AN EFFICIENT OPTIMIZATION APPROACH FOR CLUSTER HEAD IDENTIFICATION OF DATA DISSEMINATION IN URBANVEHICULAR AD-HOC NETWORK (U-VANET)

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Abstract:

Numerous nearby incidents arise on road networks daily, many of which can also additionally cause congestion and protection hazards. Vehicular Ad Hoc Networks (VANETs) have newly emerged as an effective device for enhancing road protection through the dissemination of caveat messages most of the vehicles with inside the network approximately ability limitations on the road ahead. The main challenging task is broadcasting the messages to the intermittent nodes to final destination due to high movement and dynamic path. Due to the rattling development of wireless communication technologies and the emergent mandate of services in Vehicular Ad- hoc Networks (VANETs), effective clustering algorithms are essential to break the network scalability problem and to support further operations in VANETs. By the use of cluster head, the statistics conversation is managed among vehicle nodes in addition to end-end delay is reduced. Clustering is a mechanism of grouping of vehicles based upon some predefined metrics such as density, speed, and topographical positions of the vehicles. Modified Cuckoo Search Optimized Path (MCSOP) is the cluster based optimization to select the optimal cluster head based on fitness function in terms of distance and acceleration. Then the optimum path between source to destination is identified to disseminate the messages. The anticipated MCSOP increases the throughput and minimizes overload and implications to reduce the CO2 emission from vehicles. The simulation result shows that the MCSOP outperforms the overall ration of throughput and also minimizes the end to end delay and packet drop ratio in VANET as compared with the existing work as with and without RSA

Keywords*: *Random Search Algorithm (RSA), Cluster, Data dissemination, Cluster Head, Modified Cuckoo Search Optimized Path (MCSOP)

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1. Introduction

Many individuals lose their lives or potentially are harmed because of accidents or staggering occasions occurring on street maps. Accidents and Traffic congestion create a colossal exercise in futility and fuel. In the event that the vehicles are given convenient and dynamic data connected with street traffic conditions, any startling occasions or accidents, the wellbeing and proficiency of the transportation framework can be improved regarding time, distance, and fuel utilization. VANETs are adhoc networks laid out among vehicles which are furnished with correspondence offices. These vehicles are like a hubs so every hub can go about as the wellspring of information, objective for information and an organization switch. Vehicular Ad Hoc Networks (VANET) is a convincingtool for

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further developing road safety through proliferation of caution messages among the vehicles in the organization about expected deterrents out and about ahead.

Data dissemination is difficult in VANETs because of network disconnections and the mobility.Subsequently the clustering based dissemination of data keeps away from this issue by gathering the geologically contiguous vehicle nodes into a cluster coming about fundamentally works on the versatility of the network. The communication between the links is steadier for powerful communication in a dynamic environment.

Thus, the grouping of vehicles to disperse the data among the vehicles and the advancement of bio-inspired algorithms to get an ideal arrangement spurred to foster a defied thought and to impose a bio-motivated solution for concept of clustering in VANET. Existing frameworks are intended for restricted highlights which could not ready to address the impromptu idea of intellectual vehicle communication. To satisfy the gap identified in VANET, a state-of-art is expected to play out a protected and reliable explanation. Hence, data dissemination is another prominent issue which should be addressable by the usage of optimization techniques.

2. Related Works

Data dissemination is a troublesome issue since, because of restricted transfer speed, the most extreme measure of information should be spread over the vehicle network. Information scattering calculations in VANETs are intended to communicate data to drivers, travellers, and vehicles in crisis circumstances. As a result, it's critical to remember that information must be disseminated to all cars in the interest area. Many researchers have suggested various methods for disseminating data are:

B. Ramakrishnan, e.al [1] proposed and make another cluster model for productive communication among the VANET nodes on the roadway. Here, a Simple Highway is taken for portraying the VANET. On a roadside vehicles can move uninhibitedly on either direction. Every vehicle can have a restricted radio range. Vehicle inside a radio inclusion reach can convey straightforwardly as against the correspondence through a proper side of the road unit in the current model.

Liu, L et al. [2] gave a convention Particle Swarm Optimization Contention based Broadcast (PCBB) has proposed for quick and compelling spread of crisis messages inside the geological region by using dispute window, position based sending plan and PSO clever strategy, which help to make more exact examination and execution, and expanding the level of the crisis message gathering without influencing the channel impact.

Fogue et al. [3] current better Message Dissemination subject to Roadmaps(e-MDR), another arrangement uncommonly expected to extend level of taught vehicles and abatement notice time; all the while, it mitigates impart storm issue in authentic metropolitan circumstances. We evaluate impact that our arrangement has on execution after associated toward VANET circumstances subject to authentic city maps, and results show that it beats past plans in whole conditions.

Wang Wenjie & Luo Tao [4] proposes a compelling and strong impart show subject to the idea of sending (ERBPQF) of up-and comer centers. In ERBPQF, a twofold stage h&-off-plan is acquainted with show up at speedy message dispersal in the essential

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stage and to ensure high package transport extent (PDR) in the resulting stage. By then, contemplating sign obscuring, channel struggle, lining delay, impart impedance and high adaptability of vehicles, another estimation called nature of sending (QoF) for move decision is moreover proposed. The diversion results show that the deferral and spread efficiency (DE) of ERBPQF beats opened 1 show, going with the achievement of more than 95% PDR.

GokceHacioglu et al. [5] proposed a directing calculation in light of bunching in a wireless sensor Network. For their clustering approach, they utilized a multi objective enhancement calculation non-ruled arranging hereditary calculation. To accomplish a multi objective methodology they utilized seven goal capabilities and the principal objective is to limit the correspondence cost, for which bunch choice and group head determination are considered. Their arrangements utilize a different network geography and mimic sink hub in like manner in light of a non-ruled arranging hereditary calculation.

Khaled et al. [6] exhibit issues having a place with directing conventions, for example, the cautioning messages to conveyance vehicles, for example, issues of non-view (NLOS). These circumstances cause wrong message correspondence between the vehicles and channel conflict, particularly in thickly populated conditions. This convention configuration controls the issue made by NLOS by communicating advance notice messages from crisis vehicles to vehicles and assists with lessening the above by improving the bundle conveyance proportion. The time deferral and channel use are limited by fostering a directing convention named the helpful worker convention (CVP) that can go about as volunteer vehicles, for conveying the disperse cycle the admonition message from the source to the objective vehicle figuring out a NLOS circumstance. A clever plan has been embraced by using the information on a setting mindful framework (CAS). It assists with grasping the parts of the OBU and their correspondence. It accumulates information to go with choices in view of the detected conditions. The recreation yield is shown by exhibiting that the proposed convention beat the current conventions, as estimated by different measurements like bundle conveyance proportion, neighbourhood mindfulness, channel usage, above and idleness. The outcomes demonstrate that the proposed CVP can undoubtedly distinguish NLOS circumstances. It has the ability to address the issues effectively and efficiently for both the convergence situation in metropolitan regions and the expressway situation.

Xiu et al. [7] concentrate on the QoS-obliged multicast directing issue. This issue is considered a NP-complete issue with assortments of multitude knowledge calculations that is better than other outdated calculations. A microartifcial honey bee settlement (MABC) calculation is acquainted all together with tackle the quality issues. It assists with stretching the organization lifetime by lessening the postpone cost. Multicast steering is changed over completely to a persistent enhancement issue and is planned with MABC. To execute the outcomes, it is conveyed on a traffic situation with three contextual investigations. The ideal courses are handily gotten by utilizing the MABC and it very well may be handily taken on continuously on the grounds that the

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organization configuration doesn't change too regularly.

3. Proposed Work

3.1. System Model

A VANET consolidates three kinds of components: vehicles, side of the road units (RSUs), and servers. Vehicles are preeminent disciples of the VANET which comprises of 1 …. N number of vehicles. To consider that every vehicle is outfitted with an On Board Unit (OBU), which is proficient to send and get messages by means of wireless communication [8]. The correspondence predominantly involves Vehicle to-Vehicle (V2V) communication and the Vehicle-to Infrastructure (V2I) communication. The RSU is a far off communication establishment introduced along the side of the road.

It is an intermediator among vehicles and servers. The third classification of units is servers, which deal with the vehicles and applications in VANET.

Consider a highway situation where different vehicles are moving with dynamic speed and dynamic direction. Allow us to accept that singular vehicle as dynamic concerning one another. This supposition compares well with the contention that vehicle are running with a unique speed regarding one another. The conspicuous characteristics of VANET, including the high portability and the vehicles have been disseminated generally; lead to visit changes in the geologies and separations of the association. To deal with these issues, we propose a gathering of vehicles together so that to make a dependable association on it. Each group contains a cluster head which is obligated for regulating the information about the group part for data transmission.

In this paper, the vehicle-to-vehicle (V2V) communication has been considered for our proposed cluster based information transmission technique. We expect that each vehicle has a particular feature and is outfitted with an On Board Unit (OBU). The arrangement of GPS is available for getting fundamental information which incorporates vehicle's current region, speed, and direction of vehicle. Vehicles are trading their information with one another through signal messages. The beacon messages are conveyed and accumulated at every time period, which incorporates vehicle's identifier, current position, current speed, direction, vehicle's current status, and Identification of cluster head.

3.2. Cluster Head Identification using Modified Cuckoo Search Optimization

3.3. Clustering Method:

In VANET Clustering, Cluster head (CH) assumes a critical part in the development cycle of a Cluster. A cluster can be made in different ways in view of the input measurements. The part vehicle of a cluster is called Cluster Member (CM). Other than CH and CM, a few calculations utilize two CMs to speak with different groups for the CH are called Cluster Gateways (CGs). Except if indicated as CG, all individuals from a group are named as CMs. One CH, zero/one/two CGs, and quite a few CMs can be available in a group.

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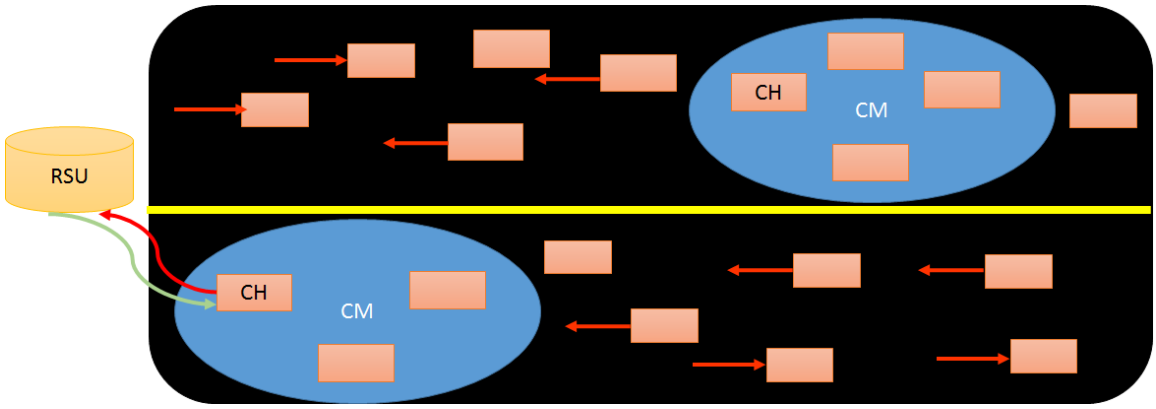

Fig. 2. Clustering Method

In the proposed system, to select the cluster head using Fuzzy Cuckoo Search Optimization which is coined as Modified Cuckoo Search Optimization Path (MCSOP).

Cuckoo Search (CS) is one of the most recent Bio-inspired algorithm, created by Yang and Deb [9]. CS depends on the brood parasitism of some cuckoo species and this algorithm is improved by the Lévy flights [10]. Late investigations show that CS is possibly definitely more effective than PSO and GA [11].As a general rule, the cuckoo birds lay their eggs in the homes of other host birds, committing its nurturing parasitism [12]. Assuming that a host bird observes that the eggs are not their own, it will expel these unfamiliar eggs or essentially leave its nest and fabricate another nest somewhere else [13]. The calculation starts with various nests in which each egg in the nest signifies a result. The Lévy flight strategy is applied for producing new result [14]. It replaces the most awful answers in the nest by recently delivered improved solutions. The best nest with great quality eggs will be carried on to the forthcoming generation.

The examination is approved out by Lévy flights for creating a novelresult$a_i(m+1)$ using the solution $a_i(m)$as shown in Equation (1):

$$a_i(m+1) = a_i(m) + \propto \oplus\, levy(\boldsymbol{\lambda}) \quad (1)$$

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

$$levy \sim u = m^{\boldsymbol{\lambda}} \quad (2)$$

In VANET, initially the vehicle as node which is identified based on the position (P), direction (D) and velocity (V).Each cuckoo is randomly chosen vehicle node.The fuzzy concept is integrated in the cuckoo search by computing a membership matrix for each nest and the fitness for each nest is calculated by using the objective function of the fuzzy K-Means. Let X = $\{x_1, x_2, \dots, x_n\}$be a set of nodes (Vehicles) to be clustered, its centroidv_i , the number of the cluster C and r be a parameter for selecting the cluster Head (CH).

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

$$F = \sum_{j=1}^{n} \sum_{i=1}^{C} u_{ij}^{r}\, d_{ij}^{2} \quad (3)$$

Where F is the sum of squared error for the set of fuzzy clusters and the associated set of cluster centers V. Here,$\|x_C - v_i\|^2$ is the distance between the data x_C and the cluster center v_i. The centroids and cluster member for each cluster can be evaluated using Equations (4) and (5)

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$$V_i = \frac{\sum_{j=1}^{n} u_{ij}^{r} x_j}{\sum_{j=1}^{n} u_{ij}^{m}} \quad (4)$$

$$u_{ij} = 1 \Big/ \sum_{l=1, x \in R}^{k} \left(\frac{d_{ij}^2}{d_{1j}^2} \right) \quad (5)$$

A fraction of nests is terminated, keeping only the best solutions. Then, the current best cluster solution is passed on to the next generation and the process is continued until it reaches a maximum number of generations or a stopping criterion. With reference to the calculation of the above equation, identify the nearest value as Cluster Head (CH) and neighbouring vehicles has to be considered as the cluster member (CM).

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

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

   Replace j by new solution by implementing Lévy flight and update the centroids

end if

8. if u_{ij} > Ai (UpperApproximate)

   Remove node from the cluster.

   end if
9. Retain the best cluster node and chose it as cluster head.
10. This best cluster act as a cluster head and passed to the next iteration.
11. end while

Presently the RSU as the regulator that guides the transmission of data to the CH and accordingly CH recognizes to the RSU. Likewise Cluster Head (CH) signals the transmission of data to the Cluster Member (CM) and furthermore to the closest non Cluster Member (NCM) in light of a similar place of vehicle. All the cluster member and non-cluster member (NCM) have been recognizing to the CH. Consequently the broadcasting of data transmission, the cluster member and other irregular vehicles have been changed their pathway.

4. Results & Disclosure:

4.1. Simulation Environment

Test model have been accomplished by utilizing the system Veins 5.1 of the OMNeT++ 5.6.2 [15]. Veins give the convention heap of the IEEE 802.11p norm for V2V correspondence and an obstruction model for signal constriction. For the test of vehicle traffic and motion, we thought about SUMO (Simulation of Urban MObility) [16], which is an open source traffic test system to

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demonstrate and to control objects in the street situation. This permits us to recreate the ideal vehicle developments with arbitrary journey speed and V2V communications as indicated by exact information. We considered an area of 3 km^2 from the Saravanampatti to Kalapatti of Coimbatore city, Tamilnadu and from Raja street to around Town Hall of Coimbatore city, Tamilnadu which was acquired through the OpenStreetMap and imported by SUMO to produce the move records of vehicles.

4.2. Properties of Parameters

Table 1 Properties of Parameters

Parameter	Value of Parameter
Environment	Omnetpp 5.6.2,Veins5.1 and Sumo
Channel required	Wireless
Algorithm Used	RSA for identification of Cluster Head
Size of Networks	Dynamics
Type of Road	Highway with Multiple Lanes
Road Length	8 km
Vehicle Density	15 ~50 vehicles/km.Lane
Features Used	Throughput, CO_2 Emission, Overhead Delay
Simulation Area	3Km^2
Simulation Time	500 sec
No. of Nodes	3000 Nodes

4.3. Evaluation Metrics

4.3.1. Throughput:

It needs the fundamental element as packet relationship and its size, data transmission rate, and total time taken between transmitted area/nodes. [17]

$$Throughput = \frac{size * amt.of\ Data}{time\ taken}$$

4.3.2. CO_2 Emission:

It alludes to the measure of CO2 getting out from vehicles and influencing the atmosphere. In fact, a definitive objective of any traffic data framework, and particularly any accumulation convention, is to lessen the absolute CO2 discharge by searching for limiting however much as could reasonably be expected gridlocks and diminishing the dynamic holding up season of vehicles in go across streets and on roadways.[17]

The average CO_2 emission is defined as follows:

$$CO2\ Emission = \frac{\sum Vehicle\ CO2\ Emission}{\sum Vehicle}$$

4.3.3. Overload:

It represents the whole number of sent packets. The main objective is to evade from the overload issue by searching for limiting the quantity of messages traded in the network. [17]

The average overload is defined as follows:

$$Avg.Overload = \frac{\sum sent\ packet}{\sum vehicle}$$

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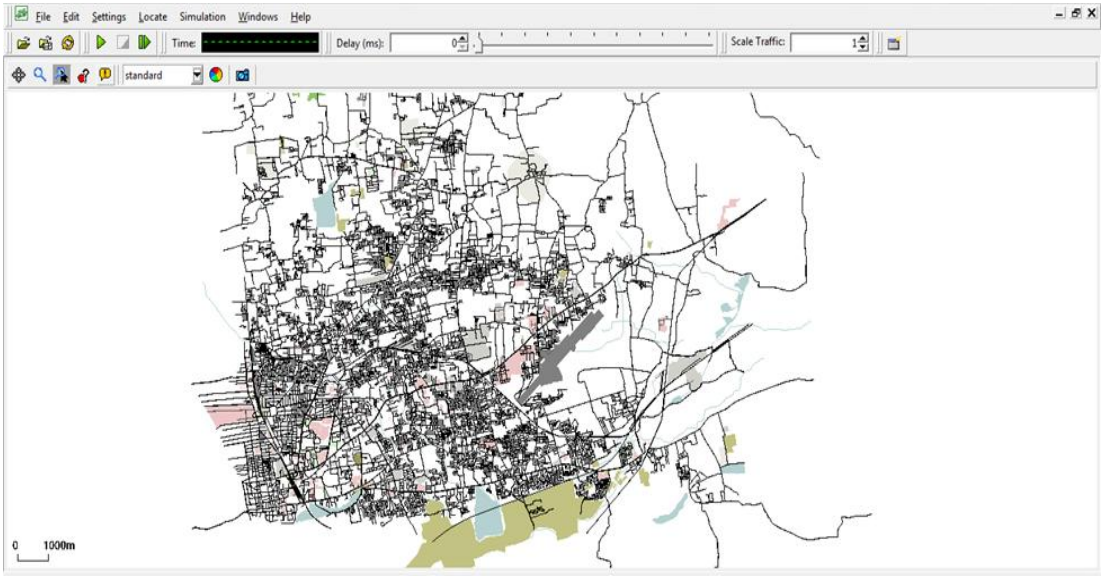
4.4. Results



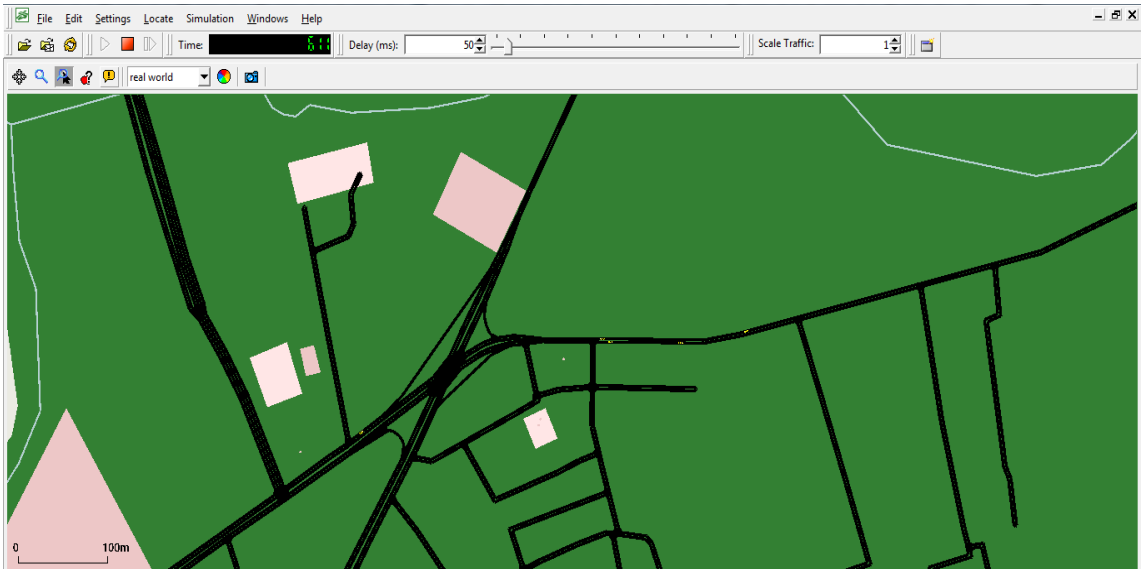


Fig.3. A realistic Scenario of Saravanampatti to Kalapatti in Coimbatore city

Fig.4. A multiple lanes scenario generated in SUMO- Saravanampatti to Kalapatti

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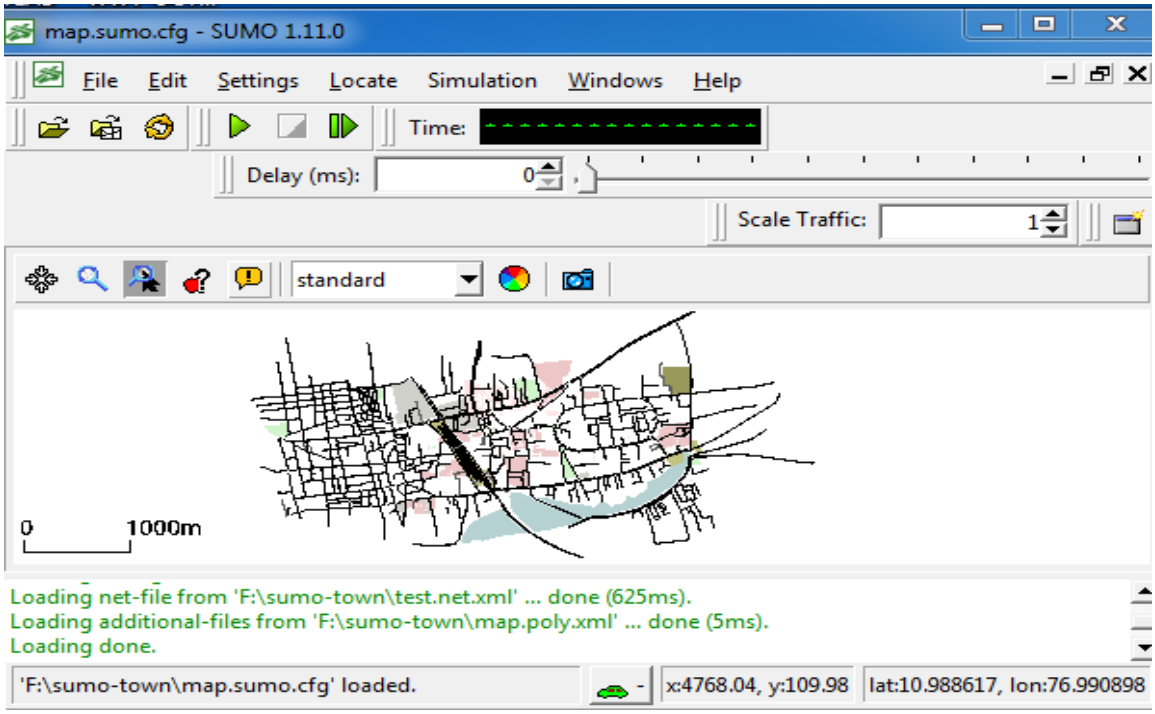

Fig.5. A realistic Scenario of Town Hall to Raja Street in Coimbatore city

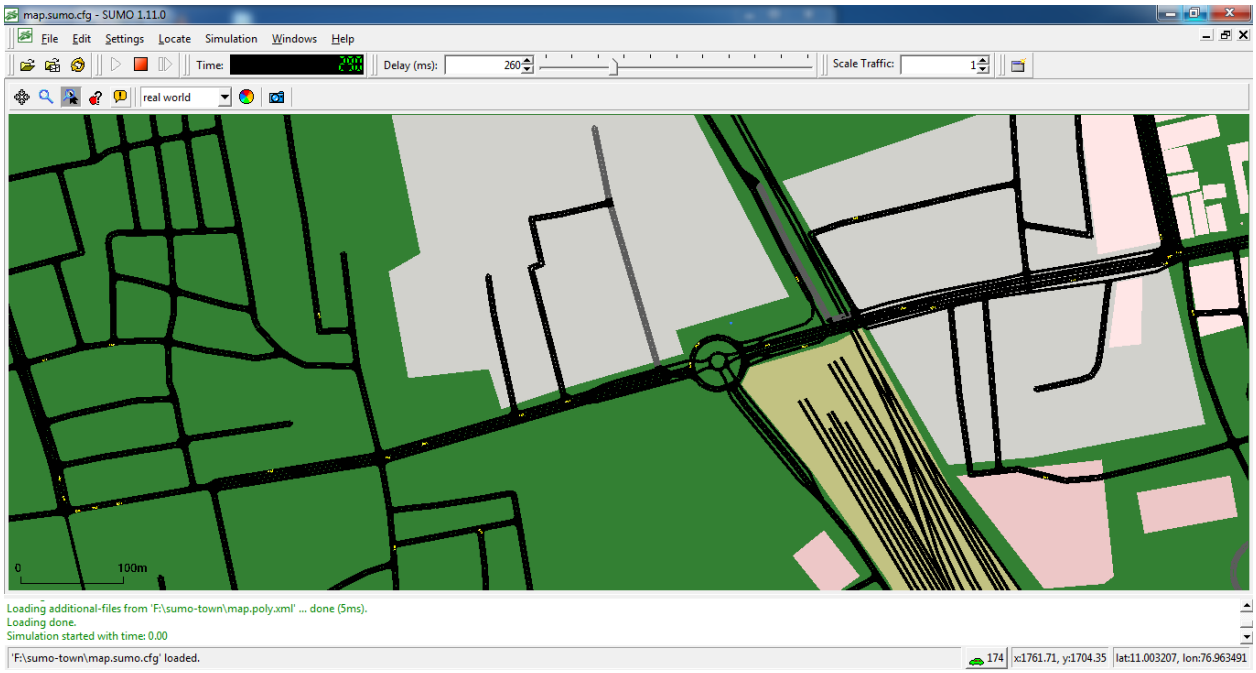

Fig.6. A multiple lanes scenario generated in SUMO- Town Hall to Raja Street

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Throughput:

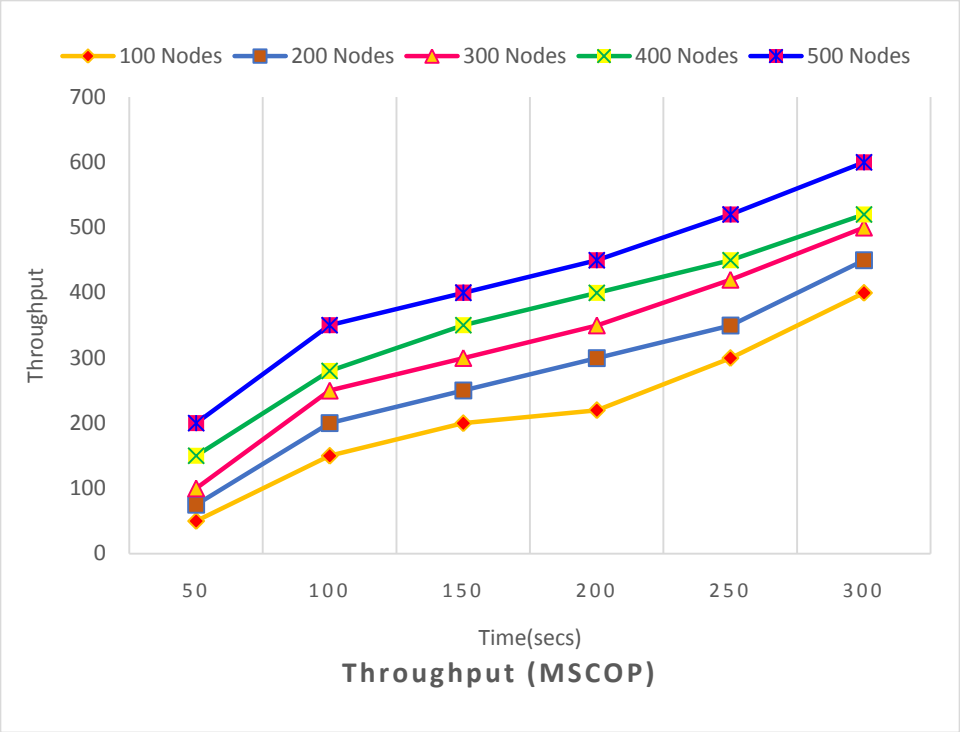

Fig.7.a.

Throughput Calculation using MCSOP

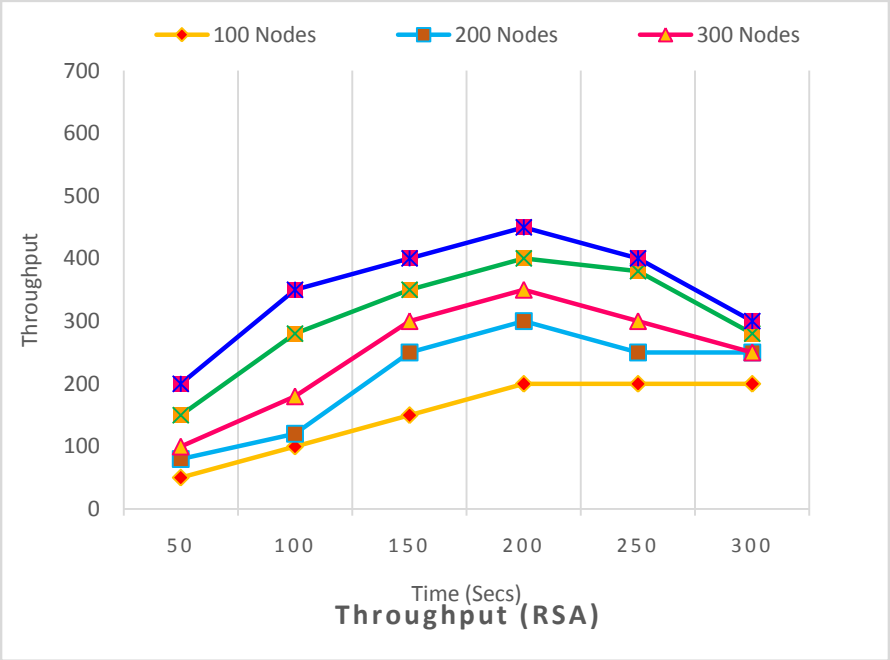

Fig.7.b. Throughput Calculation using RSA

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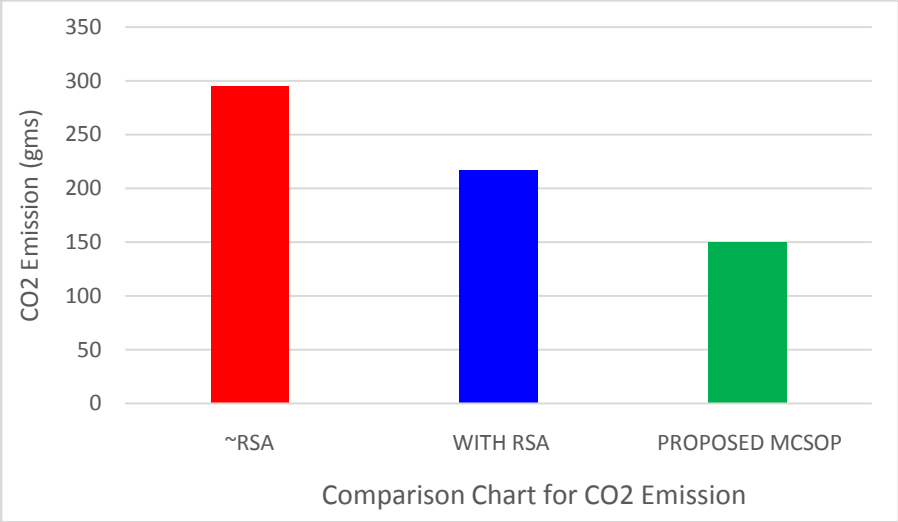

Fig.7.c. Comparison chart for Throughput Calculation

Fig.7. Throughput Calculation

CO2 Emission

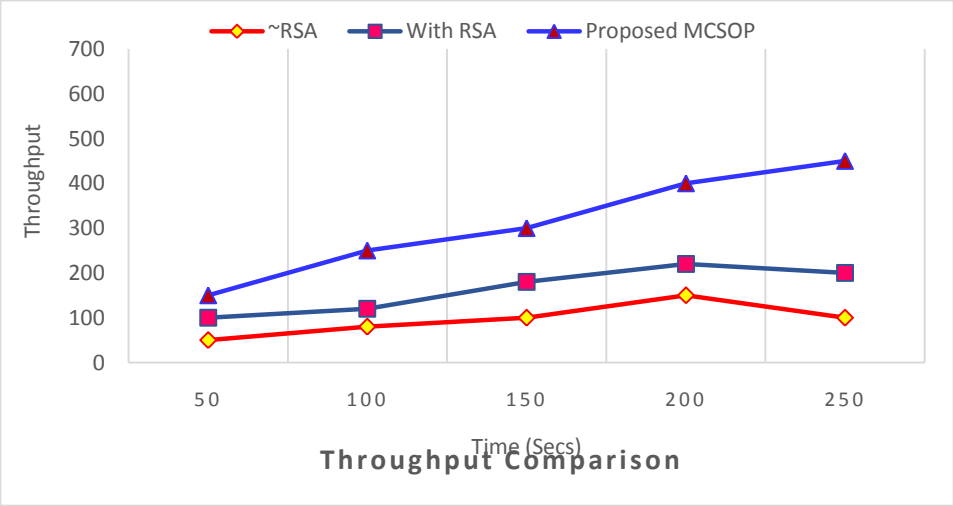

Fig.8. Comparison Chart for CO_2 Emission

Average Overload

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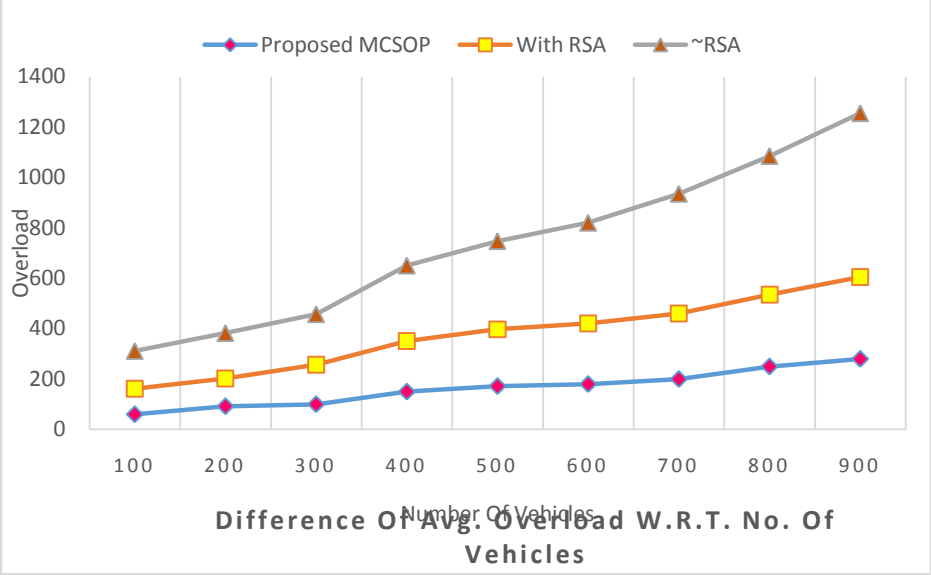

Fig.9. Overload Calculation

Figure 3 and 4 depicts the practical set-up of Saravanampatti to Kalapatti in Coimbatore city. Figure 5 and 6 portrays the realistic situation of Raja Street to Town Hall in Coimbatore city. These maps have been chosen Openstreetmaps (OSM) by manual coordination. Then, at that point, this has been exported as OSM file which is been contribution to SUMO GUI to deliver the traffic model by consolidating the Vein tool.

Figure 7 addresses throughput with respect to time. Figure 7(a) determines the throughput of proposed MCSCOP, Figure 7(b) assigns for RSA and Figure 7(c) is comparison chart of proposed MCSOP with existing algorithms for finding the cluster head. The portrayal is furthermore determined for numerous amount of nodesexperiencing the same thing for validation of our results. Regardless, throughput is more assuming there ought to be an event of proposed MCSOP when diverged from using RSA and without RSA.

Figure 8 shows that the contrast chart for CO_2 emission based on the number of vehicles increased. This examination evaluates the impact of vehicle changing to escape the bottleneck of traffic flow. Figure 8 portrays that the CO2 emanation is similarly diminished by using the proposed MCSOP for choosing of cluster head to scatter the information as exceptionally fast than the existing algorithms such as using RSA and without RSA.

Figure 9 shows the correlation of Overload computation which conveys to reduce the amount of message communicates in the network. In this evaluation, our proposed MCSOP calculation is utilized to lessen the network overload subsequently decreasing the impacts of collision.

5. Conclusion

In this paper, main contribution is to identify the cluster head of the vehicles in multiple lanes in order to disseminate the data over the network rapidly. A real location based simulation scenario of Coimbatore City has been built to assess the concert of various data dissemination evaluation measurements such as Network Throughput, CO_2 emission and Average Overload. Here, our state – of – art Modified Cuckoo Search Optimized Path (MCSOP) has been used to identify the cluster

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head for disseminating the data through the VANET. Modified Cuckoo Search Optimized Path (MCSOP) is the cluster based optimization to select the optimal cluster head based on fitness function in terms of distance and acceleration. Then the optimum path between source to destination is identified to disseminate the messages. The anticipated MCSOP increases the throughput and minimizes overload and implications to reduce the CO2 emission from vehicles. So, our proposed MCSOP outperforms than the existing algorithms such as RSA and without using RSA for cluster head selection. In future, we will be concentrating more on reducing more CO2 emission from vehicles through some novel algorithm. So that to make our environment as Eco-Friendly to us.

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