International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7648
***Article Received:** 04 June 2023 **Revised:** 26 July 2023 **Accepted:** 12 August 2023*

Predicting and Recovering Link Failure Localization Using Competitive Swarm Optimization for DSR Protocol in MANET

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Abstract: Portable impromptu organization is a self-putting together, major construction-less, independent remote versatile hub that exists without even a trace of a determined base station or government association. MANET requires no extraordinary foundation as the organization is unique. Multicasting is an urgent issue in correspondence organizations. Multicast is one of the effective methods in MANET. In multicasting, information parcels from one hub are communicated to a bunch of recipient hubs all at once, at a similar time. In this research work, Failure Node Detection and Efficient Node Localization in a MANET situation are proposed. Localization in MANET is a main area that attracts significant research interest. Localization is a method to determine the nodes' location in the communication network. A novel routing algorithm, which is used for Predicting and Recovering Link Failure Localization using a Genetic Algorithm with Competitive Swarm Optimization (PRLFL-GACSO) Algorithm is proposed in this study to calculate and recover link failure in MANET. The process of link failure detection is accomplished using mathematical modelling of the genetic algorithm and the routing is attained using the Competitive Swarm optimization technique. The result proposed MANET method makes use of the CSO algorithm, which facilitates a well-organized packet transfer from the source node to the destination node and enhances DSR routing performance. Based on node movement, link value, and endwise delay, the optimal route is found. The main benefit of the PRLFL-GACSO Algorithm is it achieves multiple optimal solutions over global information. Further, premature convergence is avoided using Competitive Swarm Optimization (CSO). The suggested work is measured based on the Ns simulator. The presentation metrix are PDR, endwise delay, power consumption, hit ratio, etc. The presentation of the proposed method is almost 4% and 5% greater than the present TEA-MDRP, RSTA-AOMDV, and RMQS-ua methods. After, the suggested method attains greater performance for detecting and recovering link failure. In future work, the hybrid multiway routing protocols are presented to provide link failure and route breakages and liability tolerance at the time of node failure, and it also increases the worth of service aspects, respectively.

Keywords: MANET, Link Failure Detection, Localization, Recovering Link Failure, Genetic Algorithm, Competitive Swarm Optimization, and Dynamic Source Routing.

I. INTRODUCTION

The versatile impromptu group is powerfully framed by remote portable hubs that randomly move without the organization of a base station or any essential issue. MANET is considered a multi-jump organization; Because the destination is beyond the communication range of the source node, intermediate nodes are used by the source node in a multi-hop network to communicate with it [1]. Routing is a key network operation in MANETs for starting a connection between mobile knots. The MANET is non-centralized, has a dynamic network topology, and dynamic mobility, and has a finite amount of resources. One of a versatile hub's essential asset impediments in a MANET is battery energy. After finding the steering way, a hub's battery energy frequently runs out.

It causes the packet to be delivered partially or unsuccessfully. A node's limited energy capacity makes routing a difficult process [2]. MANETs are emerging as significant technologies to support reliable and effective operations in mobile wireless systems by integrating directing functions into mobile knots [3]. Such networks are probable to have energetic, occasionally fast-moving, casual, multi-hop top MANETs emerging as significant technologies with the objective of supporting reliable and effective operations in mobile wireless networks by integrating routing functions into mobile nodes [4]. Such organizations are supposed to have dynamic, periodically quick evolving, arbitrary, multihop geographies, which are likely comprised of remote connections with restricted limits. For situations needing quickly deployable communications with resilient, effective dynamic networking, ad hoc network technology can offer a very elastic technique of forming communication for burn, security, and save operations.

For situations needing quickly deployable communications with resilient, effective dynamic networking, ad hoc systems technology can offer a very flexible technique for establishing communications for fire, safety, and rescue operations [5].

Due to routing path connection breaking caused by node rapid mobility, network lifespan is decreased and packet loss occurs. Similarly to this, a node has a significant impact on the network's dependability, that a node changes from a cooperative to a selfish state [6]. The network is susceptible to intrusive attacks, broken communication links, and other environmental factors. Both the network's routing and neighbour node cooperation are impacted by these factors. MANETs are emerging as significant technologies to support reliable and effective processes in mobile wireless networks by integrating routing functions into mobile knots [7-8]. For situations needing quickly deployable communications with resilient, effective dynamic networking, ad hoc network equipment can offer a very flexible technique of starting transportation for burn, security, and rescue operations [9].

Since the network environment in MANETs is dynamic, the routing protocol must be adaptive enough to function under these circumstances. Due to node flexibility and the susceptibility to being impacted by wireless channel dying, wireless communication links between nodes in MANETs are impaired [10]. The vacant capacity of transmission power, participating nodes, link quality, and node flexibility are only a few of the variables that have a significant impact on the quality of the wireless joining between nodes. These elements should be taken into account in tandem when choosing a next-hop forwarder to generate a reliable and stable routing scheme [11]. When broadcasting real-time applications, links are stabilized via link stability. Link stability is the anticipated lifespan of the link connection between two adjacent nodes. In other words, the ability to repair the link locally by choosing an alternative connection(s) in a shorter amount of time is demoted by link permanence [12].

Several ongoing studies aim to compensate nodes for their engagement in the routing process by using reputation values or game theory to incentivize node cooperation [13-15]. Several currently published research publications focus on stopping, identifying attacks, selfish activities, intrusions, and minimizing selfish nodes. With the help of reputation values or game theory, several active experiments seek to reward nodes for participating in the routing process. Numerous studies that have recently been published center on discovering, and stopping attacks, selfish behaviors, intrusions, and minimizing selfish nodes. However, the current research focused on detection and improving link failure in MANET using the Genetic with Competitive Swarm Optimization algorithm. The balance of the paper is coordinated as follows, segment 2 uncovers the writing overview of the examination, segment 3 depicts the exploration issue definition and inspiration, and segment 4 represents the proposed research approach. Area 5 exhibits trial and error and result in conversation, and the examination end is introduced in segment 6.

II. LITERATURE SURVEY

To pick the group head, a half-and-half choice tree and counterfeit brain network technique are worked with mental radio [16]. As the remaining energy level rises, the base station accepts more packets and collects more data from typical sensor nodes. To accomplish a solid information move, the on-request steering convention is intended to hold information in neighborhood capacity for retransmission during joint disappointment. An outline of the logical, organization, and reenactment models used to build directing strategies is given in [17]. This study separates coordinating conventions into three gatherings in light of their relative exhibition: route management, Quality of Service, and route discovery. Also contrasted in this study are routing dependability, packet latency, packet carriage ratio, controller the overheads, and quality of service. This paper examined some recent work that made suggestions for enhancing scalable, resource-efficient, and QoS-based routing algorithms.

In [18] Link Break prevention over the CDA AODV is introduced. While the network is connected, capacity is the desired outcome. Each terminal can only link directly with those that are nearest to it since the signal weakens as it moves from one terminal to the next during transmission. To operate as a router and forward the data till it reaches its destination when the nodes are far apart, an intermediary terminal is required. The sign power of gotten information bundles is utilized in [19] to give a most un-square quadratic polynomial relapse-based strategy for computing join breakdown time. The received signal intensity of data packets is used to evaluate the distance between the transmitting and receiving nodes. Between the time it takes for a data packet to arrive and this node distance, the authors have created an ideal error quadrate model. Following the improvement of a quadratic model, the connection disappointment time is determined by deciding the time at which the most extreme correspondence range for the concentrated transmitter-collector pair will be reached. In the situation of DHT networks, [20] describes the problem's scope and proposes a Fault-Tolerant DHT-Networks-based routing protocol. A cross-layer strategy method is used for FTDN studies network dynamics in a physical network, and the logically structured DHT network is adaptively configured to withstand errors. In particular, FTDN greatly boosts performance and guarantees network availability in the event of a failure. Results from simulation and analysis demonstrate the viability of the suggested fixes. The Energy Productive Directing (EER) convention, which depends on compelling course disappointment identification, is proposed in [21]. This research provided an innovative routing method for MANET that minimizes failed communication. The three crucial criteria are employed in this method to identify the route that ensures genuine communication. A key factor in a node failing in a MANET is the node in residual energy besides the channel and connection quality. As a result, the suggested routing system thinks that these three different parameters will determine which node along the path is best.

A MANET climate's Effective Hub Limitation and Disappointment Hub Recognition are recommended in [22]. The nodes are initialized first in this case. Next, the SNs are localized using the three steps of distance estimation, position calculation, and optimal localization after that, send the data packets out through the network. For effectively sending the data packet, the optimum path is considered. For this, there are two steps: the first is the computation of FP, and the second is the estimation of error. In [23], creators proposed the Trust-Based Energy Mindful Multipath Disjoint Steering Component for MANETS as a dependable, energy-productive way determination convention to decrease these dangers. The node's packet forwarding status, which demonstrates how effective the node is from a packet forwarding perspective, is used to calculate ATV. Only nodes with a great ATV and enough residual energy are allowed by TEA-MDRP.

The way unwavering quality and security are improved for information transmission, [24] presents a dependable and stable TA-AOMDV (RSTA-AOMDV) steering convention. As indicated by this convention, every beginning hub advances information bundles to the objective, each bounce in turn, in the vision of the nearby information it has gained from its one-jump neighbor. A sending hub self-choice system is added during the ensuing tracking downstage to diminish the correspondence above brought about by the high hub thickness and extreme blockage. In [25], the RMQS-ua (Dependable Multipath Steering Convention in Light of Connection Quality and Security in Metropolitan Regions) multipath directing convention is proposed. To guarantee reliable information transmission, we need to pick the way founded on the best connection quality and most stable availability. To survey network quality, we join the sign-to-clamor proportion, the upgraded parcel gathering proportion (PRR), and the dramatic moving normal (EMA).

III. RESEARCH PROBLEM DEFINITION AND MOTIVATION

A unique type of wireless network with a multi-hop, dynamic topology, and no central point is known as an ad hoc network. By the intermediate nodes forwarding, the data communication needs to be realized. A group of wireless communicating devices is called MANET and these nodes also work as a router. Due to its limited features such as limited battery power and frequent topological changes, routing is highly affected and it is a kind of communication network. While communicating a bundled stream from the source to its objective, a bunch of administration prerequisites should be met by the organization which is alluded to by the connection quality. Delay variance, packet loss, power consumption, delay, and bandwidth are some specialized service attributes that validate the performance of end-to-end. As a result of which the organization's execution is corrupt, and the way soundness is influenced because of the great traffic load on joins and the hubs' less energy. In an unplanned manner just like throwing the nodes on particular regions, most of the MANET applications are deployed in the nodes. Therefore, from place to place, the fault is not uniform. A large number of error messages, a huge amount of packet drops, bandwidth consumption, and communication overhead are the primary disadvantages. In the intermediate nodes, the overhead will occur if the link failure node is far away from the destination.

The exhibition of on-request source steering conventions and especially of DSR as far as the course revelation interaction and connection disappointment expectation methodologies alongside their impediments. Due to their slow discovery and response to route breakages, besides the needless exchange of periodic updates, the proactive and hybrid routing protocols do not provide satisfactory performance in terms of memory consumption reduction and control overhead in a dynamic environment with frequent topology changes. By limiting the utilization of control messages throughout the organization, on-request directing conventions were created to save data transfer capacity. At the point when it is expected by the higher convention layers, a course to an objective is just looked at. The interest in a successful connection disappointment expectation system is incremented by the incessant connection breakages inferable from hub versatility occasions that influence the organization's execution. In this way, to decrease parcel misfortune and to keep away from disappointment conditions, the versatility and area data are used to anticipate the ongoing connection status by using the connection disappointment expectation system (concerning course support).

IV. PROPOSED RESEARCH METHODOLOGY

MANET is viewed as a promising innovation that offers impermanent associations with no previous foundation, which is required during strange circumstances or transitory occasions like crises, disastrous recuperation regions, and combat zones. Because of regular geography changes in remote impromptu organizations, planning a productive and dynamic directing convention is an extremely difficult errand, and it has been a functioning area of examination. However, one of the main obstacles in MANET is the disruption of established connections caused by link breakages. In the Dynamic Source Routing protocol, the mobility of nodes causing the link failure problem is part of ongoing research. In this examination work, to keep away from spreading course mistake messages back to the source upon connecting disappointment another way from the current arrangement and to settle interface disappointment, an expansion of the DSR convention is proposed.

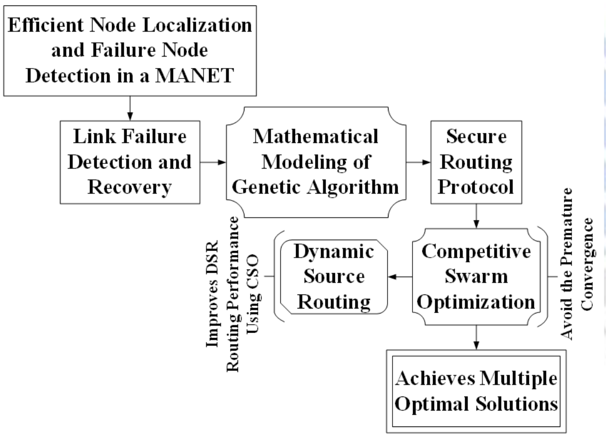

Figure 1. Flow diagram of the research work

Figure 1 reveals the workflow diagram of the proposed work. The proposed work predicts and recovers the link failure localization using Genetic Algorithm with Competitive Swarm Optimization (PRLFL-GACSO) algorithm. Initially, the link failure is detected and recovered using the mathematical modeling of the Genetic algorithm. Nonetheless, steering is performed in the vision of the CSO calculation, which further developed the DSR directing execution and it dodges the untimely assembly. Accordingly, this PRLFL-GACSO algorithm achieves multiple optimal solutions.

A. Efficient Node Localization

In mobile nodes, the network topology is extremely dynamic, the resources are limited, along with the network may not be always connected; thus, failure detection is highly complicated. Therefore, in a MANET environment, an ENL along with Failure link Detection is proposed to detect the faulty link effectively. In this work, primarily, initialize the nodes and then the nodes are localized. Distance estimation and position computation are included in localization. Next, transmit the data packets utilizing intermediate nodes, betwixt the destination and source. Next, the optimal path is selected regarding the link failure prediction and link failure recovery.

Node Initialization: Randomly initialize the nodes in the MANET environment, which are expressed as,

$$\mathbf{S_N} = [\mathbf{S_1}, \mathbf{S_2}, \mathbf{S_3}, \ldots, \mathbf{S_N}] \quad (1)$$

Where, $S_1, S_2, S_3, \ldots, S_N$ represents the number of mobile nodes, respectively.

Localization: The nodes are localized after initialization. Localization is extensively used to recognize the present location of nodes in MANET. In general, since MANET has numerous nodes, failure link detection in MANET is highly challenging. By the nodes' localization, the complications in fault link detection are mitigated highly. Along with the network overload being balanced by the localization process, the network lifetime is enhanced, and optimum resource utilization is ameliorated. For node localization, optimal localization, position computation, and distance estimation are the significant phases included in it.

Distance Estimation: The distance betwixt the source and target nodes is computed, by employing the Time of Arrival (TOA) methodology.

The speed at which the signal travels (generally the speed of light) (S), the exact time the signal receives at a destination node $(T_{Arrival})$, and the actual time that a signal was forwarded as of the basis node (T_{Sent}) are known by the TOA approach. The distance (Dt) is calculated based on equation (2) after knowing the aforementioned values,

$$Dt = S * (T_{Arrival} - T_{Sent}) \quad (2)$$

Position Computation: The destination node is localized by utilizing the Multilateration (MLT) scheme. By the MLT approach, the node's position is determined precisely even if the space measurements are noisy. In the maximum likelihood determination, distance measurements of multiple neighbour nodes are included which is exploited by a possible solution. The MLT's objective is reducing the variations betwixt the measured and estimated distances. The distance is computed by utilizing the Euclidean Distance (ED) and it is expressed as,

$$d\,(x_0, x_1) = \sqrt{\sum_{i=1}^{n}(x_1 - x_0)^2} \quad (3)$$

Where, the two nodes in Euclidean n-space are specified as x_0 and x_1. However, effectively localize the mobile nodes.

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B. Link Failure Detection and Recovery

In mobile ad-hoc networks, link failures on the route frequently render the routes connecting the pair of source and destination unavailable. Power utilization, blurring in the correspondence channel, hub versatility, and mistakes in the uproarious remote medium are the different reasons that emerge the connection disappointment. In MANET, to provide a quick recovery mechanism and reduce the number of link failures. This work presented mathematical modelling of genetic algorithms. This method detects and recovers the failures that occur in the link. This detection and recovery of link failure is the important concept of this present work. In this manner, versatile impromptu organizations are regularly profoundly unique and the steering calculations ought to be created to successfully manage connect disappointments.

Genetic Algorithm

This heuristic is used to produce useful responses for search, adaptation to non-critical failure, and advancement issues. To advancement issues, GA creates arrangements using techniques propelled by regular development, like legacy, choice, hybrid, and change, and it has a place with the bigger class of transformative calculations. Generally, courses of action are tended to in matched as strings of 0's and 1's, but various encodings are furthermore possible. The node-based encoding technique is utilized in the work that is proposed.

The development for the greatest part begins from a populace of haphazardly created people and occurs in ages. From the populace, every individual's wellness is assessed at every age, and numerous people are stochastically chosen (in light of their wellness) from the ongoing populace and changed (recombined, potentially haphazardly transformed) to make another populace. In the following cycle of the calculation, the new public is utilized. The algorithm ends for the population when either it reached a suitable fitness level or produced a maximum amount of generations. One might have wellness for a few cycles (for example positive arrangement) when the calculation is ended. Part of the tasks utilized in the suggested GA are as per the following.

Genetic Representation

In the given organization, a chromosome is an assortment of qualities and every chromosome addresses various connections of hubs or qualities. The proposed GA's chromosome is prepared of positive integer sequences that represent the IDs of nodes. The total quantity of nodes or links in the network system is used to represent the variable length of the chromosome. The length of the chromosome shouldn't surpass the greatest length (complete number of hubs/joins in the organization).

Population: A collection of chromosomes is called a population, and the formula for a family of r chromosomes is P=(c1,c2,...cr). As the quantity of hubs develops, so does the size of the chromosome structure. When a failure link is present, the quantity of chromosome structures for the initial population is generated. The selection of two chromosomes for adaptation to non-critical failure in the organization is based on the outcome of a roulette wheel. In which the node ID is provided by the gene value and the gene index, which represent the node's position (as shown by 1, 2, 3, 4, 5, etc.).

Crossover and Mutation: To make new chromosomes, the two-point hybrid (C_T) strategy is utilized. Two individual chromosomes are browsed the mating pool or populace with the most reduced worth to deliver two new posterity.

This operator generates a two-person linear extrapolation by making use of the fitness data. Using equation (4), a new solution is created, and a new random number r is generated if X' is infeasible (given as =0 in (6)), a new individual, X', is created following a uniform distribution U(0,1), whose fitness is superior to that of Y'.

$$\overline{X}' = \overline{X} + r(\overline{X} - \overline{Y}) \quad (4)$$

$$\overline{Y}' = \overline{X} \quad (5)$$

$$\eta = \begin{cases} 1 \text{ if } x'_k \geq a_k, x'_k \leq b_k \forall k, \\ 0 \text{ otherwise} \end{cases} \quad (6)$$

Mutation: In this work, we thought about that solitary point transformation process, which produces arbitrary worth between 1 to S_N where, S_N is the number of hubs. In an arbitrary position, this irregular worth is supplanted. Transformation acts that initial an irregular number among 1 and the number of hubs are created, and afterward, this worth is set in an irregular cell inside the chromosome. It has been thought that change likelihood (MP) is somewhere in the series of 0.1 and 0.3.

The one element x_k of the parent $\overline{X}$ is randomly selected and after setting the element (x'_k) equal to the non-uniform random number in the following manner, it modifies it as $\overline{X}' = \{x_1 x_2 \ldots . x'_k \ldots . x_N x_{N+1}\}^T$.

$$x'_k = \begin{cases} x_k + (b_k - x_k)\, f(G) \text{ if } r_1 < 0.5 \\ x_k - (x_k - a_k)\, f(G) \text{ if } r_1 \geq 0.5 \\ x_k \quad \text{otherwise,} \end{cases} \quad (7)$$

$$f(G) = \left(r_2 \left(1 - \frac{G}{G_{max}}\right)\right)^b \quad (8)$$

Where, a_k and b_k address separately the lower and the upper headed for the component x_k; In the function f(G), b is a shape function; G is the ongoing age number; The most number of generations is represented by G_max; r_1 and r_2

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mean consistently disseminated arbitrary number between (0,1). Until it meets the end measures condition, determination, hybrid and change activities are iterated. Until it will range to positive qualities (for example recuperation of connection disappointment in every chromosome), this strategy has been utilized to stop the end condition, any other way they would proceed is acted in the introduced calculation.

Due to unattended deployment and an inhospitable environment, failures are unavoidable in MANET. Therefore, it is necessary to sustain network operation, correct measures are taken and the link failures are identified in advance. To achieve in two phases, an approach is presented: 1) failure detection – To find the failed links and the type of failures in the MANET, this failure detection phase is utilized, and 2) To lay out the way between source hubs and sink hub, disappointment recuperation reinitializes the organization. To accomplish adaptation of the non-critical failure in the organization, these two techniques depend on GA. The proposed GA-inspired routing protocol outperforms the scheme in terms of fitness values, time complexity, packet delivery ratio, energy consumption, and failure detection ratio. The adaptation to internal failure of the organization is considered with GA to give dependable organization tasks by achieving a multi-way information move.

The proposed framework design comprises a set of hubs S_N= [S_1, S_2, S_3,… ., S_N], which are set arbitrarily. A node periodically senses the data in the presence of a fault and uses multi-hop communication to forward it to the sink node. The fault tolerance is computed by the nodes in the MANET environment. The activity arrangement of the proposed conspire is as per the following: 1) For the organization, create the populace size. 2) In light of the roulette wheel choice strategy, select two chromosomes with the most reduced wellness values. 3) Hereditary activities, for example, hybrid and transformation activities are applied to two chosen chromosomes. 4) To perform disappointment location and recuperation of each connection. 5) With dynamic hubs in the organization climate, develop the organization, and 6) Sink hub makes the move after getting the data from hubs.

Failure Detection and Recovery Process

The GA accurately identifies network faults and failures during the failure detection phase of the MANET, which is the initial stage. These are the piece of the organization the board framework. The goal of failure detection is to make sure that the services work properly. To distinguish interface disappointments, portable hub conditions go through steady changes, and network observing alone may not be adequate. Thusly, to identify expected disappointment in the connection, the disappointment discovery procedures should be set up.

The disappointment recuperation stage is the stage at which the portable organization is rebuilt or reconfigured, in such a way that disappointment or broken connections do not affect further on network execution. Disappointment recuperation process is completed as follows.

Link Failure: GA is used to select the closest node with a probability greater than the threshold level to route the data or forward the packets in the event of a link failure brought on by node failure, low link efficiency, or a lack of bandwidth in the network.

$$Si\ \varepsilon L(Si \leftrightarrow)\ [(E\_Si \geq THL\_EN) \wedge (L\_Si \geq ThL\_Leff) \wedge (R\_(Sj,max) > d\_(Si\text{-}Sj))] \quad (9)$$

Where, S_i is a hub that should be recuperated that associated with its adjoining hub, L_Si is the connection proficiency of hub S_i, E_Si is the energy of versatile hub S_i, THL_EN is the limit level energy of portable hub S_i, ThL_Leff is the edge level connection productivity of portable hub S_i, R_(Sj, max) is the greatest hub range S_i, and d_(Si-Sj) is the distance between hub S_i and Sj any other way hub will be flawed or disappointment connect in the organization.

The following is how link failure between nodes is detected: If hub S_N doesn't get parcels from its closest neighbors, whose likelihood level is not as much as the limit inside foreordained time span then it accepts that connection from those hubs to hub S_N are fizzled.

Fitness Function of GA

The wellness capability assessed every chromosome. To expand the adaptation of the non-critical failure of the framework, the proposed wellness capability is planned. It safeguards the generally gotten best chromosomes with wellness esteem. To recuperate each connection in the organization based on interface proficiency, and energy, in this work, the wellness capability is considered as the accompanying boundaries. The connection productivity between the hubs will be more than limit level connection proficiency (THL_Leff), and the energy of every hub ought to be more than edge level energy (THL_EN). The wellness capability of the proposed conspire is figured out as follows:

$$\text{Fitness(Chromosomes)} = \sum_{6=1}^{6} \text{EN}^* \sum_{1=1}^{6} \text{Leff}^*\ \text{Path}^*\text{Fault}(10)$$

Where, EN is the energy of each node, and the link efficiency is represented as Leff

$$\text{Path} = \begin{cases} 1000 & \text{if path exists} \\ 1 & \text{otherwise} \end{cases} \quad (11)$$

Where, Way is a variable, which relies on regardless of whether there is a current way among source and objective however there is no cycle in the Way.

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$$\text{Fault} = \begin{cases} \text{Fault} & = -1 \\ \text{Not Fault} & = \ \ 1 \end{cases} \qquad (12)$$

One or more link failures are present in the network; generally, the wellness ought to be non-negative.

Interface proficiency can be figured as follows. Allow ET to be the all-out energy consumed for transmission of a piece in connect I, Ci to be the limit of a discrete-time discrete-esteemed channel, SNR to be the sign-to-clamor proportion, and B to be the piece pace of a channel. Condition (13) is utilized to register the limit of channel I:

$$C_i = B\log_2(1 + SNR) \qquad (13)$$

Allow EN to be the energy consumed for the transmission of a piece for each distance di. Condition (14) used to figure E.

$$E = EN^{*}di \qquad (14)$$

Allow Leff to be the connection effectiveness for the hubs in the organization. Leff can be processed by utilizing (15).

$$Leff = C_i/E \qquad (15)$$

The connection disappointment recuperation of the organization is accomplished by utilizing the proposed calculation (GA) by assessing a negative worth of wellness to a positive worth over the hubs in the organization.

C. Secure Routing Protocol

DSR convention is planned in an impromptu organization to permit self-sorting out and self-arranging without the requirement for any current organization framework or organization. Course Upkeep Cycle and Course Disclosure are the two primary systems of DSR. In the course disclosure process, two parcels will be produced, which are called Course Solicitation Bundle (RREQ) and Course Answer Bundle (RREP), in the course support, Course Blunder Parcel (RERR) will be created. These systems cooperate to permit hubs to find and keep a sequence to the objective. DSR convention utilizes no occasional directing message, connect status detecting, and neighbor identification parcels. Additionally, the multi-hop wireless network makes use of the DSR protocol, which is an entirely on-demand routing protocol. Likewise, a serious multitude enhancement (CSO) method is proposed for directing and it further develops the DSR steering execution. In any case, this procedure changes the DSR calculation to track down the ideal ways between the conveying hubs.

Dynamic Source Routing (DSR)

Dynamic source directing is a receptive and source steering calculation. The route is discovered whenever a source node requires data transmission. This DSR is a protocol for single-cast routing. To store the course data of late taken courses by that hub, every hub involves reserve memory in this sort of steering. Course disclosure and course support are the two significant sorts of DSR steering. Source hub in verify its course store, at whatever point a source hub attempts to send a bundle to an objective hub. The source hub connects the bundle in an accessible way, on the off chance that the course is accessible to the required objective hub. Otherwise, a source node circulates route request packets (RREQ) to start the route discovery process.

Hubs that get RREQ check their course reserve. The hub affixss its location in the RREQ bundle and broadcasts to adjoining hubs, if the directing passage isn't in the course store. A course answer parcel is produced when the RREQ bundle arrives at either the objective or a hub that has directed data to the objective. The answer parcel contains the addresses of hubs that have been crossed by the solicitation bundle, assuming RREQ is produced by the objective. Otherwise, the RREP package contains the route and the addresses of the nodes it has traversed in the intermediate node's route cache.

On the off chance that the information connects layer tracks down a connection disappointment or separation to keep up with the steering data, in the regressive bearing of information sent, the ROUTE_ERROR bundle is produced and communicated from the bombed highlight of the source hub. Through the bombed connect, some of the halfway hubs likewise erase the course data. One more course-finding process is started by the source hub. DSR's advantage is a reduction in route discovery to manage the overheads due to its use of route cache. Given source directing according to the length of the course, the limit of DSR is the enormous size of the parcel header. In this way, CSO calculation is utilized to further develop the DSR executionFinally, a CSO-based energy-aware routing algorithm and a linear programming (LP) formulation for the routing difficulty are presented.

Competitive Swarm Optimization (CSO)

CSO is one of the new multitudes of knowledge-based calculations, fundamentally motivated by molecule swarm advancement (PSO) procedure, but the idea is different from standard PSO. In the position update component of particles, neither individual best nor worldwide best is engaged with CSO. Allow us to think about x number of particles, S(t) means beginning multitude. Every molecule indicates a possible arrangement. A molecule P_i (1≤i≤x) has position X_(i,d), speed V_(i,d), and 1≤d≤D in the d^th aspect of the hunt space, in any case, for every molecule aspect D is same. In every emphasis x⁄2 matches are haphazardly distributed, the multitude S(t) contains x particles, and after a rivalry is made between two particles in each set of particles. Because of the contest, the molecule having better wellness esteem, henceforth called as 'victor', will be passed straightforwardly to the following cycle

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7648
***Article Received:** 04 June 2023 **Revised:** 26 July 2023 **Accepted:** 12 August 2023*

of the multitude, S(t+1), while the molecule that loses the opposition called a 'failure', will refresh its speed and position by gaining from the champ. After gaining knowledge from the winner, the loser will also transfer to the following iteration, S(t+1). In each iteration, a particle participates in a competition once. After the day, for a multitude size of x, x⁄2 contests happen and both i.e., speed and position, of x⁄2 particles may be refreshed. Allow us to mean the speed and position of the champ and washout in m^thround of the contest in cycle t with V_(w,m) (t), V_(l,m) (t), and A_(w,m) (t), A_(l,m) (t) separately, where, m=1,2,3,… . x⁄2. Using the following learning strategy, which is based on the fundamental concept of CSO, the loser's velocity and position will be updated following the fifth round of competition.

$$\begin{cases} V_{l,m}(t+1) = r_1(m,t) \times V_{l,m}(t) + r_2(m,t) \times \left(A_{w,m}(t) - A_{l,m}(t)\right) \\ \qquad + \varphi \times r_3(m,t) \times \left(\bar{A}_m - A_{l,m}(t)\right) \\ A_{l,m}(t+1) = A_{l,m}(t) + V_{l,m}(t+1) \end{cases} \tag{16}$$

Where, r_1 (m,t), r_2 (m,t) and r_3 (m,t) ϵ [0,1] and A ̅_m (t) the mean position can be characterized in two ways one is worldwide mean and the other is nearby mean signified as A ̅_m^g (t) and A ̅_l^g (t). A ̅_m^g (t) signifies the worldwide mean place, everything being equal, while A ̅_l^g (t) indicates the nearby mean of the predefined neighborhood of particles k.φ be the boundary which controls the impact of A ̅_m (t).

A fitness function is used to check a particle's quality. To find the molecule's positions is the point of this CSO, that outcome best assessment of the given wellness capability. In the introduction cycle of CSO, every molecule is relegated to an irregular position and speed. Hence, when contrasted with PSO, CSO got the improved outcomes in the tried benchmark capabilities, consequently, it persuades us to apply in steering issues as referenced in the proposed approach.

TABLE I. PSEUDOCODE FOR CSO ALGORITHM

Algorithm 1: Pseudocode of the Proposed CSO Algorithm.

Input: population size X, dimension size x,
maximum number of iterations or evaluations
Output: the best solution A_{best}
Initialize the population of X candidate solutions, each with x dimensions;
Evaluate the quality of each candidate result using the objective function;
Select the highest-quality candidate solution as the best solution;
while a termination criterion is not met **do**
Generate the opposition points $\bar{A}_{w,m}(t)$ of the winning competitors $A_{w,m}(t)$ with equation (18);
if $f\left(\bar{A}_{w,m}(t)\right)$ is better than $f\left(A_{w,m}(t)\right)$ **then**
Replace $A_{w,m}(t)$ with $\bar{A}_{w,m}(t)$;
end
Update the best solution;
Update the solutions for the loser competitors using equation (20);
Evaluate the objective function for each new solution;
end

The Pseudocode of the suggested algorithm is presented in Table 1. As a result, the following procedures use the implement the proposed optimization method:

Initialization: The population of X candidate solutions is generated at random using a uniform supply in the range [L_m,U_m], where x is the dimension number.

$$A_m = L_m + r\,(U_m - L_m) \tag{17}$$

Where, r is a random value drawn from the even distribution; i.e., $\sim u\,(0,1)$. Here, U_m and L_m represent the upper and lower bounds, respectively, and $m \in \{1, \dots, x\}$.

Update Procedure of the Winner Competitors: The principal thought behind this idea is that both the considered applicant arrangement and its related inverse point can be assessed for quality at a similar time. These methods not only make it easier to find the best solution, but they also make convergence faster. The refreshing system for the champ up-and-comers can be planned in condition (18) in the vision of the previously mentioned thought.

$$\bar{A}_{w,m}(t) = L + U - A_{w,m}(t) \tag{18}$$

Where, the lower and upper bound vectors are indicated as L= [L_1,… .,L_n] and = [U_1,… .,U_n], individually. The winner's opposite point is A_(w,m) (t) in this case. The considered candidate solution is contrasted with the opposite point, and the point with the higher quality objective value is chosen for the selection procedure's subsequent iteration. The choice administrator for choosing the reasonable answer for advance to the following emphasis can be communicated as

$$A_{w,m}(t) = \begin{cases} \bar{A}_{w,m}(t) \text{ if } f\left(\bar{A}_{w,m}(t)\right) \le f\left(A_{w,m}(t)\right) \\ A_{w,m}(t) \text{ otherwise} \end{cases} \tag{19}$$

Update Procedure of the Loser Competitors: In the first CSO calculation, given the champ and the mean place of the populace, the failure refreshes its situation. Nonetheless, conflicts toward (A_(w,m) (t)- A_(l,m) (t)) and (A ̅(t)- A_(l,m) (t)) in the long run bring about the retrogression of the nature of the arrangement. This downside is known as the peculiarity of "two steps in the right way, one stage back". For every washout applicant, the proposed update process is produced for

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perceiving and resolving this issue. The mathematical formula for the proposed search strategy is as follows:

$$\begin{cases} V_{l,m}(t+1) = r_1(m,t) \times V_{l,m}(t) + r_2(m,t) \times \left(A_{w,m}(t) - A_{l,m}(t)\right) \\ \qquad + r_3(m,t) \times \left(A_{best}(t) - A_{l,m}(t)\right) \\ A_{l,m}(t+1) = A_{l,m}(t) + V_{l,m}(t+1) \end{cases} \quad (20)$$

Where, $r_1, r_2, r_3 \sim \mathcal{U}(0,1)^x \in \mathfrak{R}^n$. The $A_{best}(t)$ represents the current best solution; i.e., $f(A_{best}(t)) < f(A_m(t))$, $\forall i \in \{1, \ldots, X\}$, $\forall i \in \{1, \ldots, t\}$.

Termination Criteria: If the greatest number of cycles or on the other hand assuming that the halting condition is fulfilled or assessments are reached, the enhancement interaction is ended.

Subsequently, this calculation keeps away from the untimely combination and it further develops the directing exhibition of DSR, and the ideal course is tracked down given the versatility, connect quality, and start-to-finish delay.

V. EXPERIMENTATION AND RESULT DISCUSSION

The recreation is finished by utilizing the test system NS3. A discrete event time-driven simulator is Network Simulator. C++ and Tool Command Language are the simulation languages used in the open-source software NS3. C++ is fast to run and is used for packet processing. TCL is utilized for reenactment portrayal and used to control existing C++ objects. It is quicker to run and change. A lot of people use NS3 to simulate networking concepts. The reproduction boundary utilized in the reenactment is organized beneath.

TABLE II. SIMULATION SYSTEM CONFIGURATION

Simulation System Configuration	
Simulation Tools	Ns-3.33
Simulation Time	15.190 seconds
Number of Nodes	50
Routing Protocol	GACSO-DSR
Simulation Area	1000*1000 m
Mobility Speed	5 m/sec
Transmission range	250 m

Table 2 describes that 50 quantities of hubs are dispersed in the reproduction region 1000×1000 m. The mobiles are moving inside the reenactment region by utilizing the irregular way versatility model with the speed of 5 m/sec. Every center has a prompt association with the centers inside that arrive at 250 m. Execution appraisal and correlation of proposed conspire have been finished utilizing the network test system NS3. Packet Delivery Fractions (PDF), Average (E-to-E Delay), Normalized Routing Load (NRL), and Throughput are the metrics used to evaluate and compare performance.

Packet Delivery Ratio (PDR)

PDR is the ratio of the total amount of data packets produced by all source nodes to the total amount of data packets effectively distributed to each destination node. In the equation, the PDR calculation is mentioned.

$$PDR = \frac{\text{Number of Packets Received}}{\text{Number of Packets Send}} \times 100 \qquad n \quad (21)$$

In this reenactment, the boundaries of bundle size were analyzed while deciding the parcel conveyance proportion.

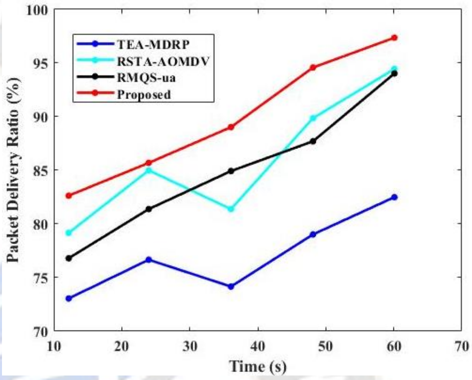

Figure 2. Performance graph for pdr

The PDR of the proposed conspire has improved when time expands as displayed in Figure 2. It shows that the suggested directing plan has supported a predominant parcel conveyance proportion of around 95% while contrasting the time. A comprehensive exhibition appraisal shows that the suggested conspire has upgraded the capability of finding the most ideal course with the help of the HBPR plot. The package conveyance proportion of the proposed PRLFL-GACSO approach is contrasted and existing strategies like Trust Based Energy Mindful Multipath Disjoint Steering Convention (TEA-MDRP) [23], dependable and stable topological change versatile ad-hoc on-request multipath distance vector (RSTA-AOMDV) [24], and RMQS-ua (Solid Multipath Directing Convention in light of Connection Quality and Security in Metropolitan Regions) [25]. The PDR for the suggested work is 97%, yet the PDR for other existing strategies is underneath 95% for RSTA-AOMDV and RMQS-ua, and 82.5% for TEA-MDRP.

End-to-End Delay

The mean time frame stretch between the production of a bundle from a source hub and a powerful transmission of the parcel is estimated at the objective hub. It computes each likely postponement that can occur in the source and every center hub, along with line period, parcel broadcast and scattering, and rebroadcasting at the organization layer. When compared to the

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methods that are currently in use, the proposed method transmits the message with a lower delay.

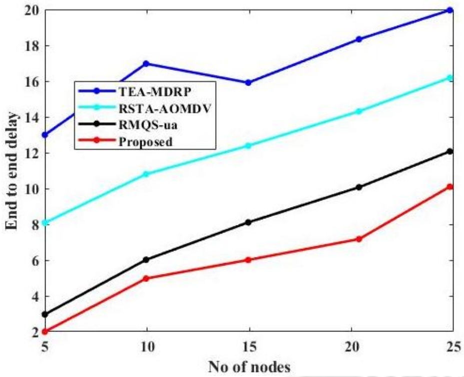

Figure 3. End-to-end delay graph

Figure 3 The mean time frame stretch between the production of a bundle from a source hub and a powerful transmission of the parcel is estimated at the objective hub. It computes each likely postponement that can occur in the source and every center hub, along with line period, parcel broadcast and scattering, and rebroadcasting at the organization layer. When compared to the methods that are currently in use, the proposed method transmits the message with a lower delay. This is expected to drag out course strength lifetime notwithstanding the early connection disappointment system which lessens the likelihood of reiteration of the course revelation process, bringing about the minimization of E2E delay.

Throughput

It is the number of bundles (bytes) that are gotten effectively in a unit period (parcel transmission period) called throughput, and it is addressed in kbps. The parcel transmission line is determined by deducting the beginning time frame from the stop time frame. The condition for the throughput is referenced in condition (22).

$$\text{Throughput (kbps)} = \frac{\text{Received packet}*8}{1024*(\text{Stop time}-\text{Start time})} \times 100 \quad (22)$$

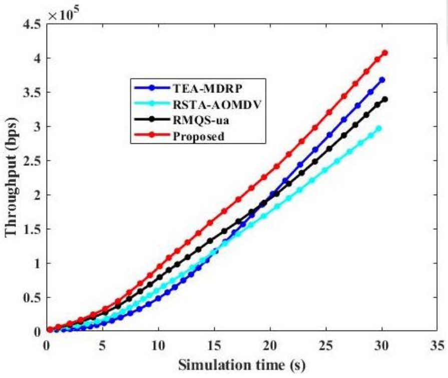

Figure 4. Simulation graph for throughput

The reenactment diagram for the suggested work is introduced in Figure 4. In this reenactment, the boundary of transmission time was analyzed while deciding the throughput. The assessment depends on the estimation of throughput with different existing plans like TEA-MDRP, RSTA-AOMDV, and RMQS-ua. The PRLFL-GACSO that has been proposed has a higher throughput of 4.125 bps. However, for TEA-MDRP, RMQS-ua, and RSTA-AOMDV, the other methods have a lower throughput of 3.7 bps, 3.4 bps, and 3 bps, respectively.

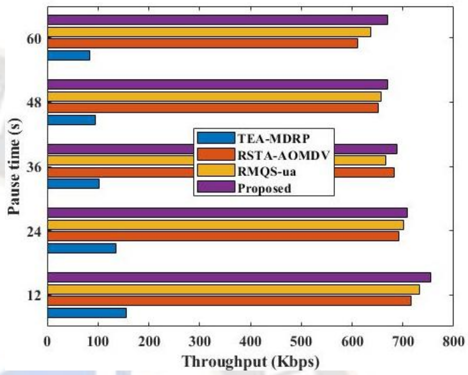

Figure 5. Simulation graph for throughput vs pause time

Figure 5 illustrates throughput against stop time. The throughput of PRLFL-GACSO, with a normal 700.2 Kbps, is higher than other TEA-MDRP, RSTA-AOMDV, and RMQS-ua strategies. The current TEA-MDRP, RSTA-AOMDV, and RMQS-ua strategies have a typical throughput upside of 114.2 Kbps, 674.2 Kbps, and 678.8 Kbps. This is because the steering of CSO-DSR depends on the greatest least sign strength measures which bring about dragging out course lifetime, besides the proposed connect disappointment system which predicts the connection disappointment in a prior time before dropping of information parcels. All of this is after a high throughput of the proposed PRLFL-GACSO.

Power Consumption

The power consumption of the network's nodes is the amount of energy needed to transmit data. In MANET particularly the issue will happen concerning the association support system and power utilization.

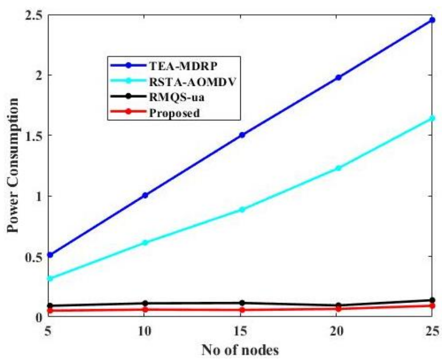

Figure 6. Performance graph for power consumption

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ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7648
***Article Received:** 04 June 2023 **Revised:** 26 July 2023 **Accepted:** 12 August 2023*

Figure 6 portrays the power utilization chart for the proposed work. The power consumed for sending the information from the source to the objective. It is seen that when the first information pieces are communicated with next to no pressure, it requires more power. By utilizing PRLFL-GACSO calculations, the power expected to send the information is less. The TEA-MDRP, RSTA-AOMDV, and RMQS-ua methods that are currently in use are contrasted with the proposed method. While contrast with this strategy, the proposed technique creates low power utilization than different strategies.

Hit Ratio

The hit ratio is the total amount of network link failures to the number of successful recoveries from those failures. Allow h to be the number of fruitful recuperation from interface disappointments and T to be the absolute number of connection disappointments. Then T is the same to h minus m, where m is the amount of failed attempts to recover events.

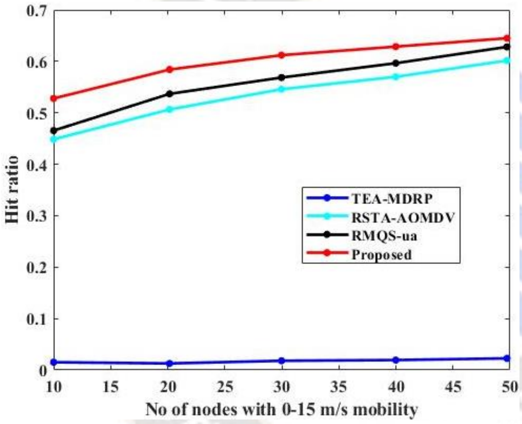

Figure 7. Performance graph for hit ratio

Figure 7 shows the hit proportions of connection recuperation in networks with changing number of portable hubs. From this figure, the hit proportions of the multitude of approaches increment as the quantity of hubs increments. This is because of the way that expansion in thickness expands the chance of getting substitute hubs for substitute ways. The proposed PRLFL-GACSO method gives exceptionally aggressive hit proportions with low directing above. Likewise see that although the hit proportions of PRLFL-GACSO are higher than TEA-MDRP, RSTA-AOMDV, and RMQS-ua, they utilize more control parcels.

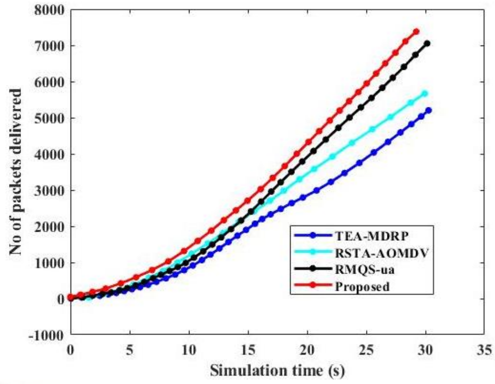

Figure 8. Performance graph for packet delivered

Figure 8 demonstrates the performance graph for the number of delivered packets. The suggested work is contrasted and the current TEA-MDRP, RSTA-AOMDV, and RMQS-ua strategies. While contrast with these current techniques, the proposed PRLFL-GACSO calculation produces a larger number of bundles conveyed. That is the proposed strategy is 0.5%, 3%, and 3.5% higher than the current RMQS-ua, RSTA-AOMDV, and TEA-MDRP techniques.

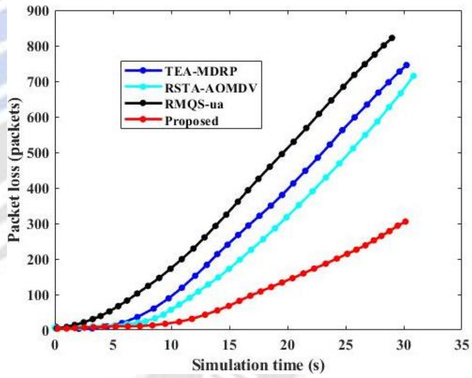

Figure 9. Performance graph for packet loss

The performance graph for packet loss is demonstrated in Figure 9. The connection disappointment expectation instrument (for course upkeep) plans to anticipate the ongoing connection status to keep away from disappointing conditions and decrease parcel misfortune by using portability and area data. The proposed PRLFL-GACSO strategy is intended for course support to stay away from interface breakages that can prompt high bundle misfortune. PRLFL-GACSO is assessed by speeding up the hubs, which prompts fast geography changes and a high chance of connection disappointment. In any case, the parcel loss of the proposed work creates extremely low qualities than the other TEA-MDRP, RSTA-AOMDV, and RMQS-ua.

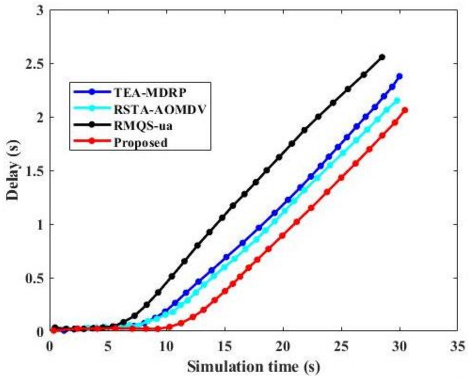

Figure 10. Simulation graph for delay

The simulation graph for the delay is presented in Figure 10. If node simulation time increases, the delay also increases in the PRLFL-GACSO method when compare with TEA-MDRP, RSTA-AOMDV, and RMQS-ua methods. It means a delay between the source node and the destination node the less time taken in PRLFL-GACSO is better than TEA-MDRP, RSTA-AOMDV, and RMQS-ua methods.

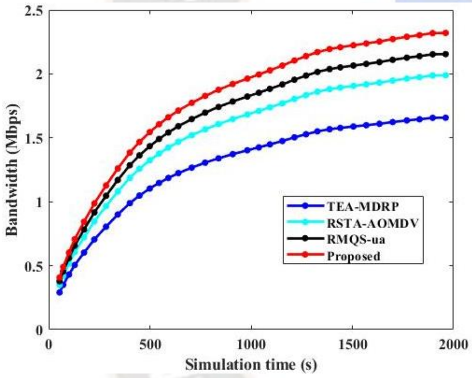

Figure 11. Bandwidth graph for proposed work

The data transmission of the proposed work is introduced in Figure 11. It is fundamentally the excess transmission capacity accessible to an organization application between two hubs in the organization at a given second. Notwithstanding, the transmission capability of the proposed work is higher than the other existing TEA-MDRP, RSTA-AOMDV, and RMQS-ua techniques. This means that PRLFL-GACSO has a bandwidth of 2.38 Mbps; however, the other methods produce lower values, which are respectively 2.15 Mbps, 2 Mbps, and 1.6 Mbps.

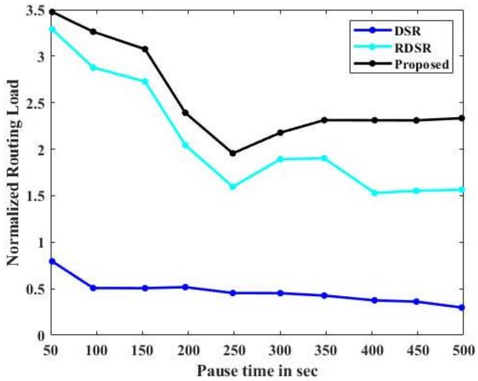

Figure 12. Normalized routing load graph

Figure 12 shows the standardized steering load (NRL) diagram of the proposed work. It should be noted that the NRL of the proposed CSO-DSR is higher than that of the other original DSR and RDSR. Though, NRL of changes in wide reach (from 3.5 to 2.4. while the NRL of DSR and RDSR fluctuates in slender reach (from 0.75 to 0.4), and (from 3.35 to 1.51). The proposed CSO-DSR has a high worth of NRL in light of the extra field, MSS, in both the RREP bundle and information parcel.

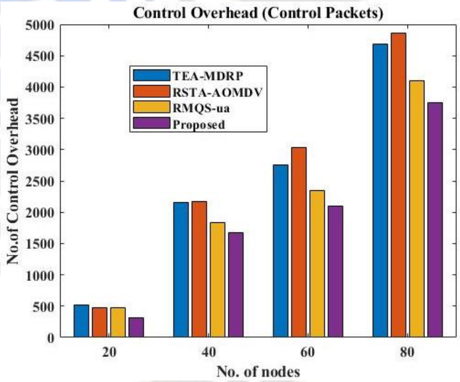

Figure 13. Performance graph for control overhead

Figure 13 shows the correlation of the control above proposed with TEA-MDRP, RSTA-AOMDV, and RMQS-ua. The control above of PRLFL-GACSO is significantly higher than that of TEA-MDRP, RSTA-AOMDV, and RMQS-ua on account of low hub development speed, since when the hub development speed is low, the likelihood of steering disturbance in the organization is more modest, while PRLFL-GACSO requires more message passing between hubs during the underlying course finding, which brings about more control messages in the organization. Be that as it may, as the hub development speed builds, TEA-MDRP, RSTA-AOMDV, and RMQS-ua have a greater likelihood of correspondence interface breakage than PRLFL-GACSO because the dependability of the connection between hubs isn't thought of. In TEA-MDRP, RSTA-AOMDV, and RMQS-ua, when the correspondence course breaks, the source hub typically needs to restart the

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course finding to re-structure a correspondence course, which causes more control in the organization.

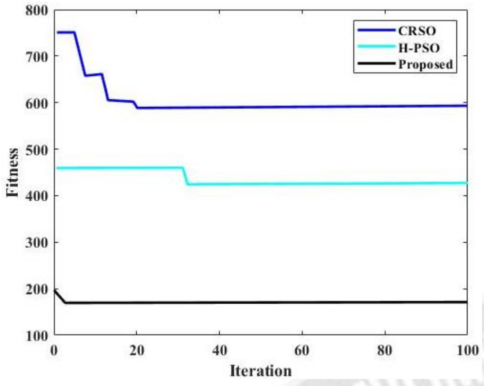

Figure14. Fitness graph for the proposed work

Figure 14 thinks about the wellness of the best molecule about every age of the three strategies. Since the wellness capability utilized by the proposed PRLFL-GACSO is simply connected with the right rate and the wellness capability, the immediate differentiation of wellness is of little importance. Nonetheless, it very well may be found that Tumultuous Rodent Multitude Streamlining agent (CRSO) [22] and Heuristic molecule swarm enhancement (H-PSO) calculation [26-28] is inclined to untimely issues on different informational indexes contrasted with PRLFL-GACSO [29]. Accordingly, the PRLFL-GACSO addresses the deformity so that the first calculation is not difficult to fall into the nearby intermingling arrangement [30].

VI. RESEARCH CONCLUSION

Portable Impromptu Organizations (MANETs) are turning into well-known systems administration choices in different situations [31]. The prevalence of MANET is principally because of its simple and fast arrangement which can be achieved in a hurry [32]. In this work, Proficient Hub Confinement and Disappointment Hub Recognition are introduced in MANET. Anticipating and Recuperating Connection Disappointment Confinement utilizing Hereditary with Serious Multitude Advancement (PRLFL-GACSO) Calculation is proposed for interface disappointment expectation and recuperation. Consequently, the Serious Multitude Advancement further develops the DSR steering execution. As needs be, the reenactment of the proposed convention in NS3 shows that, with the expansion in hub versatility, the proposed work shows a lower direction above and a lower delay when contrasted with the first convention. It considered different perspectives like bundle conveyance proportion versus information rate, examination of start-to-end delay for contrasting traffic burdens, and correlation of throughput of varying information rates in the proposed conspire through existing plans.

- Actions are taken to select the way with the best link quality and to guarantee the reliable transmission of data. This can be used to expand a measurement for way choice as far as connection quality that can further develop the organization's execution to be uncovered by the reenactment results.

- The exhibition measurements are PDR, start-to-end delay, throughput, and so forth., what's more, the proposed strategy is contrasted and the TEA-MDRP, RSTA-AOMDV, and RMQS-ua techniques.

- The PDR and start-to-finish delay is 4% and 5.5% higher than the other existing techniques. Likewise, the proposed technique further develops the conveyance proportion and decreased delay.

The results of multiplication showed that the proposed PRLFL-GACSO has a more common display than DSR as indicated by the viewpoint of bundle movement extent. Not long from now, analysts will want to make cross-breed multipath directing conventions that, as well as offer adaptation to internal failure in case of hub, connection, or course disappointment, balance load in case of high volume traffic, and at last improve multipath steering conventions with regards to nature of administration.

Abbreviation

MANET	Mobile ad-hoc network
PRLFL-GACSO	Predicting and Recovering Link Failure Localization using Genetic Algorithm with Competitive Swarm Optimization
CSO	Competitive Swarm optimization
Ns	Network Simulator
PDR	packet delivery ratio
TEA-MDRP	Trust-Based Energy Aware Multipath Disjoint Routing Protocol
RSTA-AOMDV	reliable and stable topological change adaptive ad-hoc on-demand multipath distance vector
RMQS-UA	Reliable Multipath Routing Protocol Based on Link Quality and Stability in Urban Areas
QoS	Quality of Service
CDA AODV	Cosmic Dust Avoidance–Ad-Hoc On-Demand Distance Vector
DHT	Distributed Hash Table
FTDN	Fault-Tolerant DHT- Networks-based routing protocol
EER	Energy Efficient Routing
FP	Failure Probability

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ATV	Accumulated Trust Value
SNR	signal-to-noise ratio
PRR	packet reception ratio
EMA	exponential moving average
DSR	Dynamic Source Routing
TOA	Time of Arrival
MLT	Multilateration
ED	Euclidean Distance
GA	Genetic Algorithm
ID	identification number
MP	mutation probability
ET	total energy
EN	energy consumed
RREQ	Route Request Packet
RREP	Route Reply Packet
RERR	Route Error Packet
LP	linear programming
PSO	particle swarm optimization
TCL	Tool Command Language
PDF	Packet Delivery Fractions
NRL	Normalized Routing Load
E2E	End-to-End Delay
RDSR	Reliable Dynamic Source Routing
CRSO	Chaotic Rat Swarm Optimizer
H-PSO	Heuristic particle swarm optimization

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International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7648
***Article Received:** 04 June 2023 **Revised:** 26 July 2023 **Accepted:** 12 August 2023*

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