International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

Chief Editor
Dr. J.B. Helonde

Executive Editor
Mr. Somil Mayur Shah

RESEARCHERID
THOMSON REUTERS

[Kumari *et al.*, 9(10): October, 2020]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

AN OPTIMIZED ANN BASED IMPROVED ENERGY EFFICIENT ZONE BASED ROUTING PROTOCOL IN MANET

Banita Kumari[*1], Samriti Thakur[2] & Avni Sharma[3]
[*1,2&3]HPTU, Himachal Pradesh

DOI: https://doi.org/10.29121/ijesrt.v9.i10.2020.10

ABSTRACT

Currently, Mobile Ad-hoc networks (MANET) are consider as an important portion of the wireless networks and for the communication in MANET, routing mechanism is also play a vital role. MANET routing protocol generates a different performance when it is implemented in a different network scenario. It is a challenge to find the suitable characteristic of MANET routing protocol which conforms to a certain network condition scenario. In the last ten years, many research have been done by the research to analyze the performance of MANET routing protocol but still lots of problems are faces. However, those research are related to the scope of routing protocol based MANET scenario. Basically, there two types of routing mechanism that is known as the Proactive and the Reactive routing protocol. Alternatively, there is a routing protocol which is a combination of both proactive as well as reactive, namely the Hybrid routing protocol. Hybrid routing protocols especially capable to solve the MANET energy consumption by constructing a zone routing protocol (ZRP) and it is superior to over proactive and reactive routing protocols. So, in this research, we proposed an optimized Artificial Neural Network (ANN) based Improved Energy Efficient ZRP (IEE-ZRP) mechanism for MANET with the help of the Grasshopper Optimization Algorithm (GOA). The total MANET simulation area is divided into different zones or clusters or regions to create a secure and energy efficient routing mechanism. The IEE-ZRP mechanism perform better as compare to others routing protocols that clearly mentioned in the results analysis section based on the Quality of Service (QoS) parameters such as Throughput, Packet Delivery Ratio (PDR), Packet Drop Ratio, Delay, Energy Consumption and Control Overhead.

KEYWORDS: MANET, Routing Protocol, ZRP, IEE-ZRP, GOA, ANN, QoS.

1. INTRODUCTION

Recently, communication through wireless medium or network using the sensor devices has high popularity and became one of the most predominant area of research. This type of network is generally known as Wireless Sensor Network (WSN) [1] and it can be able to perform a wireless communication at any time anywhere on the earth and also useful in lots of real-time applications. In these types of networks, basically a tiny sensor node is sued to sensed and transmit the data and it is operated on the battery. So, we can say that, these types of networks has limited energy resources, and need to maintain sensor nodes energy level during the transmission [2]. In the WSN, there are two types of communication possible with the help of wireless sensor nodes and it may be infrastructure-based or infrastructure less WSN. Also the sensor nodes may be two types, fixed or movable in the network. If nodes are fixed, then the management of energy might be possible because energy consumption in the network is depend upon the routing mechanism of the network. If sensor node is movable in the network, then it is known as the Mobile Ad Hoc Networks (MANET) and it is a set of mobile sensor nodes which move dynamically within the network region without using fixed network infrastructure [3]. In the network, wireless sensor nodes can exchange the sensed information without the help of any pre-existing fixed infrastructure network and it can change their position freely within the network at any time. These mobile sensor nodes have the restricted energy limited operation, dynamic topology and variable infrastructure. So, to design an energy efficient MANET environment, we need to construct a route for the data transmission because routing protocol performs an important function in MANETs [4].

Routing mechanism is used to find out the better routes via intermediate sensor nodes in the network and forwarding the data packets containing information which choose the route between any two sensor nodes in the network. A good routing protocol in MANET must be able to keep its energy usage as low as possible during

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

route discovery mechanism and also make secure data transmission [5]. It must be done to prevent its sensor node from getting down which can create disrupted data communication in the MANET. Hence, how to create a decent routing scenario which can regulate sensor node with the minimal energy consumption in the network becomes very important. MANET has different number of routing protocols and it can be categorized into three types: Proactive routing protocol, Reactive routing protocol and Hybrid routing protocol [6]. The types of MANET routing protocol is shown in Fig. 1.

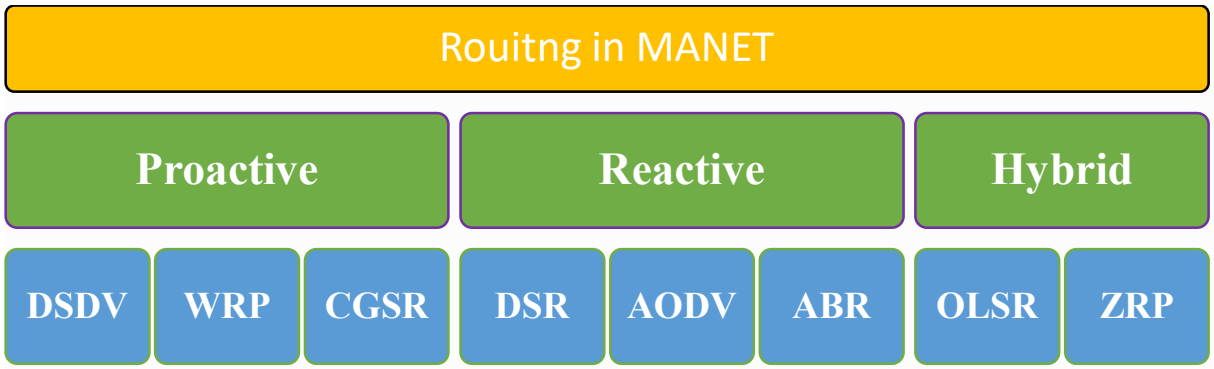

Fig 1: MANET Routing Protocols

Proactive Routing Protocols: In this routing, each hub requires to maintain individual or extra tables for accumulating directing data, and some adjustments in system topology has to be reflect by distributing the upgrades, all via system to keep up a stable system vision [7]. Types of proactive routing protocols are:

- ♦ Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)
- ♦ Wireless Routing Protocol (WRP)
- ♦ Cluster Gateway Switch Routing Protocol (CGSR)

Reactive Routing Protocols: They are also called on-demand protocols because they cannot track data or command center behavior unless there is a correspondence. If one hub needs to export one hub to another hub, then the contract scans the forward in the interest and builds the association to transmit and retrieve the data packet [8]. Types of reactive routing protocols are:

- ♦ Dynamic Source Routing (DSR)
- ♦ Ad Hoc On-Demand Distance Vector Routing (AODV)
- ♦ Associatively-Based Routing (ABR)

Hybrid Routing Protocols: This type of routing protocols present half breed model that consolidates receptive and pro-active directing protocols. The hybrid routing mechanism combines concept of both types of routing behavior reactive and proactive [9]. This protocol utilizes the advantages of both protocols and construct better routing mechanism for the MANET. Firstly, it can use proactive concept and if they faced problem then utilize the concept of reactive protocol. Types of hybrid routing protocols are:

- ♦ Optimized Link State Routing Protocol (OLSR)
- ♦ Zone-based Routing Protocol (ZRP)

In this research, we focus to design a hybrid ZRP mechanism that is known as an improved energy efficient ZRP (IEE-ZRP) mechanism for MANET using optimized Artificial Neural Network (ANN) as a classifier to detect the fail sensor nodes during the communication because the MANET has limitations in terms of transmission capacity, as well as energy capacity [11]. ZRP is based on the concept of zones, as its name suggests. For each node, a separate routing zone is defined, and zones of adjacent nodes are overlapping. In the routing zone, the radius of a small character is counted [12]. The zone thus encompasses nodes that have the most distance from the knot. An example Routing Zone is shown in Fig. 2. Where S's routing zone is included in K, not A-I nodes. In the pictures, the radius is marked as a circle around the node. However, it should be noted that the zone is defined not as physical distance but as the hops. The zone's nodes are categorized in peripheral nodes and internal nodes.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Peripheral nodes correspond to the radius of the minimum distance to the center node. The nodes with minimal distance are the inner knots. Fig. 2 shows the A-F nodes inner nodes; the knots are G-J peripheral nodes, and the K-junction is beyond the routing zone [13]. It should be noted that H node can be reached in two ways, length 2, and length 3 with fever. Though, the node resides in the zone as the shortest path is less or same as the zone radius. The number of nodes in the router zone could be regulated by adjusting the transmitting power of the nodes. Reduction of power decreases the number of nodes in the direct deficiency and vice versa. The number of adjacent nodes is sufficient to provide sufficient deficiency and repetition. On the contrary, many community members have extensive coverage and upgraded traffic. Additionally, the large transmission coverage is added to the local contradictions probability [14].

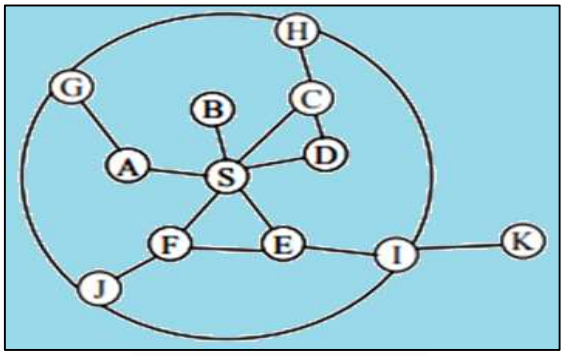

Fig 2: Routing Zone Example

Basically, the working of ZRP is based on the clustering mechanism that is known as zone-based approach. By using this concept, the problem of energy efficient routing is almost solved but the face other problems like failure of nodes during the data transmission. So, the main motivation behind the improvement in the ZRP mechanism for MANET is to provide a better energy efficient ZRP along with the failure detection capacity by utilizing the ANN as a classifier in the network where Grasshopper Optimization Algorithm (GOA) is used to optimize the

ANN and the major contributions are listed as:

- We presents a brief analysis of the existing ZRP mechanism for the MANET to find out the issues faced by the researchers
- We introducing an IEE-ZRP mechanism with the combination of ANN along with the GOA to discover a secure and energy efficient route for data transmission via Cluster Heads (CH).
- The concept of ANN as an AI technique is used to detect the failure of sensor nodes during the transmission of data packets within the network.
- To validate the proposed IEE-ZRP mechanism, a comparison with the existing state of the art using different approaches are performed in terms of Throughput, Packet Delivery Ratio (PDR), Packet Drop Ratio, Delay, Energy Consumption and Control Overhead.

In this section, we provide a brief introduction about the proposed IEE-ZRP mechanism and the main focus of research is to introduce a hybrid routing mechanism with nodes failure in MANETs, and the rest of paper is organized as: in Section 2 existing work related to the ZRP for MANET are analyzed where, the material and methods are discussed in Section 3 with experimental set up of MANET scenario. In the Section 4, simulation results are discussed and the conclusion with the future possibilities is discussed in the Section 5.

2. RELATED WORK

Lots of hybrid routing mechanism proposed by the researchers in the previous ten years, so, to find out the existing problems to designed an energy efficient routing for MANET by focusing on the routing failures issues. In 2018, ***P. T. Selvi and C. S. Ghana Dhas*** had conducted a research to develop a novel routing mechanism to improve an energy efficient zone based routing protocol for MANET. They deal with problem of energy consumption by developing an energy efficient ZRP mechanism that can able to control the network. Basically, they follow the working mechanism of a game theory approach to design an energy efficient ZRP and it becomes effective to

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

improve Quality of Service (QoS) for MANET during the data transmission. Researchers, achieve a sufficient outcomes but the failure problems of sensor node still face by them that is analyzed by the compare the experimental outcomes [15]. In 2013, ***K. Harjeet et al.*** focused on study regarding the four different types of mobile sensor nodes behavior in MANET. In this survey, researchers focused on the sensor node mobility in MANETs regarding the variety of applications at low cost. In MANET, varied routing protocols are suggested that might came under three major categories: responsive (on demand), active (table driven), and mixed routing protocols, AODV, OLSR, and ZRP. The research mainly focuses on passive, active and hybrid routing protocols such as AODV, OLSR and ZRP [16]. ***Dyabi M. et al.*** in 2014 have explained the concept of MANET (mobile ad hoc networks) on clustering. The authors propose a new algorithm in the OLSR network. Perform different numbers of simulations on several nodes and variable node speeds. Calculate the simulation with and without clustering intervals. This work has improved the performance and size of elected cluster leaders [17]. ***Loay Abusalah et al*** in 2017 has proposed variety of reactive, proactive and hybrid ad hoc routing protocols. The author has also reviewed the secure versions of the presented protocol. The four classical routing protocols used for analyzing and evaluating are: AODV, DSR, OLSR and TORA. The protected ad hoc networks need for meeting five of the security requirements, namely, confidentiality, integrity, authentication, availability and non-repudiation [18]. The examinations of the secure versions of the presented protocols are reviewed for the mentioned security requirements.

MANET is a connected component of different tiny wireless mobile sensor nodes powered by a small batteries. The batteries cannot be recharged once the mobile sensor nodes are deployed into the network. In such a case, it becomes quite important to use the battery very efficiently and need an energy efficient route for the data transmission from the source to destination node. The battery in terms of energy is consumed in order to perform the following set of operations within the MANET:

- ⊗ Routing for data transmission
- ⊗ Detection of Fails or Malicious Nodes
- ⊗ Trafficking

Routing in MANET is used to setting up the path for the transfer of the data packets from the source (T_X-Node) to destination (R_X-Node). According to survey, there are lot of routing algorithms are available but still a MANET suffers the security and energy management problems during the routing. So, we conclude some important and major point which helps to short out existing MANET security as well as energy efficient problem. Our contributions in this research is to solve mentioned energy management as well as failure detection problems in three scenario. Firstly, we introduce a clustering-based IEE-ZRP to discover a secure and energy efficient route with the help of CHs. Secondly, the concept of ANN as an AI technique with GOA approach is used to detect the fail or malicious mobile sensor nodes during the transmission of data packets and the last, to validate the proposed IEE-ZRP, a comparison with the existing state of the art using different routing protocols are performed and our designed network can be easily generalized to other challenging routing and security problems.

3. MATERIAL & METHOD

In this section, we explain the used methodology and algorithms that is to design an IEE-ZRP based MANET with the help of ANN and GOA to discover a secure and energy efficient route and the model is shown in the Fig. 3.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

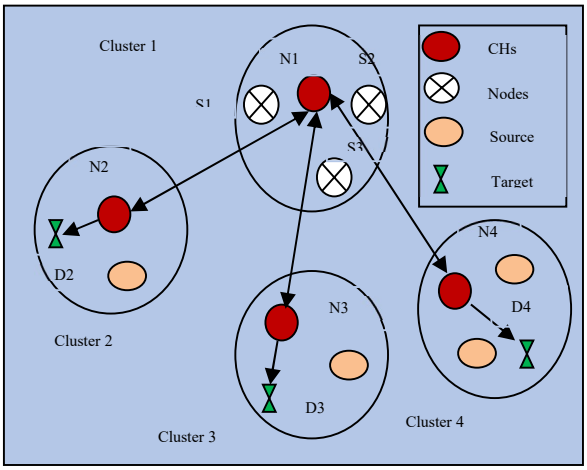

Fig 3: IEE-ZRP based MANET

In MANET, to construct a route for the data packets transmission, routing protocols are used and mostly, three types of routing protocols are available in MANET that is already mentioned in the above section named as proactive, reactive and hybrid routing protocol. In this research, we focus to design an algorithm of routing using the hybrid approach that utilizes the properties of proactive as well as reactive routing protocols. Firstly, we apply the proactive routing protocol to create and maintain the route and then after to minimize the routing overhead occurs in proactive routing protocols, reactive routing protocol is used. So, it is called a hybrid routing protocols and having better capacity compare to the single mechanism. An example of hybrid routing is the designed IEE-ZRP mechanism. In this research work, IEE-ZRP mechanism is used to find route between the T_X-Node to R_X-Node. The methodology of the proposed IEE-ZRP for MANET that is based on the zone or clustering-based routing mechanism are defined as follows:

A. MANET Simulator

For the network simulation, firstly we need to design simulator for the simulation of MANET using the concept of GUI (Graphical User Interface) in MATLAB 2016a software with IEE-ZRP mechanism. To design simulation, a specific area should be defined using the network height and width according to the given equation:

$$\boldsymbol{A = H(m)X\,W(m)} \text{ ..... (1)}$$

Where,

H → Height of the MANET simulator and

W → Width is the MANET simulator

Here, both are assumed as a fixed number and it is 1000m for height and 1000m of width, so the total MANET Simulator area become 1000m^2 and developed MANET simulator is shown in Fig. 4.

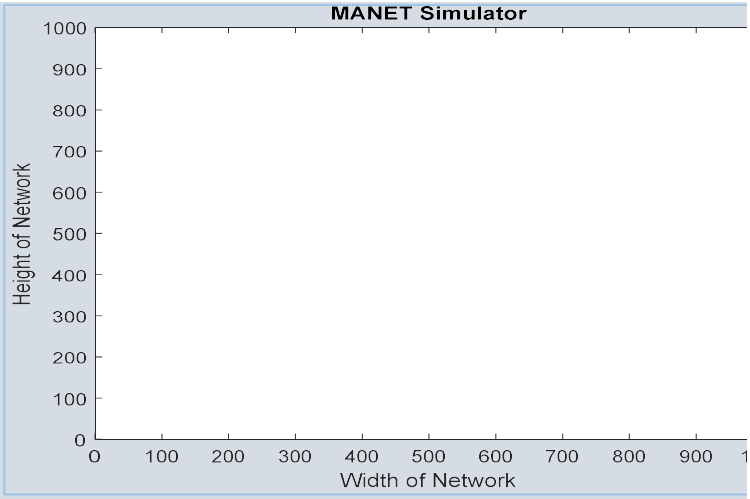

Fig 4: MANET Simulator

For the simulation of the MANET, design and develop MANET simulator is shown in the Fig. 4 with specific height (H) and width (W) and once area of simulator decided then, we move to further processing with mobile sensor nodes.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

B. Mobile Sensor Nodes Deployment

After the area generation for simulation, we move to next step that is sensor nodes deployment and we deploy total 50 sensor nodes within the area and the process of nodes deployment is shown in the Fig. 5.

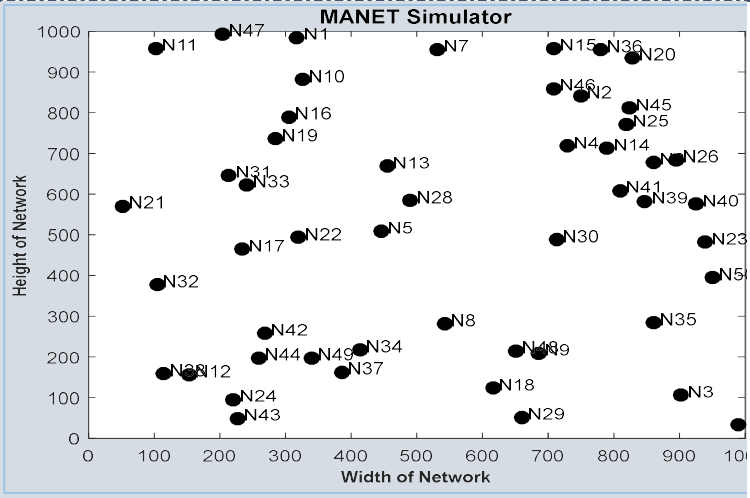

Fig 5: Mobile Sensor Nodes Deployment in MANET Simulator

C. Active & Dead Node Segmnetation

After the sensoe nodes deploymnet in the MANET simulator, we segment the sensor nodes into two categories such as Active and Dead. The active sensor nodes are denote by green and dead is denoted using read color as shown in the Fig. 6. To find out active and dead node we use given procedure:

For I = 1→Nodes
If Node Residual Energy >Threshold
Active Node
Else
Dead Node
End
End

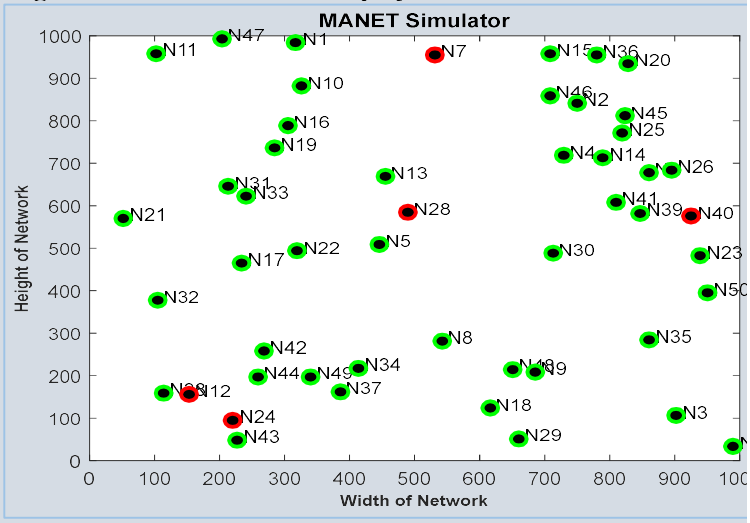

Fig 6: Mobile Sensor Nodes Deployment in MANET Simulator

D. Zone Davison of MANET Area

In this step of IEE-ZRP, we divide total simulation area of MANET into different zones or clusters or regions and assign a cluster head (CH) in each zone based on their available energy and the divided zone is shown in the Fig. 7. Where, total five zones are formed using the concept of IEE-ZRP mechanism. In the each zone, a CH is defined and according to the figure, these are sensor nodes number 13, 34, 36, 45 and 47. In the simulation, we assume each CHs can cover the entire zone that is situated in the zone area of CHs.

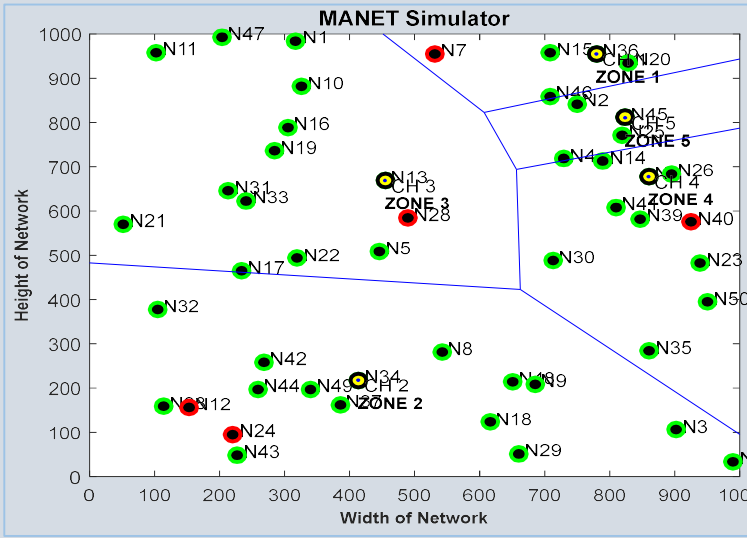

Fig 7: Zone in MANET Simulator

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

E. Tx & Rx Deployment in MANET

In this step, we select a sensor nodes as a source node (T_X-Node) and another sensor node as a destination (R_X-Node) for the simulation purpose. In the Fig. 8, the source and destination nodes are shown with the help of blue color with circular marker shape. We see that the source that is known as T_X-Node is lies in the Zone 1, where the destination that is known as R_X-Node is lies in the Zone 2. The selection of the nodes as source or destination is a random method, so we can't specify the source and destination manually. After the selection of T_X-Node and R_X-Node, we create a route for the data transmission purpose using the concept of IEE-ZRP mechanism.

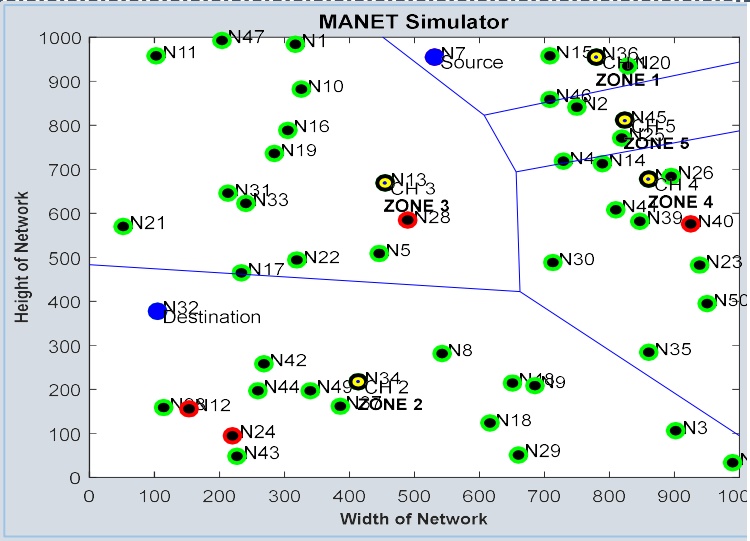

Fig 8: Tx-Node and Rx-Node in MANET Simulator

F. IEE-ZRP in MANET

After the basic set up of MANET simulator, route discovery is performed to transmit the data packets from T_X to R_X node via CH of the particular zone. The route discovery mechanism using IEE-ZRP is shown in the Fig. 9. Based on the figure scenario, T_X transmit the data packets to its CH and then CH decide to next hop or node as an intermediate nodes in the route. So, the discovered route is denoted as R.

R = [Node-7, Node-15, CH-1, CH-5, CH-3,CH-2, Node-32]

In the Route (R), Node-7 is T_X and Node-32 is R_X, when route is discovered then Node-15, CH-1, CH-5, CH-3, and CH-2 is considered in route as an intermediate nodes.

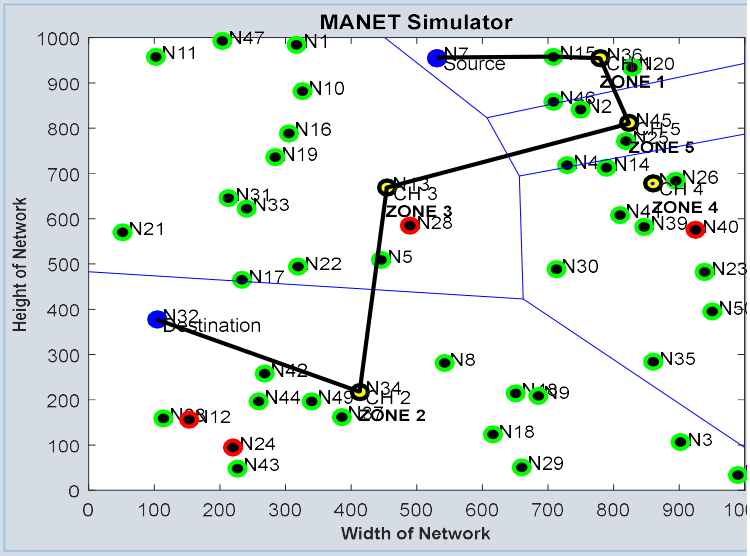

Fig 9: IEE-ZRP Mechanism in MANET Simulator

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

G. Fail Node Detection in MANET

After the routing mechanism, in this research we evaluate the performance parameters of the MANET in terms of QoS such as Throughput, Packet Delivery Ratio (PDR), Packet Drop Ratio, Delay, Energy Consumption and Control Overhead. If these QoS is not satisfactory, that means data packets are losses, then we utilize the concept of GOA-based ANN as classifier to detect the fail or malicious node within the route. According to the figure, Node-15 is a dead or fail node that is not deliver the data packets successfully to the next node and loss the data packets. So, to identify the dead or fail nodes within the route we use the GOA-based ANN in IEE-ZRP mechanism and the algorithm is written as:

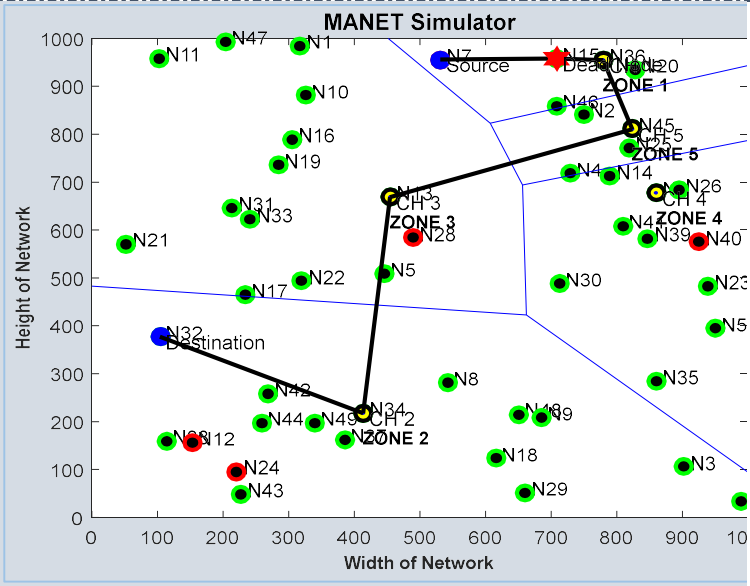

Fig 10: Detection of Fail Node in MANET Simulator

IEE-ZRP with GOA-based ANN Algorithm

Required Input	N_{SN} ← Number of Sensor Nodes
	T_X ← Source node as transmitter
	R_X ← Destination node as receiver
	N_{DATA} ← Nodes Feature Data
	Cat ← Target of ANN as a Active and Dead Nodes
	N ← Carrier Neurons Number
Obtained Output	OR and Dead Node ← Optimized and Validated Route from T_X to R_X with dead nodes

1. **Start IEE-ZRP**
2. Divide total MANET simulator into Zones
3. $Z = Z_1, Z_2, Z_3, \ldots\ldots Z_N$
4. **If R_X is not in T_X Coverage**
5. Discover route
6. Route, R = [] // Assign an array
7. Nodes (T_X) start searching its CH
8. Route, R = [T_X, CH of T_X]
9. While R_X not founded
10. Update Route and search again until R_X not founded
11. **If R_X founded**
12. Final route, FR = [T_X, CH of T_X, N, R_X]
13. **Else**
14. Check next route condition
15. **End – If**
16. To optimized the FR, GOA-based ANN is used
17. Index = Find index of N_{DATA} in FR using the GOA
18. Apply GOA
19. **If index of route is normal then**
20. OR(i) = FR (index)
21. **Else**
22. Mark as faulty route

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

23. **End – If**
24. Call and set the ANN using OR properties as training data (T), number of TX as group (G) and Neurons (N)
25. Set, MANET_Model = NEWFF (T, Group, N)
26. MANET_Model = TRAIN (MANET_Model, T, G
27. Current Sensor Nodes, NC = Properties of current node in MANET Model
28. Sensor Nodes Characteristics = SIM (MANET_Model, NC)
29. **If Sensor Nodes Characteristics is valid then**
30. OR = Validated
31. **Else**
32. OR = Attacker Nodes
33. **End – If**
34. **Returns:** OR as an Optimized and Validated Route from TX to RX with dead nodes
35. **End – Function**

Table I: MANET Simulator Experimental Setup

Mobile Sensor Nodes	**50-1000**
MANET Simulator Area	**1000m^2**
Simulation Tool	**Communication and AI Toolbox in MATLAB Software**
Routing Protocol	**Hybrid IEE-ZRP**
Simulation Time	**10 to 100 s**
Classifier	**GOA based ANN**
Validation Parameter	**Energy Consumption**
Evaluation Parameter	**Throughput, Packet Delivery Ratio (PDR), Packet Drop Ratio, Delay, Energy Consumption and Control Overhead**

The simulation results of proposed IEE-ZRP mechanism based MANET scenario using the concept of GOA with ANN is described in the next section of this research article.

4. RESULTS AND DISCUSSION

We explain and analyze the experimental simulation results of the proposed IEE-ZRP base MANET in this section of research article. Based on the Table II scenario mentioned in the above section, the simulation results of proposed simulator with existing work by ***P. T. Selvi and C. S. Ghana Dhas*** [15] are given as:

Table II: Throughput of IEE-ZRP based MANET

No. of Nodes	Existing Work [15]	Proposed IEE-ZRP
150	2450	2590
300	2510	3150
450	2597	3544
600	2675	3966
750	2710	4125
1000	2750	4300

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

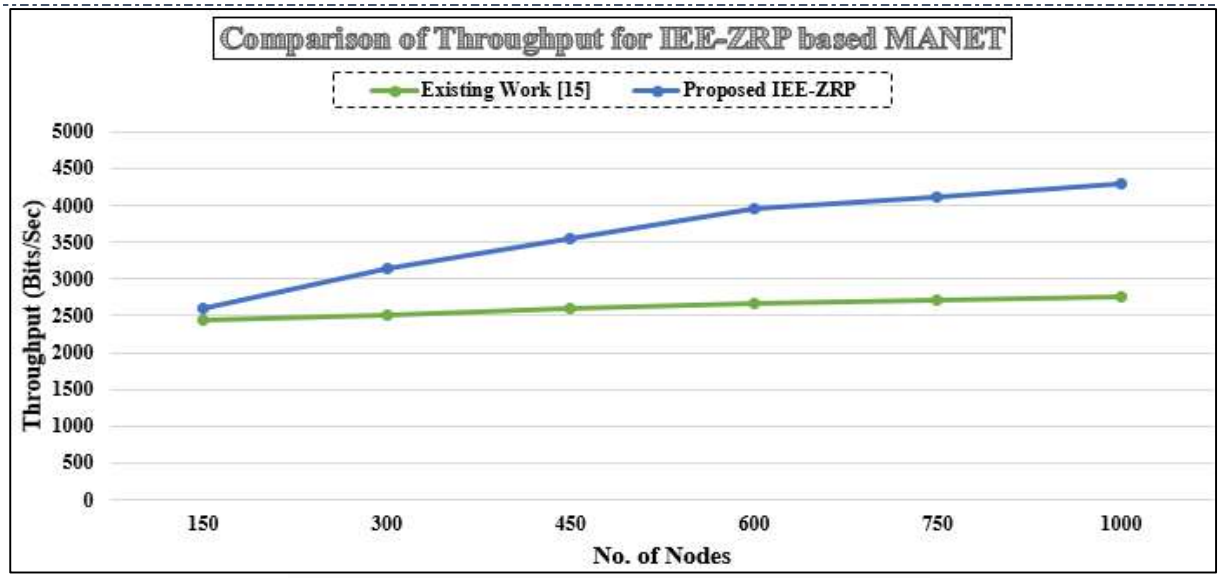

Fig 11: Comparison of Throughput for IEE-ZRP based MANET

From the above Fig. 11, we observed that the throughput of proposed IEE-ZRP mechanism for MANET using the GOA with ANN as an AI concept to detect the dead node and make an improved scenario. The throughput of network is depends on the data transmission rate of network and in Table III, we provided the Packet Delivery Ratio (PDR), according to the number of simulation sensor nodes.

Table III: PDR of IEE-ZRP based MANET

No. of Nodes	Existing Work [15]	Proposed IEE-ZRP
150	75	97.9
300	81	98.3
450	86	99.1
600	92	99.4
750	97	100
1000	98	100

PDR is the ratio of the total summation of data packet received at R_X node and the total summation of data packets generated at T_X node in the networks are represented in terms of percentage. The formula of the PDR is given as:

$$\boldsymbol{PDR}\ (\%) = \frac{\sum_{i=1}^{N} \boldsymbol{Data\ Packets\ at\ T_X(i))}}{\sum_{i=1}^{N} \boldsymbol{Data\ Packets\ at\ R_X(i))}} \times \mathbf{100} \ldots . \mathbf{(2)}$$

Where, N is the total number of the sensor nodes in the MANET. Fig. 12 shows that the comparison of PDR between proposed and existing work in terms of percentage. It shows that the PDR of IEE-ZRP mechanism is higher as compared to the existing routing protocols.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

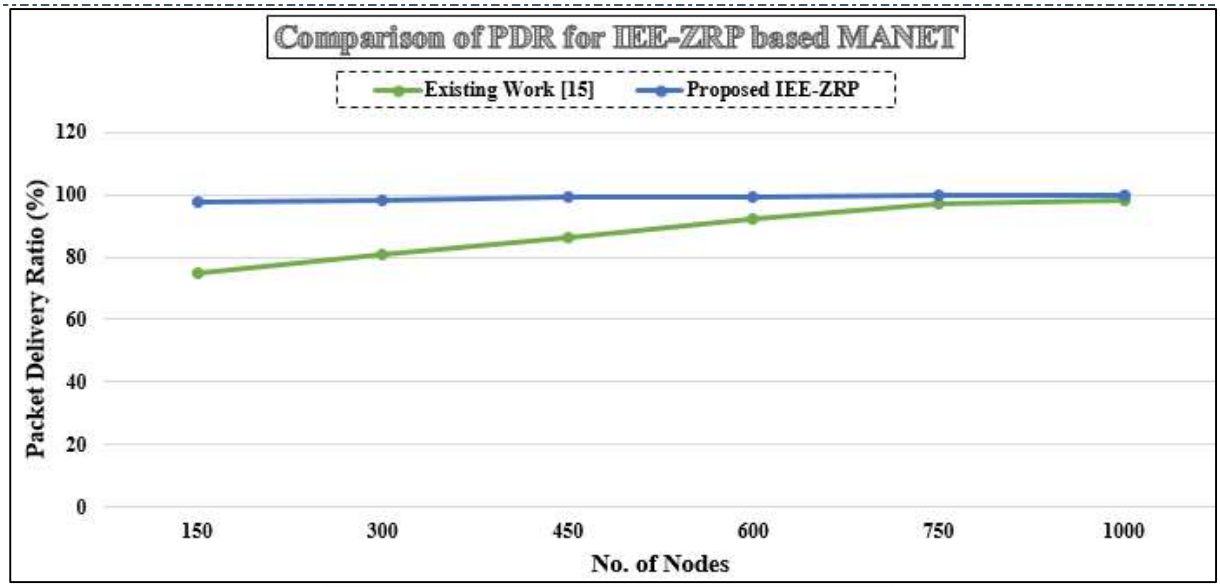

Fig 12: Comparison of PDR for IEE-ZRP based MANET

If the PDR of any network is more, then the packet drop rate is reduces. So, in the Table IV, we presents the comparison of the Packet Drop Ratio (DR) of network.

Table IV: DR of IEE-ZRP based MANET

No. of Nodes	Existing Work [15]	Proposed IEE-ZRP
150	25	2.1
300	19	1.7
450	14	0.9
600	8	0.6
750	3	0
1000	2	0

DR is the drop ratio of the MANET during the data transmission and it is calculated using the formula of the DR is given as:

$$\boldsymbol{DR}\ (\%) = \mathbf{100} - \boldsymbol{PDR} \ldots\ldots \mathbf{(3)}$$

Where, PDR is the packet delivery ratio of network

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

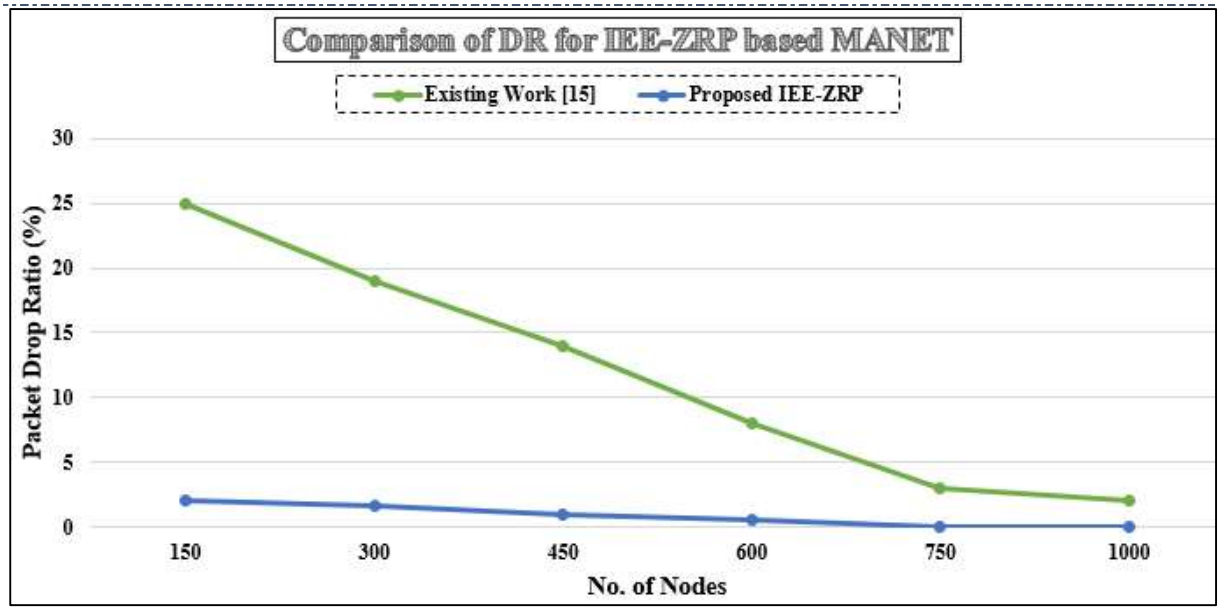

Fig 13: Comparison of DR for IEE-ZRP based MANET

From the above figures, finally we observed that the utilization of GOA with ANN to design an IEE-ZRP mechanism is a beneficial steps for the MANET because the drop rate is reduced as compare to the exiting work. So, now we check the transmission delay in the Table V.

Table V: Delay of IEE-ZRP based MANET

No. of Nodes	Existing Work [15]	Proposed IEE-ZRP
150	0.01	0.008
300	0.019	0.011
450	0.026	0.017
600	0.038	0.024
750	0.05	0.031
1000	0.07	0.043

Delay is the sum of total time taken by network to transmit data packets from the T_X node to the R_X node in the networks and it is represented in terms of second.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

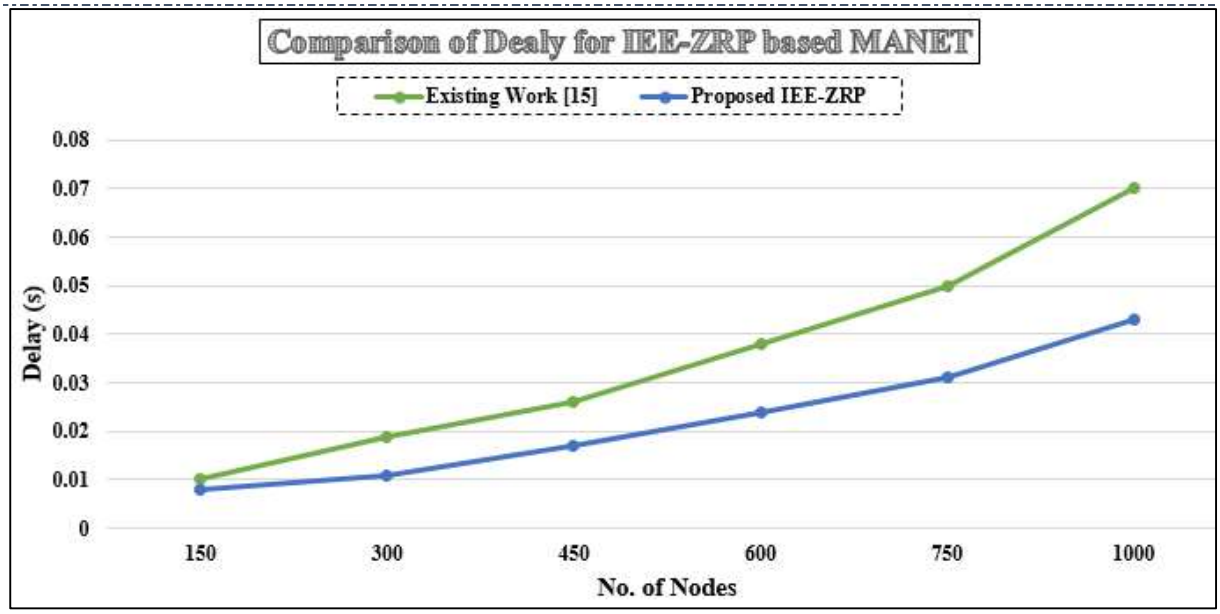

Fig 14: Comparison of Delay for IEE-ZRP based MANET

The transmission delay of the proposed IEE-ZRP mechanism is also improved as compare to the exiting work that is clearly observed from the above Fig. 14. Finally, we can say that the utilization of GOA with ANN to design an IEE-ZRP mechanism is a beneficial steps for the MANET. So, now we check the Control Overhead (COH) in the Table VI.

Table VI: COH of IEE-ZRP based MANET

No. of Nodes	Existing Work [15]	Proposed IEE-ZRP
150	80	64
300	126	78
450	158	81
600	180	89
750	196	94
1000	200	99

In MANET, COH is also an important QoS parameters like others and it is the total amount of control packets required by the IEE-ZRP routing protocol to transmit the 1Kilobits data packets for the receiver node successfully. The comparison of COH of proposed IEE-ZRP with existing work is shown in Table VI and there graphical representation id shown in the Fig. 15 that is the comparison of COH in terms of Kbps (Kilobits per seconds). It shows that the COH of IEE-ZRP mechanism is less compared to the exiting routing protocol by the ***P. T. Selvi and C. S. Ghana Dhas*** [15] and it proves the better performance of IEE-ZRP protocol for MANET that is possible by utilizing the concept of the GOA with ANN. Where, GOA is used to segregate the sensor nodes based on their behavior using the novel fitness function.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

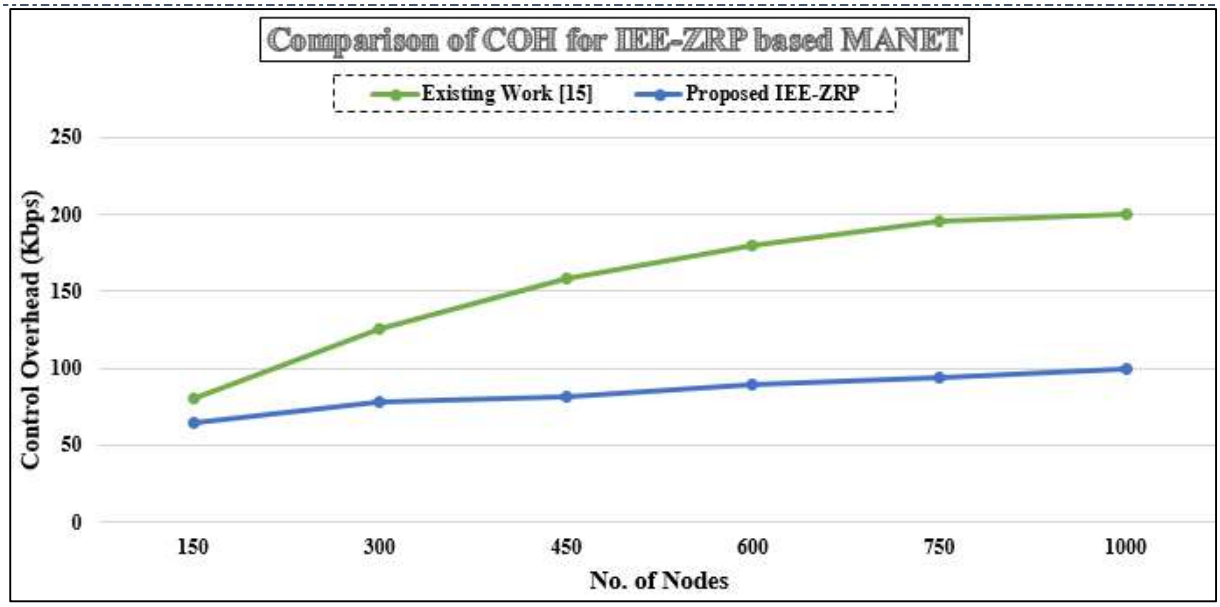

Fig 15: Comparison of COH for IEE-ZRP based MANET

Based on the above analysis, we conclude that the utilization of IEE-ZRP protocol is a beneficial steps but our motive to construct an energy efficient model. So, for this prospective the evolution of energy consumption become a compulsory steps. The consumption of energy is calculated using written equation:

$$Energy_{Consumption} = \sum_{i=1}^{N} T_p + R_p + W_p \ldots. (4)$$

Where Tp is the consumed energy by nodes during the transmission, Rp is the all consumed energy by nodes during the relieving a data packet and Wp is the consumed energy by a node during the waiting of data packets.

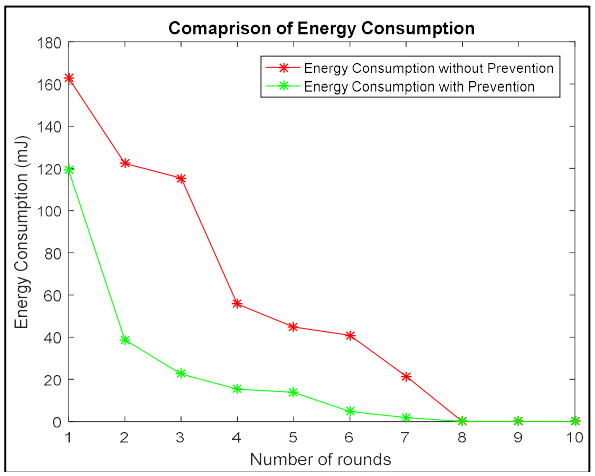

Fig 16: Evaluation of Energy Consumption for IEE-ZRP based MANET

Form the above figure, we clearly see the effect of the utilization of GOA with ANN to design an IEE-ZRP mechanism. The energy consumption rate of the proposed work is also decreases and we can say that the proposed work is an energy efficient model for MANET scenario.

5. CONCLUSION AND FUTURE WORK

In this paper, an optimized ANN based IEE-ZRP mechanism for the MANET has been proposed based on the concept of cluster wise or zone wise model. Based on the simulation analysis which observes about the QoS parameters of the IEE-ZRP mechanism, it can be examined that the IEE-ZRP mechanism which represents the

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

hybrid approach has the most efficient mechanism to deliver the packets when the destination or R_X sensor nodes are not located in the source or T_X sensor nodes coverage area. It happens because the IEE-ZRP can maintain the updated routing table in more efficient manner than the other existing routing mechanism. It can be seen that the energy consumption needed by the IEE-ZRP in the MANET network simulation is fewer than the energy consumption used by the normal ZRP in the MANET network simulation. The IEE-ZRP mechanism is evaluated based on artificial intelligence inspired methods aimed to minimize energy consumption rate with secure and fast data transmission through the trust of the route with the help of GOA as an optimization or Meta heuristic approach. The performance of IEE-ZRP based MANET is much better than existing work in all respects like throughput, PDR, DR, COH and energy consumption. So, in future, the idea of deep learning will be utilized with the IEE-ZRP as a classifier to for quick versatility conduct of mobile sensor nodes inside the network.

REFERENCES

[1] Singh M. Performance Analysis of Proactive, Reactive and Hybrid MANET Routing Protocols on IEEE 802. 11 Standard. International Journal of Computer Applications. 2012 Jan 1; 54(12).
[2] Khandakar A. Step by Step Procedural Comparison of DSR, AODV and DSDV Routing protocol. InInternational Proceedings of Computer Science & Information Tech 2012 Jun (Vol. 40, No. 12).
[3] Beijar, Nicklas. "Zone routing protocol (ZRP)." Networking Laboratory, Helsinki University of Technology, Finland 9 (2002): 1-12.
[4] Sampoornam, K. P., and G. Raaga Darshini. "Performance Analysis of Bellman Ford, AODV, DSR, ZRP and DYMO Routing Protocol in MANET using EXATA." In 2019 International Conference on Advances in Computing and Communication Engineering (ICACCE), pp. 1-5. IEEE, 2019.
[5] Trivedi, Munesh C., Sakshi Yadav, and Vikash Kumar Singh. "Securing ZRP routing protocol against DDoS attack in mobile ad hoc network." In Advances in Data and Information Sciences, pp. 387-396. Springer, Singapore, 2019.
[6] Sudiharto, Dodi W., Nur R. Pradana, and Sidik Prabowo. "The Comparative Analysis of Energy Consumption between OLSR and ZRP Routing Protocols." Journal of Communications 14, no. 3 (2019).
[7] Nithya, B., C. Mala, and R. G. Thivyavignesh. "Performance Evaluation of Dynamic Zone Radius Estimation in ZRP for Multihop Adhoc Networks." Wireless Personal Communications (2020): 1-25.
[8] Mehra, Manisha, and Mehajabeen Fatima. "AODV and ZRP Analysis for Congestion in MANET."
[9] Ghode, Sushma D., and Dr KK Bhoyar. "A Comparative Study of ZRP and Energy Efficient ZRP (E-ZRP)." Available at SSRN 3426257 (2019).
[10] Kaur, Sandeep, and Supreet Kaur. "Analysis of zone routing protocol in MANET." International Journal of Research in Engineering and Technology 2, no. 09 (2013): 3.
[11] Noorani, ZishanHaider Y. "Performance Analysis of DSDV, AODV, and ZRP Routing Protocol of MANET and Enhancement in ZRP to Improve Its Throughput." International Journal of Scientific and Research Publications 3, no. 6 (2013).
[12] Fahmy, Imane MA, Laila Nassef, Imane A. Saroit, and S. H. Ahmed. "Qos parameters improvement for the hybrid zone-based routing protocol in manet." In 2010 The 7th International Conference on Informatics and Systems (INFOS), pp. 1-9. IEEE, 2010.
[13] Sathish, S., K. Thangavel, and S. Boopathi. "Performance analysis of DSR, AODV, FSR and ZRP routing protocols in MANET." In Second International Conference on Information Systems and Technology, p. 57. 2010.
[14] Raju, Sree Ranga, Kiran Runkana, and Jitendranath Mungara. "ZRP versus aodv and dsr: A comprehensive study on zrp performance on manets." In 2010 International Conference on Computational Intelligence and Communication Networks, pp. 194-199. IEEE, 2010.
[15] Selvi, P. Tamil, and C. Suresh GhanaDhas. "A novel algorithm for enhancement of energy efficient zone based routing protocol for MANET." Mobile Networks and Applications 24, no. 2 (2019): 307-317.
[16] Kaur H, Sahni V, Bala M. A Survey of Reactive, Proactive and Hybrid Routing Protocols in MANET: A Review. Network. 2013; 4(3):498-500.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

[17] Dyabi M, Hajami A, Allali H. A new MANETs clustering algorithm based on nodes performances. InNext Generation Networks and Services (NGNS), 2014 Fifth International Conference on 2014 May 28 (pp. 22-29). IEEE.
[18] Abusalah, Loay, Ashfaq Khokhar, and Mohsen Guizani. "A survey of secure mobile ad hoc routing protocols." IEEE communications surveys & tutorials10, no. 4 (2008).

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.