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An Innovative Prediction of Link Failure and Node Lifetime in Mobile Ad Hoc Networks Using Grey Wolf Optimization

Anil Kumar Bandani[1,2]*, Makam Venkata Subramanyam[3], Kodati Satya Prasad[4]

[1] Research Scholar, Department of ECE, JNTU Kakinada, Andhra Pradesh, India

[2] Department of ECE, B V Raju Institute of Technology, Narsapur, Medak District, Telangana, India

[3] Principal and Professor, Department of ECE, Shanthiram Engg. College, Nandyala, Andhra Pradesh, India

[4] Former Principal and Professor, Department of ECE, JNTU Kakinada, Andhra Pradesh, India

Abstract: The Path Restoration System in Mobile Ad hoc Network (MANET) was tough due to the changing environment. Data packets are lost if a link is broken while delivering information, and the system is vulnerable to various assaults. Considering this, we propose the Grey Wolf Optimization technique (GWO) to predict connection failure, link and node lifetime before broadcasting packets to avoid packet loss. To define the path, we used the Route Information Protocol (RIP). Following that, GWO is manually played; with this method, this research forecasts the node and lifetime, and achieves a packet delivery ratio of 0.7. The proposed Gray-Wolf algorithm achieves an efficient packet transmission rate and improves the early detection of links and node lifetimes to maintain path stability for data transmission. The proposed model reduces end-to-end delay, overhead, and packet drop. It improves the residual energy of nodes and the packet delivery ratio. Grey Wolf Optimization is one of many examining boosting methods activated by the grouping within the wolf family and the special hunting techniques used by grey wolves. As a result, the Grey Wolf optimization method was used to find the optimal result by mocking the overall characteristics of the grey wolf colony.

Keywords: mobile ad hoc network, Grey Wolf Optimization technique, route information protocol, node, lifetime, link failure, packet delivery ratio.

使用灰狼优化的移动特别指定网络中链路故障和节点寿命的创新预测

摘要：由于环境的变化，移动自组网(马网)中的路径恢复系统非常困难。如果在传递信息时链路中断，数据包就会丢失，并且系统容易受到各种攻击。考虑到这一点，我们提出了灰狼优化技术（GWO）来在广播数据包之前预测连接故障、链路和节点寿命，以避免数据包丢失。为了定义路径，我们使用了路由信息协议(RIP)。之后，手动播放 GWO；通过这种方法，本研究预测了节点和生命周期，并实现了 0.7 的数据包传递率。所提出的灰狼算法实现了高效的数据包传输速率，并提高了链路和节点寿命的早期检测，以保持数据传输的路径稳定性。所提出的模型减少了端到端延迟、开销和丢包。它提高了节点的剩余能量和数据包的传递率。灰狼优化是由狼家族内的分组和灰狼使用的特殊狩猎技术激活的众多检查增强方法之一。因此，采用灰狼优化方法，通过模拟灰狼群体的整体特征来寻找最优结果。

关键词：移动自组织网络、灰狼优化技术、路由信息协议、节点、生命周期、链路故障，包投递率。

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About the authors: Anil Kumar Bandani, Research Scholar, Department of ECE, JNTU Kakinada, India; Department of ECE, B V Raju Institute of Technology, Narsapur, India; Makam Venkata Subramanyam, Principal and Professor, Department of ECE, Shanthiram Engg. College, Nandyala, India; Kodati Satya Prasad, Former Principal and Professor, Department of ECE, JNTU Kakinada, India

Corresponding author Anil Kumar Bandani, anilkumar.bandani@bvrit.ac.in

1. Introduction

Dynamic Wireless Ad Hoc Network is a multi-bouncing wireless network made up of dynamic mobile nodes that proceed in different directions. A MANET, also known as a wireless mobile ad hoc network or an ad hoc wireless network, is a mobile network that is constantly auto-configuring and has no fixed infrastructure. Every mobile device in a wireless Ad Network is free to move in any direction, as shown in fig.1 and it can change its links to other devices at any time. Each should be a router, forwarding traffic unrelated to its use. The first step in creating a Mobile Ad Network is to rally every mobile device to labor indefinitely because such networks may run on their own or be joined to a bigger network in some cases. Between mobile nodes, the network will have one or more completely separate transceivers. As a result, the topology becomes extraordinarily dynamic and independent. The network is decentralized, and the mobile dynamic nodes in wireless Ad hoc Network are considered mobile in figure.1 and there is no firm infrastructure that allows for multiple applications in various places. The Mobile Ad hoc Network has a significant advantage over centralized networks. The likelihood of a breakdown in a Dynamic Wireless Ad Hoc Network is significantly reduced network performance may vary due to varying architecture Establishing stable pathways between connection peers necessitates the use of stable links. Rerouting is very expensive in these networks without infrastructure since it frequently causes the mobile network to be flooded. Simulation tools such as OPNET, Network Simulator, NS2, OMNET++, and NS3 are used to analyze Dynamic Wireless Ad Hoc Network.

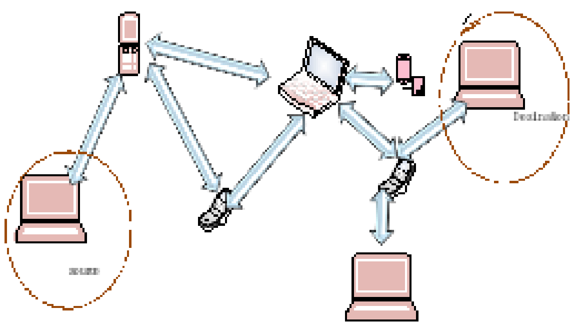

Fig. 1 MANET ((Wireless) mobile ad hoc network)

The use of Dynamic Wireless Ad Hoc Network in data mining tactics has grown, with sensor data being collected for a variety of applications such as tracking air pollution, among others. A multi-tier network architecture for 5G Green focused on energy efficiency was also recommended [1]. Wireless Networks were expected to provide comprehensive references to key wireless network concepts, including historical research results, current areas of interest, and growing directions in the future of wireless networks [2]. An ad hoc mobile network is one that does not have a fixed central hub and has no specified wireless link architecture [3]. It provides creation of a knowledge system that includes a clear picture of the mobile learning technology environment in the field, and the benefits, drawbacks, and applications of mobile learning [4]. An efficient and innovative hello-based path recovery (HBPR) routing protocol is used to calculate the shortest path. If a network layer link fails during transmission, the HBPR scheme generates an alternate path, reducing delay time and energy consumption [5]. Several previous research papers proposed various Trusted Routing Protocols and Trusted Management Algorithms. However, the efficiency of existing approaches was insufficient to meet market demands [6]. The clustering and secure cluster head selection were done to minimize the node energy consumption [7]. Link failure in MANETS was introduced, and efficient route discovery using the Grey Wolf optimization algorithm quoted in [8]-[11] introduced a Gray-Wolf Optimization-based reliable non-line-of-sight node positioning scheme for VANETs. Energy-efficient routing using a multi-objective grey wolf optimizer, and a secure communication architecture were developed in [12]-[13]. Detection of selfish nodes and reducing energy consumption in MANETs using genetic algorithms were introduced in [14]-[15]. A novel architecture for integrating intrusion response functionality for MANETs was introduced in [16], and a cross-layer scheme for QoS routings was described in [17]-[18]. A novel architecture for neighbor discovery and a clustering algorithm for cognitive radio networks was developed in [19] and [20].

2. Research Background

The difficulty of constructing a multipath routing system in a Dynamic Wireless Ad Hoc Network is the optimal path description. By enhancing the connectivity of the mobile network organization, an effective technique for improving the efficiency of the Dynamic Wireless Ad Hoc Network is required. For further advancement, the technique particle swarm optimization-based bandwidth and connection standard will be used in the multipath routing technique proposed. Taking this strategy into consideration, a new type of QoS scheme for efficient routing and better quality has been introduced known as the Advanced Optimized Link State Routing Protocol (A-OLSR) [21]-[22]. The (PDR) data transfer rate is improved, and the end-to-end delay in the mobile network is reduced. MANET stands for mobile node-to-node communication without the use of fixed infrastructure. An efficient energy optimization technique was introduced using the AODV protocol with a routing strategy where packet transmission was achieved [23]. With each node in the temporal condition of the network, the mobility and position of its neighbors ware analyzed. The EBAD explore-based active detection scheme with Dynamic source routing was developed to identify routing misbehaviors [24]. This proposed method reduces the end-to-end time between two nodes, increasing throughput. The current proposed technique has the drawback of requiring historical data values, which may not be available at the start of the simulation process. While the application requires speedy network configuration and the infrastructure for communication is tough to set up, the MANET is appropriate. Based on this approach, a method was developed to avoid link failures and node failures [25]. A novel algorithm was developed to reduce control overhead and increase packet delivery rate [26]. Whereas tree-based reliable routing outperforms ODMRP in terms of performance and efficiency was suggested for a stable and reliable connection [28]. The link failure detection method that summarizes the link breakage issues was surveyed in [29].

The major contributions of this research are summarized as follows:

- Defining the Route Information Protocol first (RIP);
- Determining the starting and ultimate destination nodes in the Network Simulator;
- Analyzing the node through GWO;
- Determining the node lifetime;
- Predicting the link failure in the hunting step.

3. System Module

The links or communication channels between a destination and source pair in a MANET (Dynamic Wireless Ad Hoc Network) are constantly unavailable due to route failure, which can occur anywhere along the communication medium or link. The breakdown of a route can occur for a variety of reasons, including node mobility, fading in the communication medium, power consumption, and mistakes in the noisy wireless medium (Fig. 2). A highly dynamic routing protocol is developed to overcome the issue of link failure. In a MANET communication channel, there are often two types of connection failures. The first is node failure, whereas the second is link failure. The route failure is greater than the node failure because the node failure is caused by a large number of link failures since the link will fail on a faulted node. Based on the behavior of a number of broken links, link failures are divided into two categories:

1. Failure of a single link;
2. Failure of multiple links.

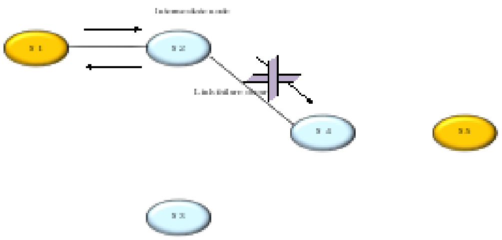

Fig. 2 System module

These route breakdowns can be further separated into a variety of route failure types, each of which is determined by the time it takes to recover from a mobile node failure.

They really are:

✓ Failure of a permanent link;
✓ Failure of a transient link (temporary);
✓ Route failure regularly (irregular).

Permanent failure is defined as a link failure that cannot be automatically repaired within a certain time span. Permanent breakdown happens as a result of battery exhaustion; damage appears in the mobile node as a result of a physical outbreak; or the mobile node is damaged by a long-term malicious attack, rendering the route non-operational. The failure is temporary and occurs just for a short period of time. Permanent failures in MANETs are transient and intermittent. The approach is used to accommodate connection failures while maintaining a reliable and efficient routing system. It is a critical component of research into wireless ad hoc routing protocols. Path or mobile node failures make pathways unpredictable because they impact the connection, or because the mobile node is unable to complete its duty of forwarding incoming packets, as is typically done in wireless mobile ad hoc routing protocol research. This form of failure causes data fall and improves the network's end to end delay. In MANETs, Fig. 2 depicts an example of route failure.

3.1. Link or Route Lifetime

The time taken by a link available for a specific period is indicated as availability of link or route lifespan. The distance between two nodes is determined by estimating the link lifetime at a specific point in time.

Let M_p be the link, K_p be the contact, MA_{kp} be the contact life time, J_{d-1}, J_d be the adjacent nodes, Z_{Jd} , $Z_{J_{d-1}}$ be the energy life time of mobile node J_d at a given time. The link lifetime is estimated using the following Eqn. (1)

$$MA_{M_p} = \min(MA_{k_p}, Z_{J_{d-1}}, Z_{J_d}) \quad (1)$$

3.2. Node Lifetime

The amount of energy available in the mobile nodes determines the routing of mobile node lifetime. Because of dual varieties of mobile nodes: active and dormant nodes (stations). The active node consumes some energy, but the idle node consumes none. As a result, as compared to dormant nodes, the active node has a shorter lifetime. Let C_F be the residual energy of node J_d , C_G be the extent of energy depleted at the node J_d and A_y be the duration in sec. The mobile node lifetime is calculated by Eqn. (2)

$$MA_{J_d} = C_F^{hA_y} \big/ C_G^h, t \in [hA_{y,}(h+1)A_y] \qquad (2)$$

3.3. Link Failure

MANET mobile nodes are self-repairing and self-guiding to each other, allowing them to move about freely and on a regular basis.

As a result, the topology of MANETs changes on a frequent basis, resulting in Node-to-node link failure. The poor signal strength of the received signal will cause the link to fail. The term "link breakdown" refers to node-to-node route failure, which affects network throughput.

4. Proposed Methodology

Dynamic Wireless Ad Hoc Networks (MANETs) are a new type of mobile networking in which stations collaborate on a one-to-one basis. Dynamic Wireless Ad Hoc Networks (MANETs) are autonomous and own-curing associate-level media between nodes that do not rely on centralized resources or established infrastructure. Given this, one of the difficult jobs is forecasting node failure before the message is sent. The performance of grey wolves may be broken down into three steps: hunting, searching for prey, and encircling the prey. They are very good at leadership behavior. Using this GWO, we were able to forecast the path and node life in Fig. 3. We can examine all nodes in the searching behavior, as well as determine the mobile node and route lifetimes using encircling prey behavior and anticipate link failure using the hunting step. The application-oriented GWO method elaborates on all of these steps. The major contributions of the research are summarized as follows:

- Define the Route Information Protocol (RIP) first;
- Then determine the starting and ending nodes in Network Simulator by evaluating the node with GWO;
- Identify the node lifespan and predict link failure in the hunting step.

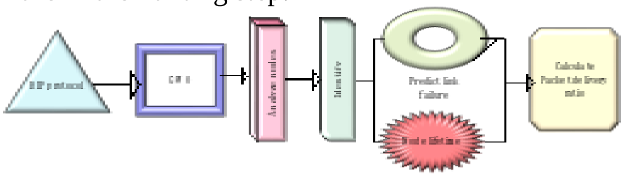

Fig. 3 Proposed technique

4.1. RIP Protocol

Routing Information Protocol (RIP) denotes the first distance vector routing protocols and is used for takeover measurable components such as bounce count. This protocol implements the number of hops used to avoid the routing loop from the transmission path. The hops count allowed in the communication line of the Routing Information Protocol allows AODV for fewer than or equal to 15, which keeps network sizes small. The route poisoning, divide boundary, and grip sliding techniques are used to avoid the spread of false information. RIP routers send them back to the network routing database every 30 seconds because the network routing table was previously relatively small nodes.

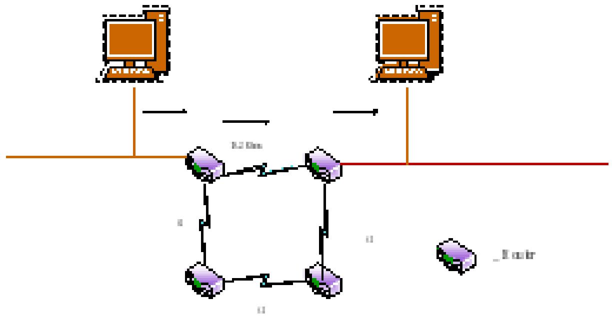

Fig. 4 RIP protocol

However, in the current condition, the routing table size is so large that even if continuous initialization is performed, there is a chance that traffic will appear sporadically every 30 seconds. Because it does not require any sophisticated settings, the RIP protocol is incredibly simple to use. The RIP protocol uses UDP (User Datagram Protocol, as indicated in fig.4) for transportation and delivers the reserved port number. We use the AODV routing protocol merely for the connection information or to create a path to analyze the route information.

4.2. Grey Wolf Optimization

The Canidae family includes grey wolves. It is a predictor because it was formerly thought to be the most natural way of existence. Grey wolves are typically found in groups of 5–12 individuals, with a rigid social hierarchy in place. Male and female pioneers are regarded as alphas. The alpha decides on a chasing strategy, a resting spot, a wake-up time, and so on. Alpha's choices must be followed by the pack. Occasionally, the alphas will also pursue other wolves in the pack. The alpha keeps their tails around them opening group's social occasion. Because of the alpha's appeal charge to be trailed by the bundle, the alpha devour is referred as overwhelming devour. In a pack, only the mate bound by the leader wolves is allowed. The grey wolves are known as beta and are ranked second in the significance chain. The betas are alternate ordinate devours who support the alpha with basic leadership and other bundle actions. A beta devour can either be a female nor a male, with purpose of being the best in the alpha, regardless of whether the alpha devours migrate abroad or become excessively aged. Because the beta devour holds the alpha in high regard, other lower-level wolves are likewise informed. It acts as an advisor to the alpha who coordinates the operations of the association. The beta establishes a connection with the alpha's overall pack directions and provides guidance to the alpha. Omega is the dark wolf with the smallest location. The omega serves as a stand-in for the essential fatty acids. Omega wolves must surrender to their respective pack wolves. They will be the final wolves to be allowed to eat. Omega may appear to be a non-essential member of the pack; however, it has been observed that if the omega is lost, the entire pack would engage in internal battling and difficulties. It occurs as a result of the omega's venting of all wolves' rage and unhappiness (s). This distributes the entire pack and maintains the dominance structure. In a similar vein, if the omegas are thought of as the pack's sitters. Although the wolf does not have an alpha, beta, or omega, the male or female alpha is known to be the subordinate (or delta in a few references).

Despite the fact that delta wolves govern the omega, they must still subject to the alphas and betas. Scouts, sentinels, seniors, seekers, and overseers make up this class. Scouts warn the group if they are in danger, and they are in charge of keeping an eye on the region's boundaries. Sentinels work for the insurance company and ensure the pack's safety. The alpha or beta wolves are considered senior citizens and are seasoned wolves. The alphas and betas benefit from the help of the seekers as they approach the prey, and they also provide nutrition for the pack. Finally, the guardians take care of the group's powerless, sick, and injured devours. Association shooting is the significant communal nature of grey devours when analyzing the communal pecking order of devours. The following are the key points of grey wolf shooting:

- Blocking, pursuing, and advancing the game;
- Following, confining, and annoying the victim before it finally succumbs;
- Executing predation on the prey.

The chasing method and social pecking order of black wolves are numerically displayed in this work for GWO planning and performance enhancement.

4.2.1. Function

Numerical models for the social chain of command, following, encircling, and assaulting prey have emerged from the beneath areas. At that moment, the GWO calculation is a plot.

4.2.2. Social Hierarchy

In the aforementioned numerical structure, the communal chain of importance of wolves, although planned with Grey Wolf Optimization, was considered the finest solution for the alpha (q). Most of the time, the second and third excellent arrangement are titled as beta (r) and delta (u) individually. Other hopeful arrangements are named omega (v). In the GWO calculation, the chasing (streamlining) is by q, r, and u. The v wolves are trailed by these three wolves.

4.2.3. Encircling Prey

Dark wolves encircle prey in the midst of the chase. The accompanying conditions are proposed using Eqns. 3 and 4 to quantitatively show encircling behavior (4).

$$\vec{O} = \left| \vec{F}.\vec{X}_2(t) - \vec{X}(t) \right| \quad (3)$$

$$\vec{X}(t+1) = \left| X_2(t) - \vec{H}\ .\vec{O} \right| \quad (4)$$

where t shows the ongoing repetition, $\vec{H}$, $\vec{F}$ are attendant directions, and $\vec{X}_z$ is considered the location direction of the game and $\vec{X}$ demonstrates the location direction of a grey devour. The vectors $\vec{H}$, $\vec{F}$ are measured by Eqn. 5 and 6.

$$\vec{H} = 2\text{w}.\vec{u}_1 - \vec{w} \quad (5)$$

$$\vec{F} = 2.\vec{u}_2 \quad (6)$$

where the elements of $\vec{w}$ are directly diminished against 2 to 0 by the span of emphases and $\vec{u}_1$, $\vec{u}_2$ are considered arbitrary directions in the range [0, 1].

4.2.4. Grey Wolf Shooting

The dark wolves can be used to locate the prey location and surround them. Then the chase is led by the alpha. Sporadically, the beta and delta may again be included in the pursuit. In the case of exploration space, there is no consideration for choosing the optimal area (prey). For the scientific recreation of the dark wolves chasing behavior, the alpha (best arrangement), beta, and delta acquire efficient awareness around the potential prey area, so that we get the first three best arrangements, and requires the other inquiry specialists (counting the outcomes) to overhaul their locations confer to the situation of the relevant pursuit operators. We can predict route failure in this searching step. The techniques that go along with them are described in depth.

$$\vec{O}_q = \left| \vec{F}_1.\vec{X}_q - \vec{X} \right| \quad (7)$$

$$\vec{O}_r = \left| \vec{F}_2.\vec{X}_r - \vec{X} \right| \quad (8)$$

$$\vec{O}_u = \left| \vec{F}_3.\vec{X}_u - \vec{X} \right| \quad (9)$$

$$\vec{X}_1 = \vec{X}_q - \vec{H}_1.(\vec{O}_q) \quad (10)$$

$$\vec{X}_2 = \vec{X}_r - \vec{H}_2.(\vec{O}_r) \quad (11)$$

$$\vec{X}_3 = \vec{X}_u - \vec{H}_3.(\vec{O}_u) \quad (12)$$

In a 2D look space, the pursue operator redesigns its situation according to alpha by Eqn. (7), beta by Eqn. (8), and delta by Eqn. (9) Witnessing this last position would be different from observing a location inside a round, whatever is indicated through the alpha, beta, and delta locations in the inquiry arena. The estimation in the situation of the prey is taken into account for the alpha by Eqn. (10), beta by Eqn. (11) and delta by Eqn. (12), with the goal that alternating wolves overhaul their places haphazardly encircling the prey utilizing Eqn. (13).

$$\vec{X}_{t+1} = \frac{\vec{X}_1 + \vec{X}_2 + \vec{X}_3}{3} \quad (13)$$

4.2.5. Encroaching Game (Exploitation)

In the act of the said before, the grey devours close the chase through harming the game and make them stop by stationary. For this numerical model nearing the prey decrease the estimation of $\vec{H}$, with that the vacillation scope of $\vec{H}$ is likewise lessened by $\vec{d}$. Therefore, by changing the qualities of $\vec{H}$ haphazardly in the interim where is a decrease from 2 to 0 over different areas, while changing $[-2d, 2d]$ the arbitrary estimations in the situation of an inquiry operator, that can be in any situation $\vec{I}^*$ between $[1,1]$ its unique position and the situation of the prey. From this the $|H| < 1$ makes a move for the wolves to assault towards the prey. The GWO calculation will seek experts to redesign its location established on the area of the alpha, beta, and delta; thus, it will disturb the game; yet, the grey wolf optimization calculation is slanted to status in neighborhood answers for their administrators by offering the administrators. It is recognized that the entire component proposed provides some level of investigation; nonetheless, GWO must require administrators to emphasize investigation.

4.2.6. Fetch for Game (Exploration)

Grey devours progressions with the situation of the alpha, beta, and delta. They move between one other looking for game and merge to abuse game. As long as the experimental model uniqueness, we give $\vec{H}$ with irregular qualities higher than 1 or not exactly - 1 in pursuit operator to moves from the prey. This accentuates gives the GWO calculation to seek all-inclusive, given $|\vec{H}| > 1$ powers the grey devours to wander from the game to locate a constructor game, other part of Grey Wolf Optimization that supports investigation is considered as $\vec{R}$, the vector comprising irregular qualities in the segment gives fluctuating loads for game to speculatively underline $(\vec{F} > 1)$ or declines $(\vec{F} < 1)$ the impact of game in characterizing the separation. This helps grey wolf optimization for demonstrating some changing conduct all through enhancement, favoring investigation and neighborhood optima evasion. It is demonstrated that is not straightly diminished as opposed to $\vec{H}$. It requires $\vec{F}$ to give arbitrary qualities consistently with the end goal to stress investigation for preparing amid starting emphases and indefinite cycles, this segment additionally helps rather than nearby optima stagnation, particularly amid the last emphases. The $\vec{F}$ vector can be examined as the blow of impediments for grasping nearer to the prey in nature. The obstructions in nature show up amid the chasing ways of wolves and in present, it helps in forestall them rapidly and advantageously nearing prey. This is actually what occurs in the vector $\vec{F}$. As per the situation of a wolf, it can shift haphazardly which gives the prey a weight and make them hard and pushes to go after the wolves, or the alternate way around.

The hunt begins with a shifting population of dim wolves (hopeful arrangements) in the GWO calculation; the prey situation is assessed using the advancement of emphases, alpha, beta, and delta devours. Every application arrangement rethinks its prey separation. For the underscore inquiry and misuse, the parameter is reduced from 2 to 0.

Competitor arrangements incline to separate by the game $|\vec{H}| > 1$ during merges fronting the game during $|\vec{H}| < 1$ lastly, the Grey Wolf Optimization calculation is fulfilled towards the extremity measure. The Pirate-code of the grey wolf optimization calculation is spoken to perceive how GWO is hypothetically considered for taking care of enhancement issues and with that, a few might be noted.

According to the new theory, a social chain of importance aids GWO in preserving the best arrangements obtained before; the cycle's course.

A circle-molded neighborhood surrounding the arrangements is defined by the encompassing instrument, whichever can be expanded out to more advanced measures as a rapid-circle. The shifting measurable components $\vec{H}$, $\vec{F}$ help member answers to get rapid-circles among various, changed radii. This shooting approach provides members with answers for locating the prey's location.

Inquiry and abuse are certainty with the expected estimations of $\vec{d}$, $\vec{H}$. The accepted estimations of measurable components $\vec{d}^{\wedge}$, $\vec{H}$ enable GWO for moving change in both the investigation and misuse. For the decrease $\vec{H}$, half of the procedure is changed to investigation $(|\vec{H}| \geq 1)$ and the rest half is changed to abuse $(|\vec{H}| < 1)$. The GWO has two noteworthy parameters to be changed $\vec{d}$ and $\vec{F}$. It can incorporate mutation and imitate the overall life cycle of a grey wolf simulation, and other evolutionary operators. Below is the pseudo-code for application-oriented GWO.

4.2.7. Pseudo Code of Application-Based GWO Algorithm

- ✓ Initialize the grey wolf population (no. of nodes) $\vec{X}_p (p = 1,2,\ldots h)$

- ✓ Begin the $d, \vec{H}$ and $\vec{F}$
- ✓ Estimate the fitness of all nodes
- ✓ $\vec{X}_q$ = the best hunt operator (link lifetime)
- ✓ $\vec{X}_r$ the second-best hunt operator (node lifetime)
- ✓ $\vec{X}_u$ the third-best hunt operator (link failure prediction)
- ✓ while (t < total no. of nodes)
- ✓ for every fetch mediator
- ✓ Renew the location of the latest fetch mediator with equation $\vec{X}_{t+1}$

End

For

- ✓ Update $d, \vec{H}$ and $\vec{F}$
- ✓ Estimate the fitness (prediction of node, link lifetime and link failure)
- ✓ Update X_q, X_r, X_u

t = t + 1

- ✓ end while
- ✓ return $\vec{X}_q$

It can incorporate mutation and imitate the overall life cycle of a grey wolf simulation, as well as other evolutionary operators.

5. Results and Discussion

Our contemplated work is completed on the Ubuntu environment using (NS 2) Network Simulator, which runs on NS 2.1.jar and nam. In our research on dynamic wireless ad hoc networks, data delivery is an essential issue and a difficult effort. To make the route, we define the route information protocol called AODV. Before sending the packet, we must anticipate the node and connection lifetimes. In this case, the Grey Wolf Mechanism is critical for prediction analysis; we can predict node lifespan, link lifetime, and link failure using it, as demonstrated in Fig. 5, packet delivery using RIP GWO in Fig.6, and speed versus delay ratio in Fig.7.

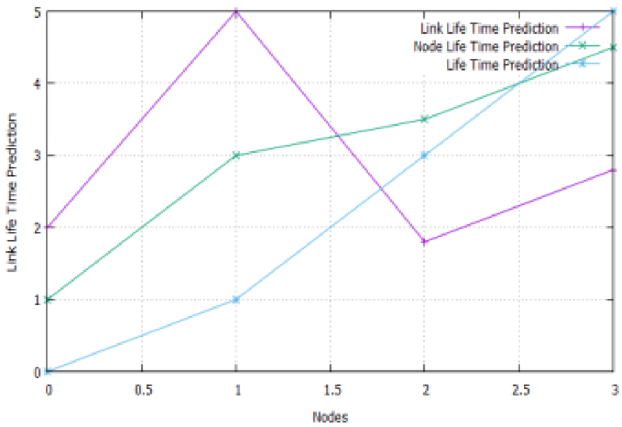

Fig. 5 Lifetime prediction

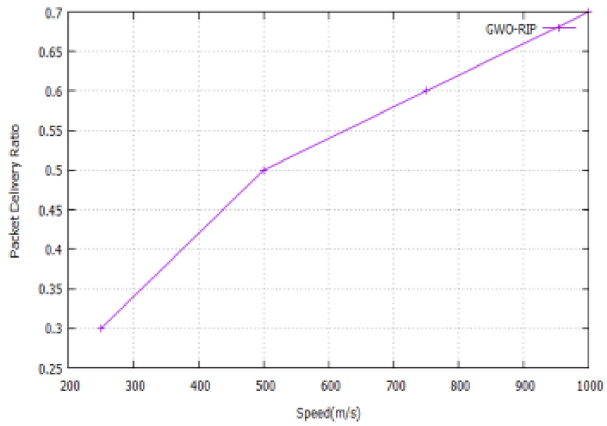

Fig. 6 Packet delivery ratio

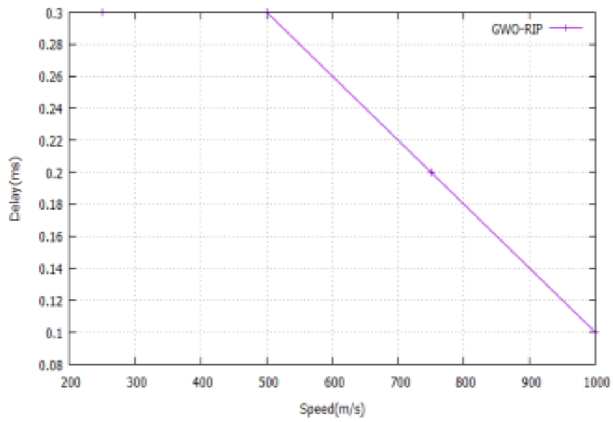

Fig. 7 Speed vs. delay

5.1. Performance Comparison between Packet Delivery Ratio, Speed and Energy Consumption

We can explain some comparative results from other MANET research, such as PSO for mobile node, route lifetime, and ENDR protocol, in order to contrast the achievement of the current proposed technology with other approaches.

The comparison of packet size vs. delivery ratio is shown in Fig. 8, speed vs. delay is shown in Fig. 9, packet size vs. packet drops is shown in Fig. 10, packet size vs. residual energy is shown in Fig. 11, speed vs. delivery ratio is shown in Fig. 12, packet size vs. overhead is shown in Fig. 13, speed vs. residual power is shown in Fig. 14, speed vs. packet drop is shown in Fig. 15. When all of these factors are considered, our method outperforms the others.

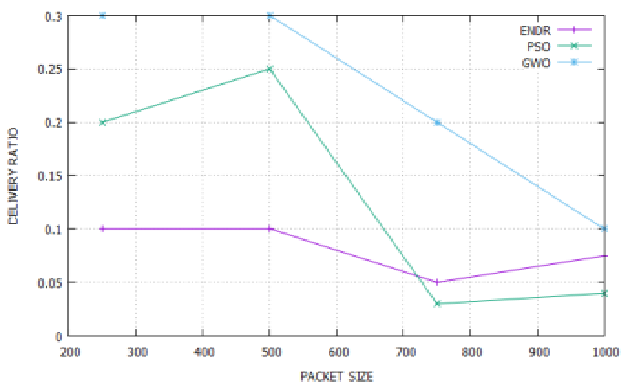

Fig. 8 Data packet size vs. packet delivery ratio by various methods

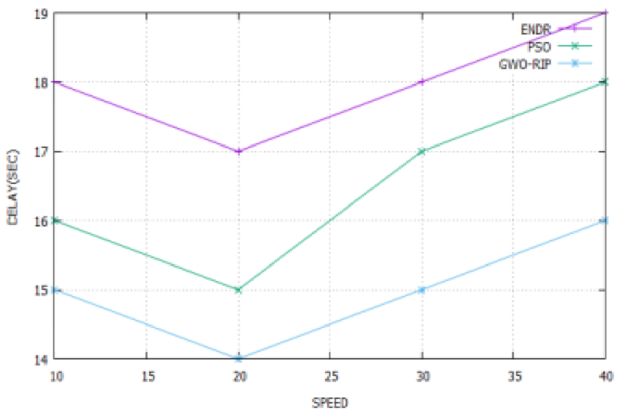

Fig. 9 Speed vs. delay by various methods

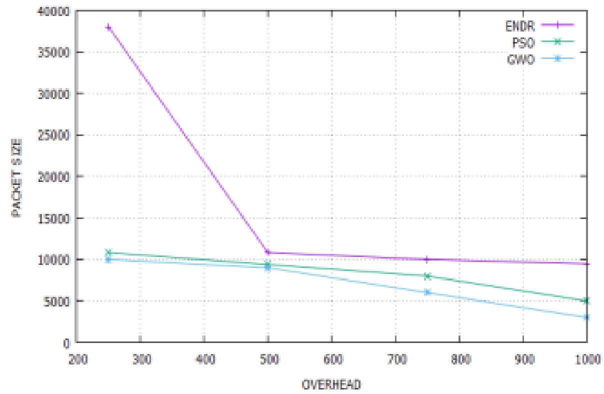

Fig. 13 Data packet size vs. overhead

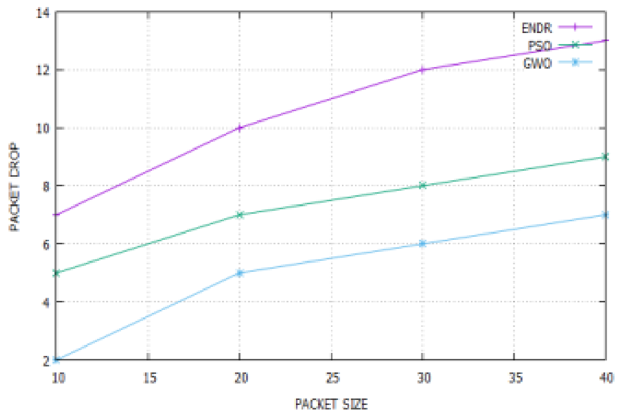

Fig. 10 Data packet size vs. packet drop

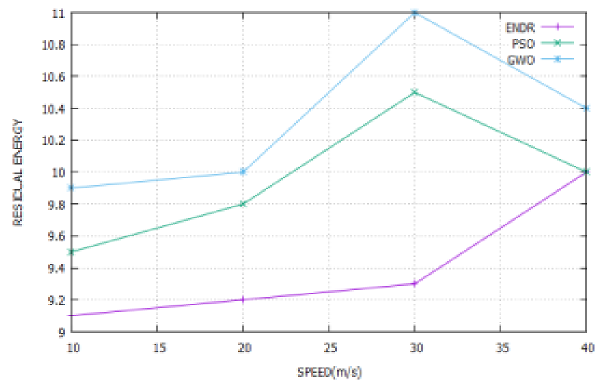

Fig. 14 Speed vs. remaining energy

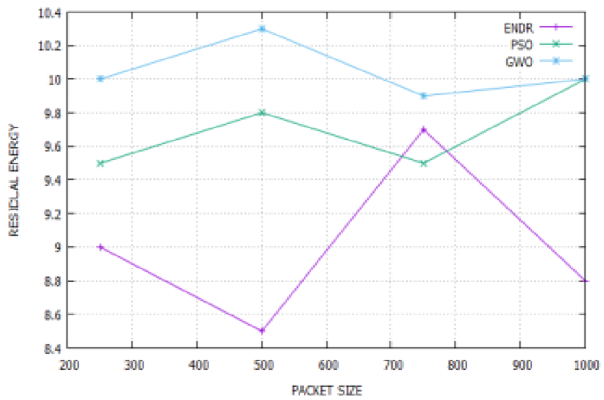

Fig. 11 Data packet size vs. residual energy

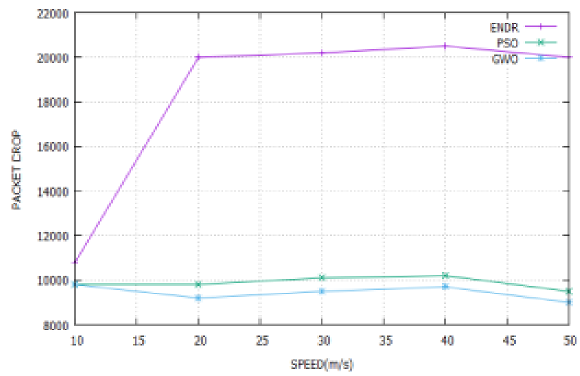

Fig. 15 Speed vs. data packet drop

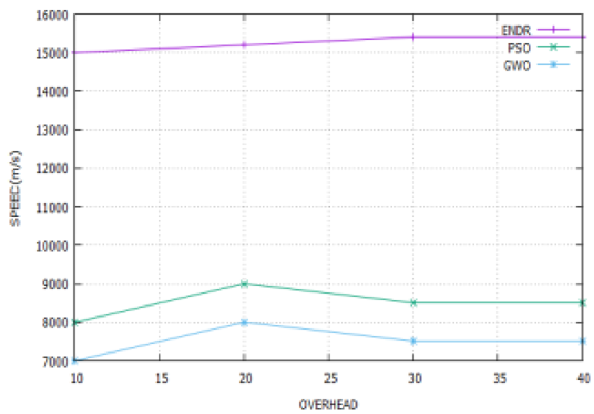

Fig. 16 Speed vs. overhead

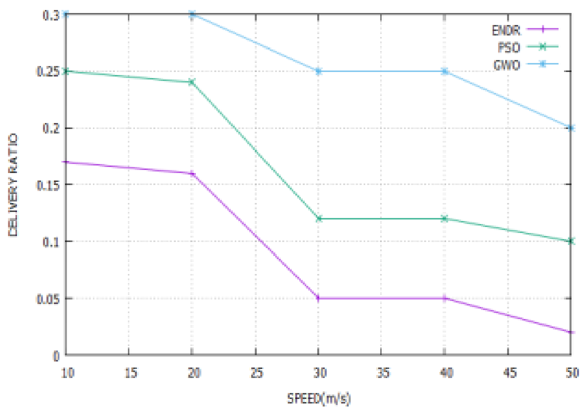

Fig. 12 Speed vs. packet delivery ratio

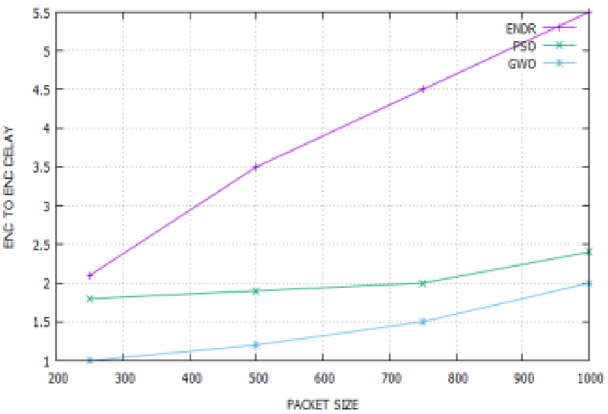

Fig. 17 Packet size vs. end-to-end delay

6. Conclusion

The Grey Wolf was the subject of our investigation. We offer an optimization-based lifetime prediction mechanism that yields better results than our current work in mobile ad hoc networks. If a path or link is broken, the mobile node is likely to fail. To address this issue, we will anticipate node lifetime, link lifetime, and link failure before the transmission process begins. GWO will update the node status Information prior to transmission, reducing the likelihood of packet loss. In comparison to existing Methodologies, our proposed strategy utilized less energy and had a higher end-to-end latency. Three Important methods of hunting, searching for prey, attacking prey and encircling prey are developed to execute optimization. This Technique is used to develop a routing approach that solves the challenges like route establishment and link recovery. The selection of the optimal route is done by adapting grey wolf optimizer. Node localization issue is also solved with the proposed algorithm. The proposed study has a low corrective efficiency, a poor local exploration capability, and a low concurrency percentage.

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