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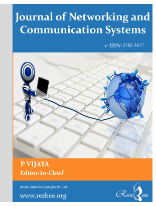

Fuzzy Butterfly Optimization Algorithm for Ring Cluster-based Routing Protocol for WSN

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Abstract: The latest development of WSNs pays huge attention to numerous researchers because it is helpful to the extensive range of applications. At the time of the routing approach, small sensors powered with batteries in WSN can perish rapidly. In order to solve this problem, numerous solutions have been exploited till now, one of the main solutions is a ring routing protocol. An energy-effectual mobile Base station routing model is referred to as the ring routing protocol that is based on virtual ring composition. This is easily configurable and accessible. A hierarchical routing model is also called the ring routing protocol in WSN with a mobile sink that exploits greedy geographic routing. Additionally, an energy-aware ring routing protocol is modeled based on multi-objective constraints. At first, with a normal node and pre-defined radius, the ring is modeled, through this ring structure the information is broadcast to Base Station. Specifically, a node that is closer to the sink exhausts sooner than the other nodes as well as develops overhead regarding the packet delays as well as energy utilization. If a ring node starts to drain the energy, spontaneously the neighbour node initiates role of ring node. Additionally, election of a normal node as ring node is optimally attained based on multi-objectives namely energy, distance among regular node and ring node as well as distance among network centers to a regular node. In this work, a Fuzzy Butterfly optimization Algorithm (FBOA) is developed because the optimization plays an important role in electing neighbors as ring nodes. Finally, adopted approach performance is validated with traditional models concerning energy dissipation, throughput, as well as transmission delay.

Keywords: Energy, Node, Ring, Routing, Sensors, WSN.

Nomenclature

Abbreviations	Descriptions
WSN	Wireless Sensor Network
GA	Genetic Algorithm
ADC	Analogue to Digital Converter
PSO	Particle Swarm Optimization
BS	Base Station
MOFPL	Multi-objective fractional particle lion algorithm
RP	Routing Protocol
BOA	Butterfly Optimization Algorithm
LEACH	Low Energy Adaptive Clustering Hierarchy
NOF	Normalized Objective Function
Taylor C-SSA	Taylor based Cat Salp Swarm Algorithm
FF	Firefly
AN	Anchor Node
ACO	Ant Colony Optimization
CH	Cluster Head
E2E	End to End
SNs	Sensor Nodes

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1. Introduction

WSN comprises numerous numbers of SNs that are dispersed in the environment to sense, validate as well as receive data. In WSN, the sensor nodes are reasonably priced and possess maximum capabilities in processing, sensing as well as information transmission. In various applications like defense domain, weather forecasting, and medical field as well as industrial applications, the WSN is exploited [14] [15]. The sensors in WSN are small in size, and the power resources of nodes use a limited battery. Additionally, the sensors collect information by utilizing the ADC and it transforms the information to the foremost location referred to as BS. SNs act as an intermediate to transfer information to the sensors and the BS. To make results for several applications, obtained data are evaluated at BS. Additionally, the WSNs power resource must be utilized in a sufficient manner as it cannot be recharged or exchanged because the sensor is positioned in an inconsiderate as well as the no-man environment. The WSN model is exaggerated by various metrics like fault tolerance, scalability as well as energy effectuality, and so on. In WSN, the sensors drain the energy in 2 ways environmental parameters sensing as well as data transmission to BS via nodes. The utmost energy is utilized for the data transmission while comparing with the data processing as well as sensing from the environment in WSN [1].

In WSN, by utilizing the wireless communication medium, the routing explains transmission of packets amid SNs as well as BS. During routing, the most important issue is the energy expenditure of every SNs in WSN. WSN lifespan of the network is directly based on energy of each SNs. Therefore, to assure the improved lifespan of the network of the WSN via the effectual node's routing, therefore the routing protocol is required. In WSN, the energy of the nodes must be reduced during responses and message packet transmission. Thus, the routing protocol is exploited for node routing and that is categorized based on multi-objective constraints. Moreover, several clustering approaches are exploited such as the working mode of nodes and topology of a network. For WSN, routing protocol model is directly based on metrics such as the utilization of energy, connectivity, scalability, coverage, deployment of node, as well as security [2].

In WSN, the energy is one of the important constraints, thus the multi-hop routing is exploited over the communication energy. Also, the delay should be reduced however the energy utilization is increased as well therefore the routing requires storing the energy. Thus, the researchers seek to model an energy-efficient routing protocol [3]. In WSN, nodes present are powered-battery, the SNs batteries are expensive. Thus, maximization of RP is important and it is performed via the effective reduction of E2E delay. For routing, to choose only one path from a source node to arrive at BS, path is examined via single path routing protocols. However, in order to choose one more path the multipath routing protocol is examined. In single path routing, some drawbacks exist that as the numerous noise factors in the WSN environment. The multipath routing protocols work on the network load with high effectuality as the routing path availability is maximum. It maximizes bandwidth as well as the reliability of the WSN [4].

The major aspiration of this work is to propose an optimization FBOA technique for optimal choice of a normal node as a ring node. While a ring node tries to die, a neighbor node is chosen to play a key role of the ring node. Here, a best neighbor node is chosen for particular objectives such as energy, distance among regular node and the ring node as well as distance among network centers to a regular node.

2. Literature Review

In 2021, Loveleen Kaur and Rajbir Kaur [1], examined the current routing protocols for sensor networks as well as developed action plans for the diverse techniques followed. In the IoT, the major disadvantage was the requirement for energy. Moreover, various directions to rise lifespan of expectations of the network have been received in the rising level of interest. Nowadays, numerous mount of an accomplishment has risen. Modeling the routing protocol was considered the attractive model for these, as shown by energy requirements for the transmission of information. This work starts with a completed explanation of the basis as well as its related works. Moreover, this work develops a novel RP to maximize energy effectuality of a sensor in the IoT. In 2022, Rohit Ramteke *et al.* [2], developed an adaptive PSO together with genetic mutation-based routing to choose the CH for IoT-based software-defined WSN. The adopted approach act as an important role to choose the control nodes it was performed by exploiting the parameters such as distance as well as energy. The adopted model has experimented with heterogeneous networks possessing diverse computing power attended using single and multiple sinks. The simulation was performed based on performance matrix like stability period, average remaining energy, fitness value, and so on. In 2020, Prachi Maheshwari *et al.* [3], developed on energy utilization reduction as well as increased network lifespan. Presently, the routing algorithms as well as clustering were extensively exploited in WSNs to improve the network lifespan. In addition, to elect best CH from a group of SNs, the BOA was used. Here, selection of the

CH was optimized by the remaining energy of the nodes, distance to BS and neighbors, node centrality as well as degree. Then ACO was exploited to identify route between BS and CH. Also, it elects the optimal route on the basis of distance, residual energy, as well as a degree of a node. In 2019, A. Vinitha *et al.* [4], worked on the issues regarding energy utilization in WSN. Therefore, an energy-effective multi-hop routing named Taylor C-SSA was presented which was the combination of C-SSA with Taylor series. In order to obtain a multi-hop routing, this technique utilizes the 2 stages. It was called selection of CH and the information transmission. Initially, using LEACH protocol, energy powerful CH was elected for efficient information transmission. Here, SNs transmit information to CH then CH transfers information to BS via best hop. Moreover, Taylor C-SSA was utilized for election of optimal hop. In 2019, Reeta Bhardwaj and Dinesh Kumar [5], worked on multi-objective constraints namely distance, delay, traffic rate, energy, and cluster density. The MOFPL was used for energy-aware routing. The MOFPL approaches identify optimal CH from various CH nodes in WSN. After that, based on multi-objective function, the optimal routing path was performed.

3. Adopted Energy Effectual Ring Cluster-based Routing Protocol

Generally, antennas are Omni directional in SN that permits wireless signals to extend in spherical wave format. On the other hand, signal spreading is in the form of a circular wave in a 2-dimensional plane. During the transmission process, the ring domain communication topology has the capability to utilize the 360^0 signal transduction proficiently as a result collision of a message can be rigorously reduced. The sensor networks used batteries for power and therefore the Sensor network depletion is faster when compared with the other nodes it is because of data traffic to BS. In addition, while ring structure gets troubled because of ring node's termination, subsequently, the transmission of the data turns out to be deadly as well as develops maximum delay. To overcome this problem a new energy effectual ring clustering routing protocol by exploiting the meta-heuristic model is developed in this paper. In the network center, the location of the normal node, BS, and ANs is registered. Under various levels, ring structures are formed with a fixed ring radius. BS is really mobile as well as they lead deplete their energy higher. The BS chooses ANs between their neighbors. Moreover, communication that occurs among the BS, as well as SNs, is controlled by the ANs servers. Furthermore, while a BS travels away from the communication range and connects to ANs, it directly chooses a new AN and notifies the elder ANs concerning MAC address to identify the location of the novel anchor nodes through the ANs packet. The SNs transmit “ANPIREQ packet” towards the ring at the time of the data dissemination. It produces ANPIRESP once the ring node obtains ANPIREQ packet. Furthermore, while a ring node depletes its energy, it repeatedly switches to regular nodes reg or normal nodes. Meantime, the normal node closer to the dying ring node is chosen as the ring node. This chosen is performed optimally using the optimization approach. In addition, the multi-objectives such as En, $\mathrm{dis}_{\mathrm{ring-reg}}$ and $\Delta\mathrm{dis}_{\mathrm{NC-ring}}$ is exploited for the selection.

3.1 Adopted Ring Construction

(a)Simulation Area: In the area of 600m x 600m, the developed ring construction is performed. The node communication range is fixed at 80m and default ring radius=150±20m.

(b)Ring Formulation: The ring nodes are the “one-node-width, closed strip of nodes in the ring” [6]. If the deployment of WSN occurs ring structure construction takes place as stated below:

The primary ring radius is determined by concatenating neighboring nodes and a ring structure is devised in a closed loop form. The network center is ascertained by a particular threshold and this node is a member of WSN. Additionally, ring structure is created by choosing a node that lies at left point of ring and performs geographic forwarding counterclockwise or clockwise manner. Until ring nodes are selected construction of a closed loop primary/primary node is attained. In this scenario, if an initial node is not reached, this procedure is continued by choosing one-hop neighbors [13]. Conversely, even if a primary point is not identified subsequent to a convinced number of practices, subsequently the radius can be set with a diverse value and aforesaid process is repeated [13].

3.2 BS Position Advertisement

The BS act as the movable nodes, as well as they, chooses the ANs between their neighbors at the time of the locomotion. In between the SNs as well as the BS the anchor node manages the communication. Furthermore, while a BS leads to moving separately from range of communication that connects ANs, it incessantly chooses a new AN and notifies elder AN regarding MAC address and location of the novel AN by exploiting AN packet. At present, elder AN is awake of novel AN, therefore it can relay data intended for it to transmit data to new ANs. In addition, by AN to BS directly data packets are relayed as well as this is termed as the follow-up model. Conversely, not only by the distance, the quality of the radio link is affected but also by various metrics [13]. To estimate quality of a link, the beconing model is the best flexible technique. Here, by the BS, beacon messages are periodically broadcasted, and for the initiated reply messages from the neighboring nodes, link quality is calculated through a standard estimation measure. Furthermore, regarding the calculated link quality estimation measure, BS determines to decide on the alteration of AN. Behind the position of the BS advertisement, the main requirements are the MAC address as well as the location information delivery of the recently chosen AN. While a new AN is elected, chosen AN transmits ANPI to the ring. Furthermore, while AN is distant from ring, it forwards ANPI packet to network center, while AN within a ring, subsequently transmits ANPI packet towards a point by exploiting the greedy geographic forwarding, which exists in opposite network direction. Subsequent to ANPI packet reception, ring nodes reply with an ANPIS packet using the ring node to its neighbor in both the anti-clockwise as well as clockwise direction.

3.3 Transferring Data of BS from the Ring

While data is present with BS, it desires to distribute the data to the BS. The BS gathers the AN location information in prior to transmitting data. The new position of the AN's is saved in the ring. For ANPI packet delivery to ring procedure, retrieval model is same as procedure. To the ring, ANPIREQ packet is transmitted by source node. The packet of ANPIREQ involves the SN location while ring node obtains the ANPIREQ packet.

3.4 Data Dissemination

The source node attains the response (ANPIRESP) on the basis of the request (ANPIREQ), the position of AN's information is learned by the source node and initiates direct transmission of data to the AN through geographic forwarding.

3.5 Ring Node Change

Because of the AN information requests as well as advertisements processing, the ring node energy consumption is superior to the normal nodes' energy consumption. The traffic level handled by the ring node is superior to the reg. Furthermore, to place an end to nodes becoming destroyed quickly, they are recommended to switch their roles reg over time. In addition, there is no central control entity for WSN nodes, thus every ring node can autonomously switch its role with the nearer regular node individually. Furthermore, while a ring node depletes reg nearer to ring node turns out to be ring node. The optimal ring node election is performed by an optimization technique, and a defined multi-objective constraint is used for the selection. Eq. (1) defines the multi-objective constraint [13].

$$\mathrm{Obj} = \frac{1}{3}(1 - \mathrm{En}) + \mathrm{dis}_{\mathrm{ring-reg}} + \left(\Delta \mathrm{dis}_{\mathrm{NC-ring}}\right) \tag{1}$$

(a) Energy (En): Eq. (2) determines the complete energy cost, wherein $\mathrm{En_S}$ represents sensing energy cost, $\mathrm{E_l}$ is the electronic energy. Eq. (3) indicates the energy utilization for the data transmission, wherein, No number of data packets at distance dis and $\mathrm{En_{TX}}(\mathrm{No}:\mathrm{dis})$ represents total energy for transmitting. Moreover, $\mathrm{dis_0}$ indicates threshold distance which is stated as $\mathrm{d_0} = \sqrt{\frac{\mathrm{En_{fs}}}{\mathrm{En_{pw}}}}$ and $\mathrm{En_{el}}$ indicates energy needed to transmit per bit data [13]. As stated in eq. (4), the energy utilized to receive a similar No number of data packets is designed. Here, $\mathrm{En_{RX}}$ is 50*0.000000001. Eq. (5) indicates the fitness function for energy wherein $\mathrm{fit}_{(a)}^{\mathrm{ene}}$, $\mathrm{fit}_{(a)}^{\mathrm{ene}}$ states energy fitness to maximum. By eq. (6) and (7), the functions $\mathrm{fit_a}$ and $\mathrm{fit_b}$ can be ascertained, respectively. Moreover, β lies among $0 < \beta < 1$, and σ_1, σ_2 and σ_3 represents constant parameters equivalent to En, dis_{r-r} and dis_{NC-R}, correspondingly. Additionally, $\sigma_1 + \sigma_2 + \sigma_3 = 1$

$$\mathrm{En_{total}} = \mathrm{En_{TX}} + \mathrm{En_{RX}} + \mathrm{En_1} + \mathrm{En_S} \tag{2}$$

$$En_{TX}(No:dis)=\begin{cases}En_{el}*No+En_{fs}*No*dis^{2}, ifd<dis_{0}\\ En_{el}*No+En_{pw}*No*dis^{4}, ifd\geq dis_{0}\end{cases} \quad (3)$$

$$En_{RX}(No:dis)=En_{el}No \quad (4)$$

$$fit_{i}^{ene}=\frac{fit_{(a)}^{ene}}{fit_{(b)}^{ene}} \quad (5)$$

$$fit_{a}=\sigma_{1}*fit_{i}^{Dis_{r-r}}+\sigma_{2}*fit_{i}^{EN_{r-r}}+\sigma_{3}*fit_{i}^{dis_{NC-R}} \quad (6)$$

$$fit_{b}=\frac{1}{n}\sum_{x=1}^{n}\left\|N^{x}-B_{s}\right\| \quad (7)$$

(b) Distance model (dis)**:** As mentioned in eq. (8), distance matrix $DM(m*n)$ is stated for distance amid $ring, reg$ nodes. As per Eq. (9) distance matrix $DM(m*n)$ is stated for distance among $Nc-reg$ nodes. On the basis of eq. (10), Euclidean distance is calculated among reg and $ring$ positioned at x, y position is designed. On the basis of eq. (11) Euclidean distance is calculated among $ring$ and Nc positioned at p, q position.

$$DM(m*n)=\begin{bmatrix}dis_{N0_{ring1,reg1,}}\ dis_{N0_{ring2,reg_{2}}}.........dis_{N0_{ringn-reg_{n}}}\\ dis_{No_{ring1,reg1}}\ dis_{No_{ring2,reg2}}.........dis_{No_{ringn,reg\,n}}.\\ :\\ :\\ dis_{No_{ring\,m,reg1}}\ dis_{No_{ring\,m,reg1}}..........dis_{No_{ringm,reg\,n}}\end{bmatrix} \quad (8)$$

$$DM(m*n)=\begin{bmatrix}dis_{N0_{Nc1-reg1,}}\ dis_{N0_{Nc2-reg2}}.........dis_{N0_{Nc2-reg\,n}}\\ dis_{No_{Nc1-reg1}}\ dis_{No_{Nc2-reg2}}.........dis_{No_{Nc\,n-reg2}}.\\ :\\ :\\ dis_{No_{Nc1m-reg1}}\ dis_{No_{Nc\,m-reg2}}..........dis_{No_{Nc\,m-reg\,n}}\end{bmatrix} \quad (9)$$

$$dis_{x,y}=\sqrt{(ring_{y}-reg_{y})^{2}+(ring_{x}-reg_{x})^{2}} \quad (10)$$

$$dis_{p,q}=\sqrt{(ring_{p}-reg_{q})^{2}+(ring_{p}-reg_{q})^{2}} \quad (11)$$

As stated in eq. (12), (13), and (14), fitness function of distance $dis_{ring-reg}$ is exhibited. As stated in eq. (15), (16) and (17) fitness function of distance $dis_{Nc-ring}$ is stated and Cen_{x} indicates x^{th} network centre

$$fit_{i}^{dis_{ring-reg}}=\frac{fit_{(a)}^{dis_{ring-reg}}}{fit_{(b)}^{dis_{ring-reg}}} \quad (12)$$

$$fit_{(a)}^{dis_{ring-reg}}=\sum_{x=1}^{No_{ring}}\left[\left\|Cen_{x}-B_{s}\right\|+\sum_{y=1}^{No_{ring}}\left\|Cen_{x}-X_{x}\right\|\right] \quad (13)$$

$$fit_{(b)}^{dis_{ring-reg}}=\sum_{x=1}^{No_{ring}}\sum_{y=1}^{No_{reg}}\left\|Cen_{x}-X_{y}\right\| \quad (14)$$

$$fit_{i}^{dis_{Nc-ring}}=\frac{fit_{(a)}^{dis_{Nc-ring}}}{fit_{(b)}^{dis_{Nc-ring}}} \quad (15)$$

$$fit_{(a)}^{dis_{Nc-ring}}=\sum_{p=1}^{No_{Nc}}\left[\left\|C_{p}-B_{p}\right\|+\sum_{y=1}^{No_{Nc}}\left\|C_{p}-X_{p}\right\|\right] \quad (16)$$

$$fit_{(b)}^{dis_{Nc-ring}}=\sum_{p=1}^{No_{Nc}}\sum_{q=1}^{No_{ring}}\left\|C_{p}-X_{q}\right\| \quad (17)$$

4. Proposed FBOA

The fuzzy BOA is exploited in this paper, for the routing by choosing the ring nodes by exploiting the defined multi-objective model. Initially, the exploitation as well as exploration ratio of this approach is stated with p parameter and remnants constant subsequent to the initialization at set off optimization procedure [10]. Then, during the whole optimization procedure probability switch remnants constant in conventional BOA approach. During some iteration this might leads to the approach to carry out the inappropriate search behaviour. Finally, the BOA exploits a pairwise interaction among 2 arbitrary butterflies to carry out the local search. It is easy scheme which may works for easy issues but cannot assure the optimization issue requirement with highly complicated search domains. This problem is systematically assessed and exhibited in [11] [12]. In order to overcome all the aforesaid issues, a novel FBOA model is proposed in this paper. Here, using fuzzy decision phase search behavior of approach is robotically adjusted.

The mathematical formulation of the FBOA is represented as follows:

$$^{t+1}X_i = {}^{t}X_i + \tau \cdot \psi \cdot \left(r_1^2 \times g^* - {}^{t}X_i\right) + \alpha \cdot \overline{\tau} \tag{18}$$

wherein,

$$\overline{\tau}_i = 1 - \tau_i \tag{19}$$

$$\alpha = +1, \text{ if } f\left({}^{t}X^V\right) < f\left({}^{t}X_j\right) \tag{20}$$

$$\alpha = -1, \text{ if } f\left({}^{t}X^V\right) \geq f\left({}^{t}X_j\right) \tag{21}$$

wherein, r_1 and r_2 indicates 2 arbitrary values uniformly chosen amid 0 and 1; τ indicates fuzzy decision factor, f (.) returns value of objective model for required vector; ${}^{t}X^V$ indicates virtual butterfly.

To present excellent measurement criteria, a dimensionless term named NOF is stated for each butterfly in colony. Mathematically, adopted NOF for i^{th} butterfly is stated as follows:

$$NOF_i = \frac{f(X_i) - f\left(g^*\right)}{f\left(X^{worst}\right) - f\left(g^*\right) + \xi}, i = 1,2.,,,M \tag{22}$$

wherein, X^{worst} and g^* indicates worst and optimal butterflies in population, correspondingly; X_i signifies i^{th} butterfly; M signifies population size; ξ indicates minute positive scalar to put off deviation by "0" conditions. It is obvious that in a reduction issue lesser value of NOF i represents superior circumstance The below equation exhibits updating procedure of tendency factor for i^{th} butterfly τ_i on the basis of its prior value ${}^{old}\tau_i$ and increment of $\Delta\tau_i$ is ascertained using fuzzy phase.

$$\tau_i = {}^{old}\tau_i + \Delta\tau_i \tag{23}$$

The virtual butterfly is a supplementary idea that is concerned in direction-finding procedure to enhance search ability of approach. It is stated as weighted average of all butterflies. Certainly, this idea is created by exploiting all butterflies information of the colony on the basis of their objective model values. Mathematically this conceptual butterfly is stated as below:

$$X^V = \sum_{i=1}^{M} c_i^{-w} X_i^P \tag{24}$$

where,

$$c_i^{-w} = \left(\hat{c}_i^w \Big/ \sum_{i=1}^{M} \hat{c}_i^w\right) \tag{25}$$

and

$$\hat{c}_i^w = \frac{\max_{1\leq j\leq M}\left(f\left(X_j^P\right)\right) - \left(f\left(X_j^P\right)\right)}{\max_{1\leq j\leq M}\left(f\left(X_j^P\right)\right) - \min_{1\leq j\leq M}\left(f\left(X_j^P\right)\right) + \mu} \tag{26}$$

$i = 1,2,\ldots\ldots,M$

M exhibits population size and $f(\cdot)$ returns objective model value for chosen butterfly; μ indicates a minute positive scalar. Initially, if the optimal butterfly is caught in local minimum, virtual butterfly presents an optional search path to stop any premature convergence. Then, modelling a striking and hideous effect on other butterflies transmits population range needed for a competent search procedure. Finally, in few iterations X^V indicates in superior position than optimal agent (g^* in these circumstances, virtual butterfly presenting an uncontaminated attraction effect on other butterflies performs all of them toward this recognized capable point [10].

5. Result and Discussion

An energy effectual ring cluster RP was experimented in MATLAB. A simulation analysis validated was performed regarding count of residual energy, throughput, as well as transmission delay and the corresponding outcomes obtained were noted. This experimentation was performed by evaluating the adopted model with traditional approaches like FF, PSO and GA.

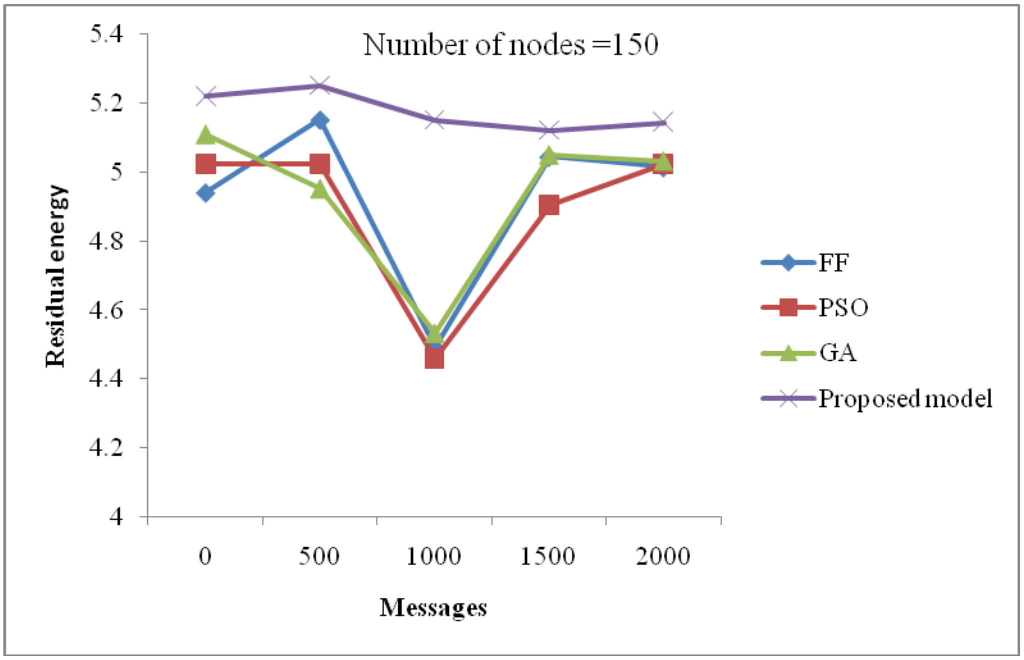

Fig.1. *Analysis of adopted and traditional techniques regarding the residual energy*

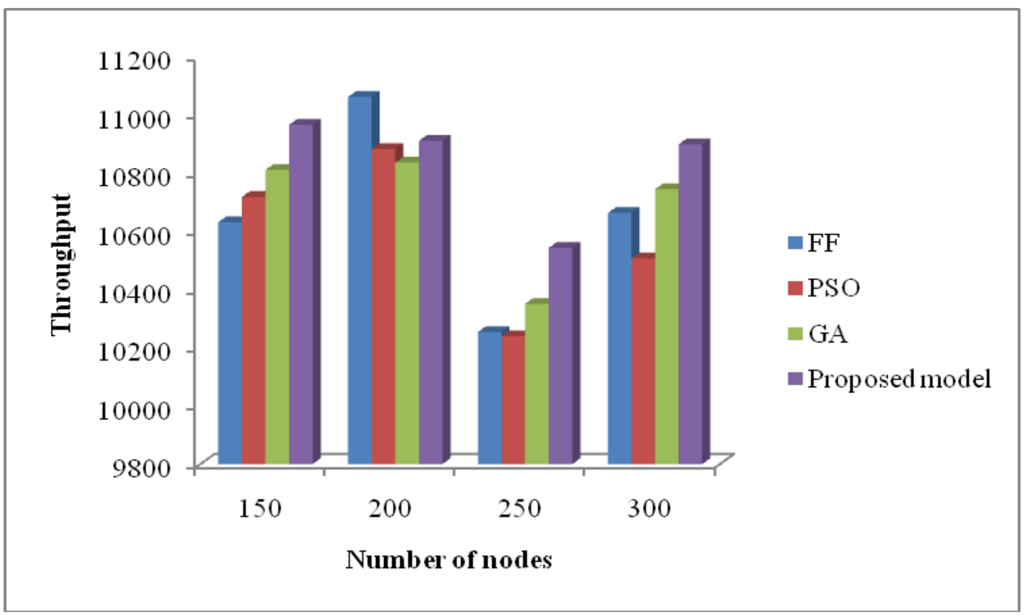

Fig.2. *Analysis of adopted and traditional techniques regarding the Throughput*

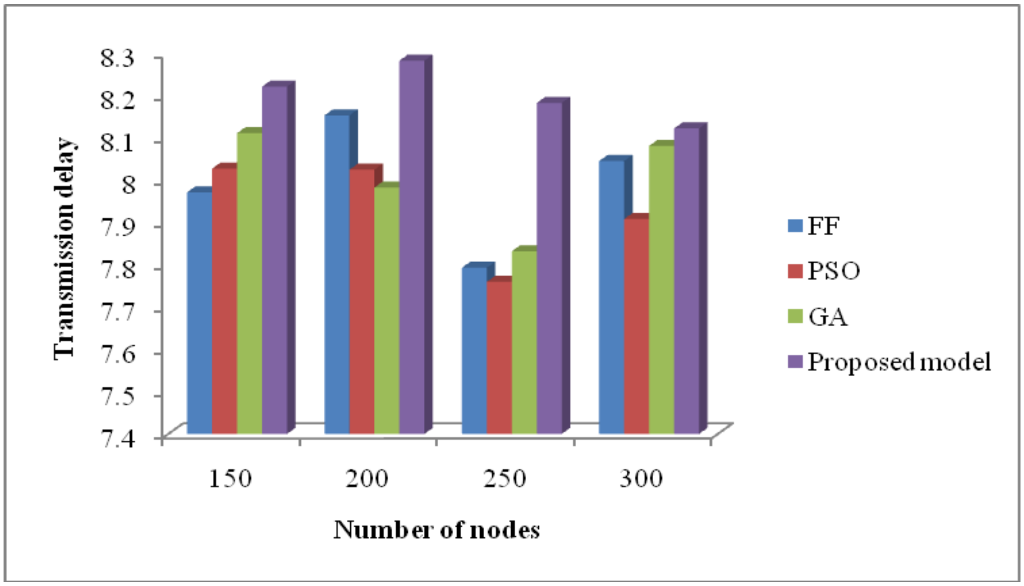

Fig.3. *Analysis of adopted and traditional techniques regarding the Transmission delay*

Fig 1 evaluates the analysis of adopted and traditional techniques concerning residual energy. Here, it is obvious that the adopted model has high residual energy and therefore lifetime of network is improved by adopted approach from the overall evaluation. Fig 2 evaluates the analysis of adopted and traditional techniques regarding throughput. Here, it is clear that adopted model has maximum throughput and minimum delay in transmission of data. Fig 3 exhibits analysis of adopted and traditional techniques regarding transmission delay. Here, it is obvious that the adopted model has the maximum transmission delay, while data transmission at 10mbps speeds. However, the number of messages transmitted is superior to the adopted model at the same time. This evidently there is only an insignificant number of data losses.

6. Conclusion

In this paper, an energy aware routing protocol was designed on the basis of defined multi-objective. At first, with predefined normal nodes and radius the ring was designed as well as the data was transferred to the sink by using ring structure. Instinctively, the neighbour node switches its role when ring node attempts to deplete the selection of the normal node was obtained by optimally using the defined multi-objectives like energy, distance and delay. In this paper, an FBOA optimization model was exploited because it plays a noteworthy role in electing neighbors as ring node. Ultimately, proposed model performance was estimated with the traditional models about the energy utilization, transmission delay, and throughput.

Compliance with Ethical Standards

Conflicts of interest: Authors declared that they have no conflict of interest.

Human participants: The conducted research follows the ethical standards and the authors ensured that they have not conducted any studies with human participants or animals.

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