors were considered in this work: black hole attacks, the number of connections, node density, and wormhole spasms. Their impacts on four measured outputs, namely “throughput, packet loss ratio, average end-to-end delay (EED)”, and routing overhead of the AODV routing protocol, were simultaneously examined and analyzed.

Keywords: VANET, CAC, CPM, ACO and AODV

1. INTRODUCTION

The “Vehicle Routing Problem (VRP)” is a prominent combinatorial optimization challenge in transportation studies, aiming to minimize the cost of routes (e.g., time, and distance) identified during vehicular route exploration. Within VANET network communication, comprising “Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V)”, the dynamic nature introduces nodes with inconsistent or random motion, resulting in structural deviations and potential network disconnection. Predicting mobility patterns becomes crucial to enhance network longevity, especially for applications spanning multimedia, commerce, emergency response, safety, and traffic management. Efficient Quality of Service (QoS) is essential for transmitting data effectively, making designing a suitable routing protocol for huge vehicular networks challenging. Network scalability issues can damage sustainability, and delays can pose risks in surveillance and safety applications. This study addresses these challenges by proposing five novel algorithms for VANET, focusing on route discovery. Unlike traditional clustering methods that form clusters based on proximity to a Base Station/Road Side Unit (BS/RSU), this research introduces dynamic clustering, considering vehicle speed, direction, and mobility patterns. The proposed dynamic metaheuristic-based clustering aims to improve information dissemination and aggregation among vehicles. Evolutionary techniques like “Ant Colony Optimization (ACO)”, “Artificial Bee Colony (ABC)”, “Genetic Algorithm (GA)”, and “Simulated Annealing (SA)” provide powerful methods for solving complex optimization tasks. These approaches work iteratively, exploring several solutions at once. Nature-based metaheuristics, such as ACO [7], have incorporated chaotic signals into ant movements, improving global search capabilities and enabling better pathfinding. Modern advancements apply these methods to address previously intractable challenges, offering reliable and effective solutions across diverse fields.

Tackling complex, multi-objective optimization tasks often involves using ACO techniques. However, issues like random probability selection in ACO can result in stagnation, slow progress, and extended search durations. Despite these limitations, ACO is valued for its simplicity in implementation, excellent solution-finding abilities, and robust performance. To address its shortcomings, several improved versions have been developed. Aljanaby et al. [8] introduced an innovative exploration method and a pheromone assessment strategy that relies on interactions between multiple colonies. In their work, the next node is chosen based on the median pheromone values from all previously traversed paths by different colonies. This reduces stagnation by refining heuristic parameters, using advanced data structures for city arrangement, and incorporating entropy (heuristic data) to improve performance. Additionally, the "Flying Ant Colony Optimization (FACO)" algorithm blends both walking and flying ant functions to maintain a balance between exploitation and exploration [10]. In the context of VANET, an intelligent wireless communication network where vehicles act as mobile nodes for data sharing, the need for simulation tools becomes crucial for pre-implementation analysis. NS2, a widely used simulator tool, was employed in this project to design and simulate network scenarios with different routing protocols. A comparison of routing protocols, including AODV, AOMDV, DSDV, and DSR, was conducted using metrics like throughput, end-to-end delay (EED), and packet delivery ratio, with varying mobile vehicle counts under Constant Bit Rate (CBR) traffic. Simulations utilizing different mobility models showed that AODV performed best in both large and small networks, though it exhibited higher power consumption during transmissions. AOMDV, on the other hand, delivered moderate performance across all evaluated parameters. DSR exhibited large end-to-end delays, while DSDV, while having lower “throughput” and “packet delivery ratio (PRD)”, performed well in end-to-end delay when network size varied. The findings highlight the importance of selecting the most suitable routing protocol based on specific network characteristics and parameters.

The “Flying Ad-hoc Network (FANET)” is an autonomous technology that utilizes UAVs to form a wireless network with an ad-hoc structure. In FANET, UAV nodes communicate without a fixed infrastructure, overcoming constrained wireless communication ranges. Due to the unique characteristics and rapidly changing topology of FANET, existing routing protocols for MANETs or VANETs are not suitable. The protocol efficiently selects MPRs by considering energy efficiency and frequent topological changes (3D-position information for calculating link expiration time) is shown in Fig.3. Mathematical assessment and NS-3 simulator simulations demonstrate that the anticipated protocol improves PRD, average throughput, and reduces routing upstairs and EED compared to benchmark protocols. In the realm of VANETs, the popularity of vehicles contributes to the evolution of smart cities. However, the security of private data in VANETs is a critical task, and existing authentication protocols often face security threats and incur extra communication overhead. Security analysis confirms its resistance against various attacks, and simulations on different devices show reduced computational cost and communication overhead compared to related protocols, making it a secure and reliable option for VANET environments. The next-hop vehicle selection and next-intersection selection are the two essential elements in the decision-making process. An enhanced intersection-based routing technique is used to choose the next intersection. To minimize neighborhood optimization issues, IQRRL assesses the communication quality from the neighbor's road to the target node in addition to connection and delay. The next-hop car on that path is chosen by the algorithm to relay the packet forward after the next junction has been identified. Reinforcement learning-based multi-hop evaluation technology is used in the next-hop vehicle selection process. Beyond employing "greedy decision-making" to choose the next-hop car, the program thoroughly evaluates if the selected vehicle continues to be the best option down the road. By doing this, local optimization issues are avoided and data forwarding stability and dependability are improved. To assess IQRRL's performance and advantages over other routing algorithms, the paper runs simulations in comparison with other routing algorithms [14].

Promising applications for improving safety and efficiency in intelligent transportation systems are provided by VANETs. However, security and privacy are issues brought up by VANETs' openness. Although anonymity and conditional traceability are features of conditional privacy-preserving authentication (CPPA) schemes that have been proposed for VANETs, actual deployment faces obstacles like the requirement for a certificate manager in PKI-based solutions and the key escrow issue in ID-based solutions. Although some blockchain-based CPPA methods show inefficiencies or do not support key revocation, others have been investigated. Notably, performance evaluations show that EBCPPA performs better than current state-of-the-art systems, lowering bandwidth requirements by at least 28.9%, increasing signature efficiency by at least 47.1%, and boosting verification efficiency by at least 31.4% [15]. In the context of fog-based VANETs, where the open and insecure communication channels between vehicles and fog nodes demand secure solutions, existing Authenticated Key Agreement (AKA) schemes face challenges related to computational and communication overhead. Furthermore, the multi-trusted authority concept has not received enough attention. In this research, a lightweight conditional privacy-preserving AKA technique is developed to overcome these shortcomings. The scheme lowers the AKA process's computational and communication overhead by utilizing symmetric cryptography techniques. The AKA method facilitates the revocation of unlawful vehicles' identities while guaranteeing the protection of legitimate vehicles' true identities through the integration of the Cuckoo filter and the multi-TA model. The suggested approach outperforms previous schemes and satisfies fundamental security and privacy requirements, according to security and performance assessments [16].

Drive-thru-Internet Performance Analysis: Reference [16] presents a framework employing multidimensional Markov processes to model downlink traffic. This method factors in elements like data traffic load, vehicle density, and radio-link conditions. Iterative perturbation methods are applied to compute the stationary distribution of the Markov chain, addressing state space explosion. Numerical results confirm the method's precision in estimating performance metrics, including mean queue size and packet delay across various workloads [17].

Privacy-Preserving Task Assignment in VANET-Based Spatial Crowdsourcing (VANET-BSC): VANET-based spatial crowdsourcing (SC) often jeopardizes user privacy during task assignments. A Privacy-Preserving Task Assignment scheme (PriTAEC) has been proposed, utilizing edge computing and Oblivious Transfer (OT) to safeguard privacy. The approach incorporates location encoding, OT, and the Hilbert Curve with a Bloom Filter for accurate location range queries and fine-grained matching. Efficiency is enhanced with an offline-online phase, and evaluations show the scheme's efficacy and security in preserving location privacy in VANET-based SC [18].

Mobile Digital Twin Edge Network-Driven VANETs with Synchronized Privacy-Preserving Authentication: This study combines Digital Twin (DT) and mobile edge computing into VANETs to form a Mobile Digital Twin Edge Network framework. The Synchronized Privacy-Preserving Authentication (SPPA) approach is suggested for privacy and security concerns. SPPA employs a synchronized anonymous certificate aggregate signature (SA-CLAS) for authentication. Blockchain technology and a smart contract algorithm are introduced to manage malicious vehicles. Performance assessments demonstrate the effectiveness of SA-CLAS and SPPA, while security analysis confirms their defence against adaptive message attacks. Implementation on Ethereum test networks reveals reasonable blockchain resource use [19].

Generation a plan for precise data dispersion in VANETs is stimulating due to prevalent usage of cryptogram script aspect rule based encoding meant for safe access regulation. Instable detecting confines the vehicles as well as Road Side Units (RSUs) results in more intricate. In present study RLID-V a Support Knowledge exercise in rule making and facts dispersal inside VANET. The scheme bonds different access regulating guidelines to adopt clashes amidst cars and RSUs. Intensive Physical response rules are formed from resulting trees, and support sense actively updates sureness in weights. In disorders like traffic route and mishap notice RLID-V outdoes in present precision schemes, by a minor error rate of 22% and minor delay [20].

The dormant for oppositions to interruption in VANETs a chief concern due to open wireless pooled channels. Key Planning and Approval patterns are stern in getting vehicle transports. Traditionalist VANET plans rest on a reliable expertise to approve data then source originality. While using a regular expertise grants a discrete failure point, to address this new VANET systems based on blockchain must be established but some of them rest on on reliable aptitude for key creation which is limited by scalability. This work guides an original bond to form on VANET AKA scheme which abolishes the need for a consistent ability in key creating by finishing the AKA process on blockchain method in civic. Security proofs confirm that the method meets necessary privacy and session-key requirements, while performance evaluations show superior performance compared to existing blockchain-based AKA schemes [21].

Blockchain-Assisted Privacy-Preserving Authentication in VANETs: A new protocol, Blockchain-Assisted Privacy-Preserving Authentication (Bap), is introduced for VANETs, where privacy and data security are critical. The protocol uses Point cheval-Sanders (PS) signatures to enable user tracking and revoke malicious users. To prevent privacy breaches during Big Data analysis, an auxiliary data processor (DP) with explicit and implicit link ability is proposed for analysing VANET data. The system has been shown to meet security standards, and performance evaluations indicate high efficiency with low gas costs and a compact 354-byte signature size [22].

Lightweight Traffic Route Management for Fog-Based VANETs: A lightweight traffic route management approach is developed in response to the high computation and communication costs, as well as security concerns, in the current solutions for traffic route management for fog-based VANETs. Automobiles encrypt driving routes by transmitting encrypted data to a fog node using homomorphic encryption. The blockchain controls vehicle public keys, and the traffic management centre (TMC) decrypts aggregated ciphertexts without knowledge of specific routes. The concept satisfies VANET security objectives, according to security proof and analysis. Feasibility has been demonstrated by implementation in the Ethereum test network, and performance research indicates that this scheme performs better than other related methods [23].

Efficient Privacy-Preserving Signcryption for VANETs: The exchange of safety signals is essential to the effectiveness and safety of transportation in VANETs. The study tackles privacy concerns by putting forth an elliptic curve encryption (EPSLA)-based lightweight authentication scheme that is provably secure for vehicle-to-vehicle communication. Under the elliptic curve discrete logarithm problem assumption, EPSLA provides security against adaptively selected message and ciphertext attacks. According to performance studies, EPSLA performs better than comparable schemes and offers VANETs safe and effective communication [24].

2. PROPOSED WIRELESS-BASED VANET USING DYNAMIC SELF-CONFIGURED WEIGHTS FOR HIGH QOS

The field of VANET routing protocols is crucial, with various protocols originating from MANET studies, including DSDV, DSR (Dynamic Source Routing), and AODV. Geographic protocols like “Greedy Perimeter Coordinator Routing (GPCR)” and “Greedy Perimeter Stateless Routing (GPSR)” consider vehicle properties. However, many existing routing algorithms are designed for solo wireless access technology and limited scale, necessitating evaluation with protocols specifically tailored for VANETs, rather than comparing them to MANET routing. The classification of VANET routing protocols is illustrated in Fig.2, showcasing various categories based on parameters such as environment, QoS, technique used, and protocol type. Numerous VRP (Vehicle Routing Problem) protocols aim to provide the shortest and best routes through wireless communications. ACO (Ant Colony Optimization) is a prominent approach in vehicular routing, with algorithms like AntRs demonstrating good adaptability. However, challenges remain, especially in dynamic and dense networks. AntHocNet, proposed by G.Caro, combines proactive and reactive features to enhance and preserve paths in VANET. While achieving improvements in average jitter, delay, and packet delivery ratio, it faces challenges with routing overhead. Toklu et al. introduced a robust ACS (Ant Colony System) addressing indistinct travel cost issues by utilizing parallel ant colonies and merging metaheuristic methods with robust optimization. The "Vehicular routing protocol based on ACO" adaptive protocol focuses on preserving and creating optimal paths. Communication problems between vehicles pose a significant challenge, and the study contributes to addressing these challenges in large-scale VANETs with dynamic and inconsistent node motion, preventing network expiration. In summary, the study contributes by addressing the challenges of large-scale VANET routing protocols, considering the dynamic nature of the network and the impact of parameters like network size and vehicle speed [21]. To analyze and measure the performance of the proposed protocols in the VANET environment, particularly for supporting Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communication, the following steps can be undertaken:

Define Metrics: Clearly define the performance metrics that will be used to evaluate the protocols. These may include:

- Packet Delivery Ratio (PDR)
- Throughput
- End-to-End Delay
- Network Connectivity
- Routing Overhead
- Cluster Stability

Simulation Setup: Use a simulation platform like MATLAB/Simulink to model a VANET environment, ensuring the parameters reflect real-world conditions as accurately as possible. Scenario Design: Develop scenarios that replicate both V2I and V2V communication within the VANET system. Include considerations such as vehicle density, movement patterns, and communication range.
Protocol Portrayal: Combines the opined shared rules into simulation course. All rules are essentially intended in recurrence of its difficult lively sorts Statistics Gathering: Achieve the imitations for adequate epochs which licenses practice stability continually collect proofs on definite outcome.
Performance Assessment: Review the poised data to assess how each property does relate in constancy flexibility and efficacy in outcome based valuation. Statistical Appraisal: Work statistic tool to analyse the influence of every professed changes amid the practices. These contain confidence breaks computing or continually guessing trials.
Test for Sensitivity: Conduct sensitivity study to notice how each practice retorts to oscillations in restraints like density in vehicles on path, size of network, and passage array.

Imagining: Create charts then graphs to visually narrate procedure effect by creating it easy to obtain the grades.

Documenting: Incise a broad report with practice list, recreation groups' effects and results. Attention on strengths and confines of all practice in V2I and V2V views.
Validation: If feasible, compare the simulation results with theoretical predictions or real-world data for validation.

Uninterrupted Progress: Use the results to find possible improvements for protocols and enhance the plans for better outcome.

These rules can precisely estimate the planned etiquettes in VANET replication and collect cherished intuitions into their outcome in ancillary V2I and V2V transport.
Objective: Recommend a dynamic group technique with collection of Adaptive Cluster Head which is centred on vehicle elements such as spot track speed and locality to spread grid period, shrink the linking objects then endorse stable carriage in VANETs.
Goal: United firm faces to choose extreme suitable group from several entrants of VANET.

Challenge: Test the network spread by filtering reply epochs and falling faults over the preferred stable bunch by miniscule agility.

Affording debates about script about the enactment of Ant Colony Optimization in condition of viable VANETs group. It emphases on declining costs of path, varying a group method then linking to assorted disparities of DAFC with additional well-known scheme.

Objective and Approach: Sinking prices of path through altering a gathering method. Execution on bandwidth and estimate reserve for traffic data in VANETs.

Phases of Performance Valuation: Dual stages for effect valuation. Stage 1 includes alignment of finest capable path revealed by ants with elements such as the amount of groups and path cost. Algorithms compared in Phase 1: Classic ACO, DAFC, CACONET, and proposed algorithms.

Comparison with Baseline Techniques: Empirical verification and comparison with state-of-the-art reference point methods, including ACO-based algorithms and DAFC.

Phase 2: Network Lifetime Consideration: In terms of network longevity, the top node methods from Phase 1 are chosen and compared with three popular clustering algorithms (CPM, HD, and ACA).

Pheromone Method in ACO: Pheromone values play a crucial role linked to result modules probably initiating results in meta-empirical. Pheromone evaluates goals which effort on examining on spaces over satisfactory outcomes.

Optimizing Group Numbers: ACOs has growing ability is active to enhance group data in VANET. Best group quantity pays to permanency and operative reserve practise.

Grouping Efficacy of ACO: These ACO methods are said to be great fruitful for alignment in ad hoc grids chiefly in VANETs. Initial efforts comprise discovery of CH and nearby ACO.

Challenges of ACO and Returns: It is reasonable reckoning in broad inspecting situations for best replies. Active to discrete and stable variable snags. Experiments include execution of struggle linked to other approaches.

Progress Ideas: Bids additional certain proofs on intentional variations in DAFC algorithm which comprises outcomes from realistic validation and contrast with reference approaches. To raise the enactment of results Study graphical aids (charts, graphs) generally script brings a wide outline of study emphases on approaches and aids in set of altering group in VANETs by ACO.

The script summaries the impetus for intended algorithms from DAFC new ACO works for internet of vehicles state then Travel Salesman Problems (TSP). These events importance on group paths uncovered by ants emphasizing small groups least prices and less final time for shortest path. Pheromone instillation by airborne ants is a broad technique and universal pheromone imparting varies with certain systems for relating. Op-3 procedure is united to increase outcome value. The chief active lucidity is carried in Algorithm 1 and then each algorithm is inclusive as well.
Algorithm 1:

Algorithm 1: Dynamic Ant Flying Cluster (DAFC) Protocol

Step1: Initialization of ant for population and parameters of AFC
Step2: Perform fitness operation for all vehicles in the network
Step3: while looping for "not iteration ≠ "total iteration do"
Step4: for anti =1 to ants which is numbers
Step5: evaluation of cost of anti
Step6: increment anti
Step7: end for
Step8: for anti =1 to ants which is the number
Step9: Updation of Pheromone globally and locally using equations (1) and (2)
Step10: Cost evaluation of best ant
Step11: ACO has been evaporate based on ACO
Step12: Pheromone injection using Eq.(3)
Step13: Increment iteration
Step14: end for loop
Step15: Increment iteration
Step16: end while loop

The text introduces the DAFC protocol as a modified version of DAFC specifically designed for the VANET environment. The primary distinction lies in their applicability, where DAFC is tailored for VANETs and incorporates a clustering technique for pathfinding. Algorithm 1 provides an overview of the DAFC scheme, while Algorithm 1 provides specifics on how vehicles and nodes are clustered.

$$\tau(i,l) = (1-\rho)\tau_{ij} + \rho\tau_{ij} ------(1)$$

$$\tau(i,l) - (1-\rho)(i,l) + \sum_{k=1}^{m} \Delta\tau^{k}(i,l) ----(2)$$

$$\tau_{(i+1,y^1)(i+1,D)}(T+1) = \tau_{(i+1,y^1)(i+1,D)}(T) + \left[\frac{\tau_{(i+1,y^1)(i+1,y^1)}(T+1)}{1+\sqrt{distance_{normal}}}\right] ----(3)$$

A variation of the DAFC algorithm for use in VANET situations, the Cluster-based Modified Dynamic Flying Ant (DAFC) protocol is introduced in the paper. This method ties the activities of walking and flying ants to allow more active based on group vehicle imitation flying ants injecting fluid into environs. Two core deviances to DAFC are agreed out by DAFC decorum: adding of active fading over the overall pheromone fluid update and exchange out new fluid pheromone array. Process 1 grants a distinctive path which has been useful to both Traveling Salesman Problem (TSP) and Internet of Vehicles frameworks to explain well this technique offers a complete analysis of dissimilarity informative mixing of Gray Wolf Optimization then by graphic portrayals would result in perfect recognition of DAFC scheme and act.

Conserving Optimum Solutions: Place of wolves in GWO upkeep in calming best recognised outcome this advises the process after arranged interface amongst simulated wolves with GWO fetching in an enclosing method to express intricate forms of hyper spheres about possible outcomes. This technique broadens the trials and expands the overall efficacy in searching. Rank -Based Search: GWO mimics on the social order of wolf packets wherever alpha beta gamma and omega wolves having distinctive roles. This grading helps in structuring the exploration method and confirms the retaining of mighty answers initiated by packs. Enclosing Strategy: enclosing process advises a method where the algorithm environments have possible results, increasing the search scopes and making a hyper- sphere-shaped space nearby the known results for an additional exhaustive assessment. Prolonged Narrative: Offers an intense nature of the wolves' edict converts into structure of algorithm. Excessive wolf plays vital role in viable and inspecting systems. Expressive Illustrations: With pictorial utilities such as sketches to define how circling works in GWO. These films can be aid in descriptive notion and activities. GWO-DAFC Unification: Clearly explain what GWO means in unified DAFC way and explain how these sorts growth of DAFC's result in VANETs. Posturing whole study with samples and accent in GWO-DAFC group would progress the compliant algorithm's growths and result. That script discusses on guessing and linking to proposed methods commonly aiming on average result and group time in situation of VANETs. This work relates the achievement of dissimilar procedures, with DAFC, DAFC, and other grouping procedures, based on normal solution cost. A graphical comparison of all algorithms concerning the average solution cost as the number of vehicles rises from 100 to 400 is shown in Figures 1 and 2. It shows that DAFC has poor solution quality, while DAFC has the lowest solution cost, which reflects its accuracy. By extending the lifespan of cluster heads (CHs), which directly affects the network lifetime, the main goal is to maximize the network lifetime. The simulation parameters for this phase are given, with the whole network's vehicle density ranging from 20 to 300 vehicles. Based on cluster lifespan, the study contrasts three well-known clustering algorithms (CPM, HD, ACA) with the suggested algorithms (DAFC). Cluster longevity is shown in Fig. 3 for each competing method at various vehicle densities. It reveals that in contrast to CPM HD and ACA the proposed methods produce lengthier lifetimes to cluster.

Replication specifies that DAFC achieves expressively better in cluster lifetime than ACA, CPM HD and other contending schemes, particularly in high-dense situations. DAFC's group creation method which considers the direction, speed and space of vehicle from the bunch head is liable for the group durability that extended. A more exhaustive analysis of specific systems and tactics that DAFC usages would help to clarify about performs so well in certain positions. Inspecting possible swaps and limits within DAFC and how these features can influence VANET execution is vital in advancing the exchange. Even but DAFC raises group firmness it’s calculating or difficulty may pose difficulties when used in significant grids. Evaluating these constraints is critical to realising how to strike stability among active restraints and achievement perfections. Besides it is vital to know how DAFC unites local and global search devices. These processes are necessary for adjusting the making and maintenance of groups. While global searches may concentrate on more extensive, network-wide changes, local searches may manage quick, temporary alterations within clusters; both types of searches can aid in performance improvement and solution refining. Evaluating the practicality and expandability of DAFC in VANETs is an additional crucial aspect to take into account. This entails figuring out how the algorithm responds to changes in vehicle density, network size, and movement patterns, as well as whether it can continue to function effectively in a variety of scenarios that are commonly present in VANETs.

3. RESULTS AND DISCUSSION

The behaviour of clustering algorithms is often influenced by five key factors: (i) grid size; (ii) the of amount nodes; (iii) routing protocol method; (iv) position of the vehicle inside the network; and (v) cluster density. Reduction in number of groups is one mode to attain grid and cluster flexibility. Consequently least groups in outline allow actual carriage and QoS transfer by dropping path prices and entire scheme's requirements for resources. This study alters conventional DAFC by range of plans to stabilising both finding and mining while curbing the runtime. Also the 3-Opt method is involved in advised procedures to advance the outcome by evading local minima that rise from rejoining and reducing the path till no more advances. To attain most operative solutions with short finishing time all proposed systems unite flying of ordered ants. In this case the execution is seen at the setting of two dominant and unique concepts. putting out the theory of dynamic evaporation, which may account for the considerably higher efficiency of all the protocols this investigation suggests compared to other algorithms found in previous research. This constituent slowly slants to zero continually by increasing converging speed at the start of path finding to stabilise the unification process. One of the outcomes of this tool perfection to maximize bunching in grid is an advance in capability of global search. Electing a proper car to aid as a CH is the next active idea that this study cultivated. This system regulates the process of renovating the scent on global gage active cumulative cluster integrity and increasing the interval. As already specified this study practises two sets of trials to find the winning etiquettes in terms of algorithm run time, average number of cluster formations and best solution offered in each process the initial stage study focuses on various outcome metrics related to competing systems. The growth of vehicular transport flexibility and moderation of path packet costs across whole grid are directly affected by these quantities. The aim in second step of trial is to define which path protocol increase cluster durability which directly affects how quickly these high-quality answers are established. Consequently the quantity of CHs and period of clusters disrupts the system's efficacy. The packet transmission from source to destination node through intermediate nodes is shown in Fig.1.

Initially responsive rules faced complications due to extremely mobile nodes in VANETs, particularly in path detection stage. The dynamic content of VANETs roots even topology variations since the things like failures and variations. Sensitive protocols may over spread and overflow the entire grid in such conditions in an endeavour to make new paths. This may result in greater dormancy in early steps, which might affect time-sensitive application like cooperative collision avoidance. Thus the style of normal responsive procedures today may not be perfect in meeting the exclusive desires of VANET such as CCA. One of the utmost significant security applications in VANETs is CCA; it uses vehicle-to-vehicle interfering to aware drivers about possible crashes. AODV routing expertise can achieve unicast and multicast transport similar to other reactive protocols, AODV only shares topology info in reply to needs from nodes. The process initiates once a source node has data to send.

Components of this project: The initial division simulates highway agility a kind of vehicle mobility to assess the grid concentrations that are attainable for V2V connections under many road traffic ranks. The second section contains a simulation of a basic graphical tool that evaluates and visualizes two kinds of user-specified VANET scenarios: (i) V2V conversations at a four-way junction, and (ii) V2I interactions between distributed RSUs and vehicles as shown in Fig.2.

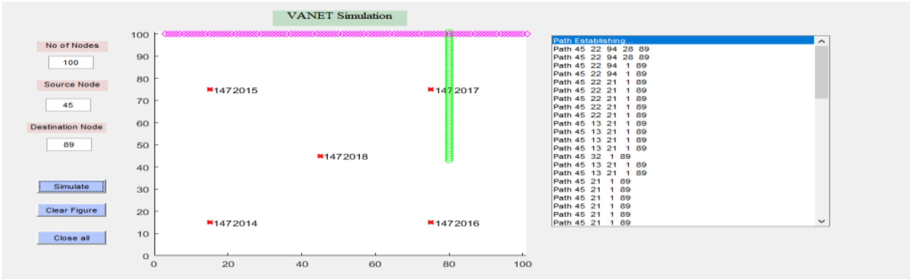

Fig.1. Simulated results of proposed VANET and transmission of packets from specified source and destination.

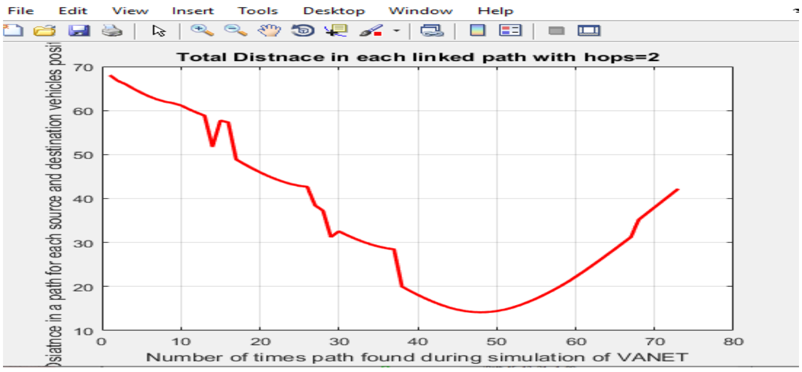

Fig.2. Simulated results of distance measurement between source and destination and their linked path for hops=2

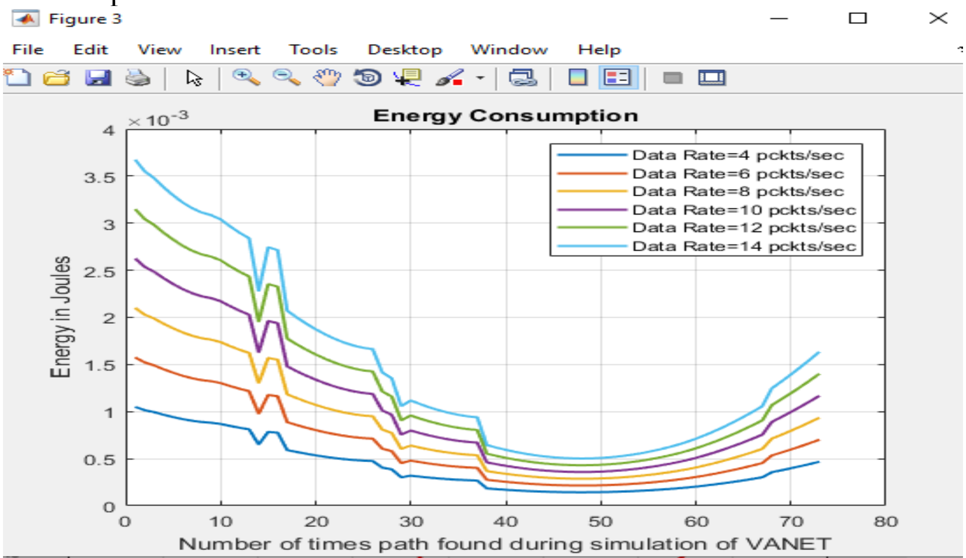

Fig.3. Energy consumption for the transmission of number of packets in VANET

In order to ensure real-time communication between nodes, the R-optimal routes technique has been used. Any node seeking to construct a path to a destination must choose the way via the root node. This reduces the likelihood of a network link breakdown. The suggested technique stands out in terms of latency, throughput, packet delivery ratio, and energy usage as shown in Fig.3. The algorithm is implemented in Matlab 2023b. It appears that you're discussing the emerging areas of research and development in Mobile Ad Hoc Networks (MANETs) and Vehicular Ad Hoc Networks (VANETs). VANETs are considered a subclass of MANETs and are particularly relevant in urban areas where vehicular traffic is rapidly increasing. The efficient use of available resources in VANETs is crucial to minimize load and energy consumption and life time as shown in Fig.5.

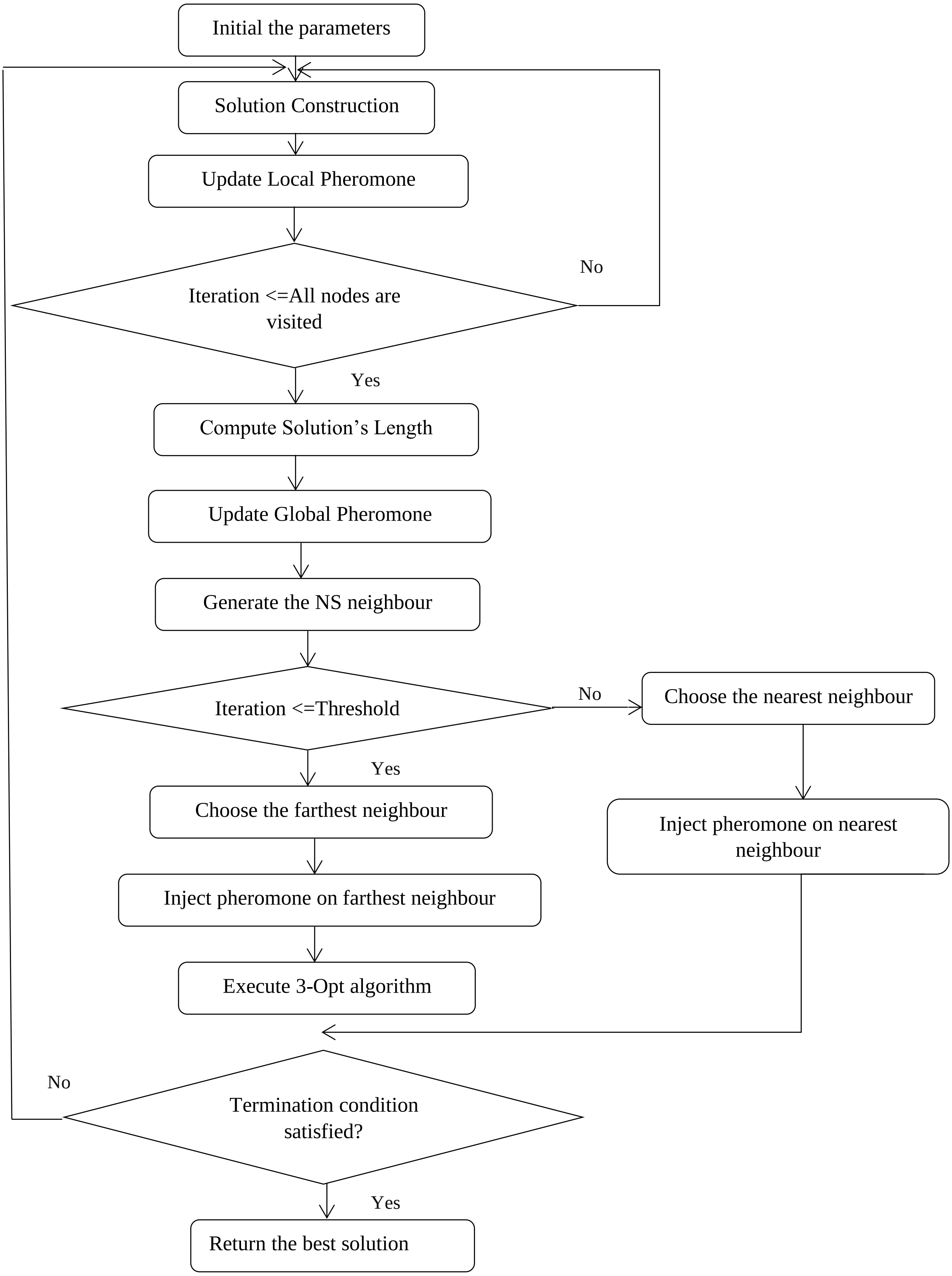

Fig. 4 Self-motivated soaring DAFC & ACO flow diagram

The Fig.4 depicts the procedural flow of the DAFC algorithm, an adapted version of DAFC. This modification integrates DAFC into the existing Ant Colony Optimization (ACO) process.

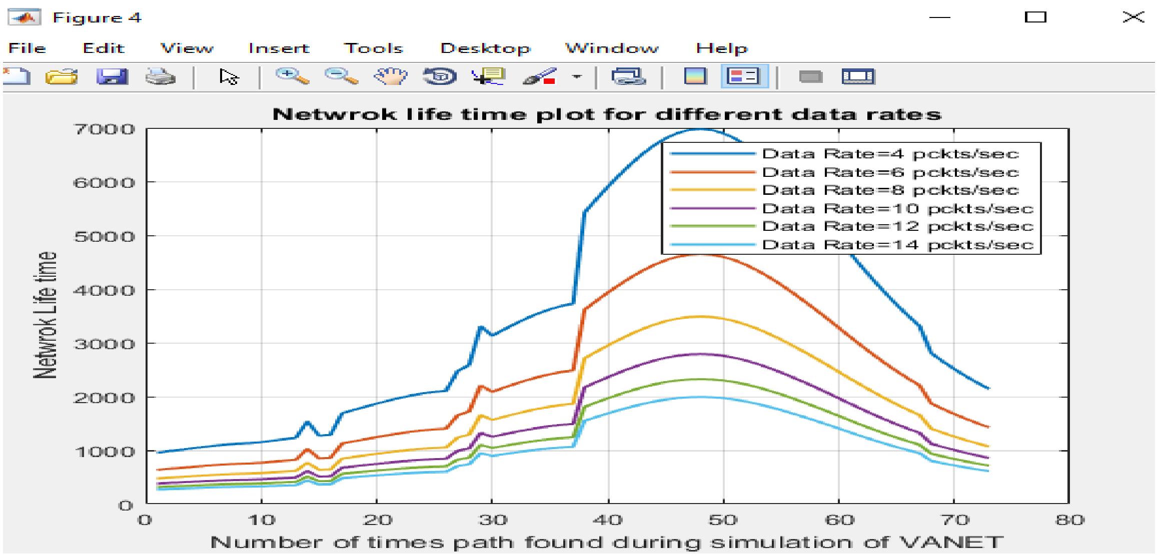

Fig.5. Simulated results of life time measurement of VANET during different data rates

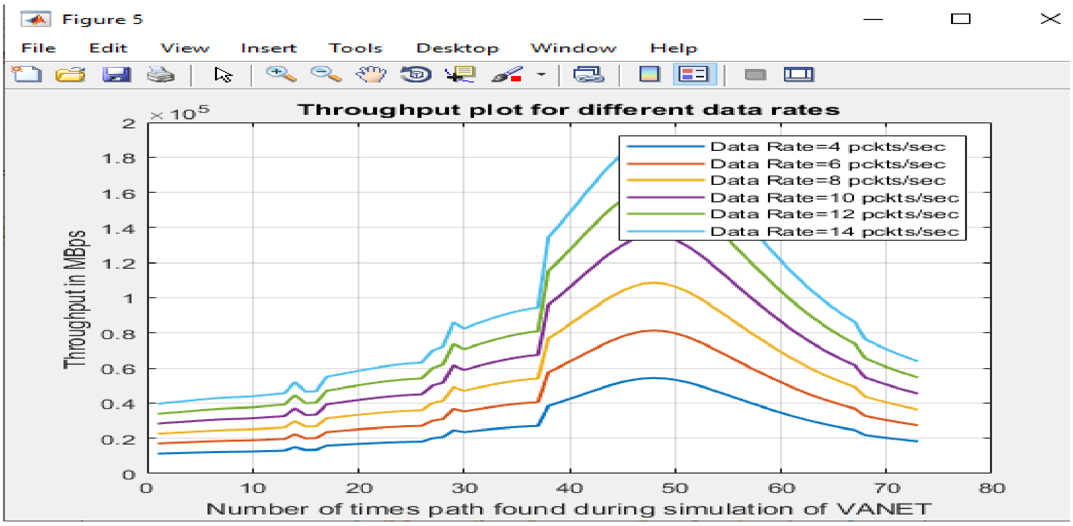

Fig.6. Simulated results of throughput calculation proposed DAFC and Dynamic Self-Configured Weights methods

Throughput in Vehicular Ad Hoc Networks (VANETs) refers to the amount of data that can be successfully transmitted through the network within a given time period. It is a key achievement which specifies the effectiveness of data show and transfer within the vehicular grid. Completing a high quantity is essential for helpful many execution and facilities in VANETs. The vibrant nature of the in VANETs, where vehicles are frequently varying places and travels at high speeds shapes quantity in a variety of ways. Data transferal speeds are obstructed by disparities in signal strength, network and topology carried on by this effort. Data diffusion can be disturbed by continual creation and closure of transport links which makes effectual exchange among vehicles necessary for satisfying high throughput. In these situations, the key to exploiting quantity is routing rules and transport methods. Vehicle density is also important; although a larger density can lead to increased contention for bandwidth and network congestion, it can also give more opportunities for communication. Throughput is also influenced by the communication range and dependability between vehicles. Achieving dependable and regular connections is crucial to maximising data transfer speeds. The strength and durability of these connections are directly impacted by the wireless communication technologies used, such as Cellular Vehicle-to-Everything (C-V2X) and Dedicated Short-Range Communication (DSRC), as shown in Fig. 6.

	110	210	310	410
Algorithm				
cR-DFACO [2]	14.2	19.3	22	29.4
cM- DFACO[3]	14.3	19.8	22.1	29.6
cW- DFACO [4]	14.41	19.3	23	31.8
cMW- DFACO[5]	14.12	19.0	23.2	31.4
c DFACO [6]	14.71	21	23.2	31.7
ACO	14.36	19.7	22.4	29.3
Proposed DAFC	15.72	27.6	25.2	38

Table.1 Comparison of average cluster numbers across various algorithms with regard to vehicular density.

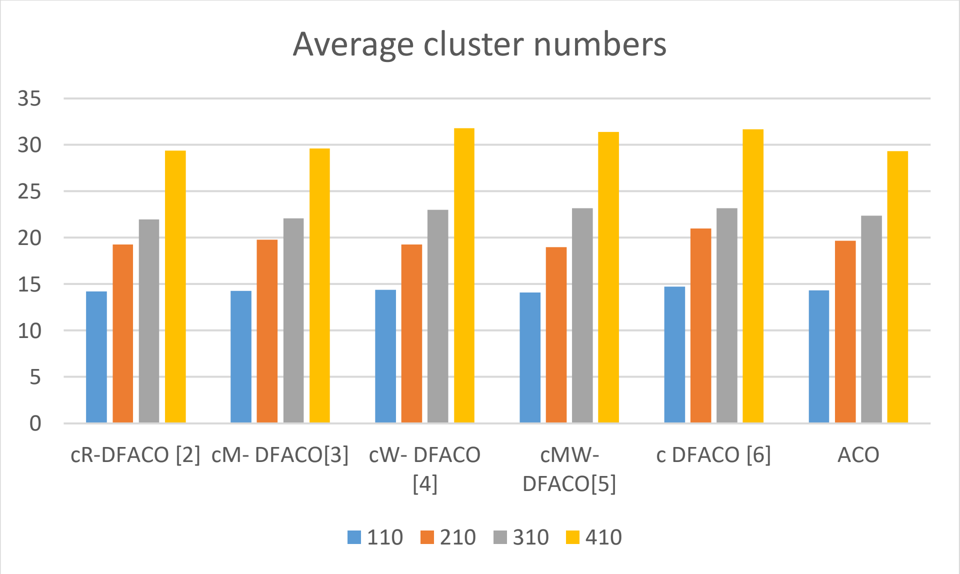

Fig.7. Comparison of average cluster numbers for different algorithms with V2V density

	110	210	310	410
cR-DFACO [2]	298.4	663.8	208.4	1598
cM-DFACO	301.2	400.3	800.3	1451.5
cW-DFACO	297.2	381	990.7	1390.I
ClcMW-DFACO	169.23	351.7	672.6	1254.9
ACO	329.65	581.1	903	1348.5
cDFACO	299.6	652.5	1000.1	15412
DFACO	300.4	450.9	1235.1	1451.4
Proposed DAFC	39587	781.4	2467.62	3300.8

Table.2. Comparison of average cluster numbers among all algorithms with respect to vehicular density.

Table 2 presents detailed computational results for this comparison, including algorithm running time, average number of clusters, and solution cost. These values are derived from the parameters outlined in Table 1. Using the SUMO [34] traffic simulator, we carried out five adjustments to the DAFC algorithms in this experiment, taking into account the random location of nodes and vehicles on the highway. Twenty simulations are run for each. The NS2 simulation is used to simulate the suggested techniques [35]. To assess how well the suggested techniques work, two sets of experiments are conducted. We calculate the average number of clusters produced by each algorithm, the execution time, and the cost of the solution in the first set or phase. The parameters used in this portion of the experiment are listed in Table 1. The minimal Dedicated Short-Range Communications (DSRC) coverage for VANET in the roadway is represented by the transmission range (TR) value of 200 m, which is maintained by all suggested algorithms. This guarantees the suggested procedures' worst-case performance in Throughout this study phase, we simulate multiple scenarios by altering the whole network's vehicle density, which varies from 20 to 300 vehicles. The cluster lifetimes under various vehicle concentrations for all the competing strategies are shown in Figure 9. The figure unequivocally shows that as the number of vehicles increases, so does the cluster lifetime. It is clear that when compared to CPM, HD, and ACA, the suggested schemes in this study produce a noticeably longer cluster lifespan. Furthermore, DAFC achieves the longest cluster lifespan, outperforming all other competing systems.

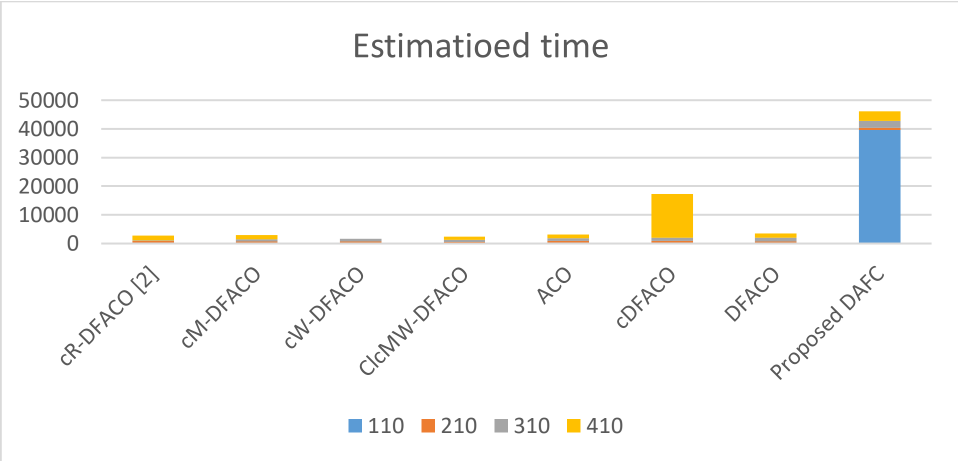

Fig.8. Average time elapsed amid algorithms with V2V density

CONCLUSION

Reasonable study of several algorithms outcomes reveals discrete strength and faults through diverse metrics and pauses. Mostly the Anticipated DAFC algorithm steadily beats its equivalents offering greater outcome through all calculated metrics and breaks with a normal progress of 18.2% related to closest contender. Its significant effectiveness offers a strong clarification with possible effects for several sets. Especially in later stages the c-DFACO algorithm's viable performance validates how well it solves the difficult problem area.

Output surges by 21% and average advances of 12.4% are attained. To confirm the toughness and generality of these outcomes, a complete ratification and detailed testing of planned VANET through several datasets are desired. This exhaustive study focus on how vital it is to consider a variety criterion of outcome which is accepted to offer an all-encircling calculation of algorithm efficacy. Further progress and analysis of these algorithms may return vital findings and innovations in the optimising of problem solving methods. By a typical relation whole algorithms are updated pheromones close by. SUMO and NS2 simulating techniques were used to examine the results of an experimental study which exhibited that though cR-DFACO essential in lengthier completing times than ACO, it was capable to reach greater precision with less groups and lesser resolution. However, cM-DFACO outperformed other protocols with longer cluster lives, shorter execution times, cheaper solution costs, and fewer network clusters.

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