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Energy Efficient Firefly Algorithm Based Localization with Optimal Routing for Wireless Sensor Network

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ABSTRACT

Nowadays the most importantissues in wireless sensor network to identify the location and direction of sensor nodes. In network organization and sensor data integrity, the location information is very important. Mostly inWireless Sensor Network applications(WSN) sensor nodes are required to know their locations with high standard of accurate such as anomalydetection etc. This Localization principle is support sensor nodes to figure out their location in sensor network. In Proposed, useEnergy efficient Firefly algorithm basedLocalization with Optimal Routing (EFLOR) is proposed to enhance the packet deliverance based on locationrevise of mobile nodes and numerous path routing. The present work has three phases. In first phase, clustering nodes introduced to improve link quality and load balance. In second phase, numerous pathoptimal routing is monitor based on Johnson's algorithm. Furthermore, routing messages are transmitted to reach a pathas disjoint set of node. Third phase, mobile node location is changed with use of network succession ratio to optimize the cost of network. Simulation shows that the proposed protocol achieves high packet delivery rate, more network lifetime, minimum delay and minimumcommunication overhead compared to existing.

Keywords: WSN, Localization, optimal numerous path routing, energy, link quality, load balance, firefly.

1. INTRODUCTION

A sensor network is a large number of sensor nodes are ordered and that are densely organized in a network field. Every sensor nodes are presents a sensing task for perceiving particular events.Particular node marked as sink, it is in charge forcollecting sensing dataexposed from all the sensors and sends the data to work manager. In network, if some sensors failure to communicate with sink directly means several neighbour sensorshave been transfer the data [1]. Such communication has some critical issues such as Localization, deployment, and coverage in WSNs. The above issues the Localization is considered as most important issue in WSNs usedas vehicle tracking, surroundings monitoring and survey be controlled byrecognizing the locations of sensor nodes [2].Then the location-based routing protocol [3] is focused to efficient data transmission. In [3], the processing and data forwarding are presented build thenode deploying locationinformation's.

The Localization method is normally considered to fixing sensors roughly else providing every sensor with a Global Positioning System, the receiver to solve the Localization problem in WSNs. But,owing tothe big scale location of sensor networks andthose methods become costly else ineffective, therefore researchers proposed various Localization schemes for WSN Localization. The various approaches are orderasrangebased and range free.In range based approach, distance among the nodes or angular deviation among the neighbouring sensors are used to estimate locations [4-6] in network.The distance or angle estimation techniques are included Time Of Arrival (TOA),Time Difference Of Arrival (TDOA), RSSI-

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Received Signal Strength Indicator and Angle Of Arrival (AOA). The above schemes are naturally have reaches the maximum level accuracybut those schemes want simulationto evaluate distances or angles. In range free approaches, don't required any distance or angle data's aboutLocalization [7-11], but it needs link between the network and material of received messages. Existing presented schemes are, Centred method [7], APIT method [8], DV-HOP method [9], convex hull [10], Bounding box [11], and Amorphous algorithm [12]. It can't achieve as efficient precision as compared to range based approach and those schemes offer an economic approach.

In this paper, the ranging information is used for evaluate the position. It is done based on two waya such as traditional way or optimization algorithm. The traditional way of solving is a set of simultaneous equations. The optimization is minimizes theLocalization error.Energy efficient routing depends on optimization is one of most important goal in WSN [13]. In WSNs, routing is discovering path between source and base station for transmitting or communicating data. The way of communication is carried out in two ways such as single path or multiple paths communication. Thedistribution of routing based on multiple paths is leads more balanced energy compared than single path routing. In WSN, many routing protocols are introduced to improve the energy efficiency. As well, those schemes presented other capabilities such as intrusion detection, renewable energy, mobile sensors, fault tolerance, quality-of-service, and security.

In this paper, Energy efficient Firefly algorithm based Localization with Optimal Routing (EFLOR) is proposed to enhance the packet receiving rate in network is based on location update of mobile nodes and numerous path routing.Initially, cluster formation is introduced to improve link quality and load balance. Secondly, numerouspath optimal routing is predicted based on Johnson's algorithm. Finally,network progression ratio used for updated the mobile node locations for optimize the network cost. The detection of location is mostsignificant taskin WSN as well as accurate location information also important. The accurate locationcould enormously recover the performance of energy saving, routing, data aggregation and maintaining network security. Experimental results show that the proposed methodreached themaximize the packet delivery rate, increase network lifetime, reduce delay and minimum communication overhead than existing schemes. The rest of the paper is organized as follows: the section 2discusses related works on Localization. In section 3, describes the proposed methodology. Section 4 reports simulation results of proposed method. Section 5 concludes the work.

2. RELATED WORK

Jiang et.al [14] presented a novel Localization approach for unknown nodes to their position through their near anchor nodes are obtained. Now recentone was introduced to estimatethe distance between unknown nodes and anchor nodesfor minimizing the noisethrough Localizationwhen it is larger node's communication radius. To estimate the related position of nodes the self-adapting genetic algorithm is introduced. This estimation is reduced the Localization error.

Yetkin and Gungor [15] introduced a new Received Signal Strength Indicator (RSSI) based fingerprint technique. It uses logical inferences. In this work, closed area was splitted into cells 1×1 mt. the each cell RSSI characteristic is stored in databasewith the purpose of prepare a radio map.TheRSSIs of anchor nodes obtained from base stationwere evaluated with radio mapdealing to logical algorithms. The target Localization is estimated based on mathematical terms.

Wei Zhag et.al [16] proposed a two-phase robust Localization algorithm based on uniformity of Beacons in Grid computing. The first-phase is based on voting method. The voting is based on the consistency of beacons in the grid. It is used to filter out part of the distrustful nodes. The second-phasewas adopted the loss function in M-estimation of Robust Statistics to attain a robust solution with the remained nodes.

Zhang and Hong Pei et.al [17] discovered a two-hop CMLA-Collaborative Multilateral Localization Algorithm. Event-drivenschemes are introduced for implemented this algorithm. It is estimated the distance between two hop nodes and applied anchor nodes have a two hop that denotes a new node to network. The error rate calculated and is reduced tominimum level to compute coordinates of unnamed nodes. In this method, if any unknown node cannot be localized through two hop anchors nodes means it was localized by anchors and localized nodes inside two hops.

Chengpei et.al [18] proposed a WSN Localization method based on Plant Growth Simulation Algorithm (PGSA). It is a bionic random algorithm. It isdistinguishes the improving techniques plant phototropism. The experimental analysis shows thatthe PGSA is quick convergence, simple, and robustness, and it is flexible one for the large-scale settings.

Oguejifor et.al [19] presented a Localization system. It follows a RSSI approach in WSN to enhance packet delivery rate andtoevaluatethe system position estimation accuracy. This workprovidesminimum three anchor nodes needed in network. Anchor nodes forward packets kept their node position and some parameters are time to finding accuracy.Then unsighted node within the communication range calculatesapproximately its distance to the anchor nodes andunsighted nodes receive packet from anchor nodes if it peradventure and itfocus the location.

Xiajoun Zhu et.al [20] observed two candidate solutions.In first solution, if nodes are within transmission range means assuming that nodes can hear from each and the other presuming closer nodes observe larger RSSI. Practically the two candidate solutions do not work well. Next level ofapproach,"near" is changed to "the nearest" and "bigest" to "the bigest". Establish that the new presumption is somewhat reliable in practice.

Rama Prabha and Parvadha Devi [21] introduced a fuzzy logic based restriction system for remote sensor hubs. That is portable in uproarious, savage situations. Fuzzy multi lateration and a grid prediction are used by constituent frameworks to process the area of a hub as a zone. Then this worksignal strength is frightened into bins which encode the ambiguity.

LasloGogolak et.al [22] presented fingerprinting Localizationthis work,the RSSI values between communication links are identifiedthe early situated sensors and the mobile sensor were recorded in an indoor environment. Feed-forward type of neural network was trained the recorded RSSI values. The experimental result of the training is a neural network incapable of performing indoor Localization. Then the accuracy of the Localization between the original and the practicalvalues was calculated with Euclidean distance and established with the cumulative distribution function.

Mistry & Mistry [23] discussedon RSSI based Localization in WSN. It will discusshow to reduce location errors and useddifferent models and techniques to get better accuracy. After that it focused on how to make an algorithm scalable and how get better energy competence by provided that authentication and key management.

3. PROPOSED METHODOLOGY

In this section, thecluster with improvednumerous path routing is introduced to improve link quality and load balance has been discussed. Numerous pathroutesare deployed to improve the network lifetime. Localization scheme is proposed to place the target node and undefined sensor nodes follows on firefly algorithm.

3.1. System overview

In proposed system, initially, the cluster head selection and cluster formation is present to give maximum energy saving and minimum performance loss against the more battery consumption and overcome the problem of network unbalancing and node failures. In second phase, numerous path routing is predicted and route request packets are transferred to reach a set of node put out of place paths. In last, Localization

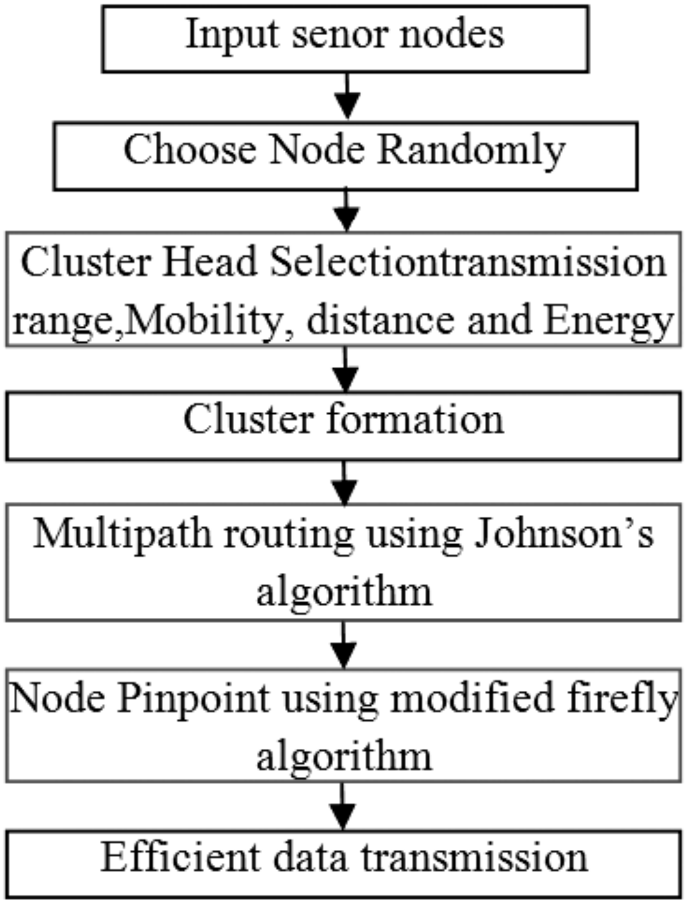

Figure 1: Overall architecture diagram

scheme is proposed to locate target node and undefined sensor nodes follows on firefly algorithm. It is achieved high packet delivery rate.

3.2. Cluster formation

In this phase, the clusters are created by using the formation of sensor nodes, which are have a ClusterHead collects the data in the cluster's sensor nodes then the aggregated data transmitting from several hops to the base station and this process reduces the bandwidth by removing the redundant data in a cluster node. Clusters have a sensor nodes are divided in to virtual groups of networks. In this group, nodes may be assigned as cluster head, gateway and cluster member participants. The main responsibility of cluster head is to act as local coordinator, performing intra cluster packet transmission, issuing authentication to data packets and packet transfer, and so on. Cluster access is a non-cluster head node with inter-cluster connectivity, so it hasrights to processnearest clusters and forward data in between clusters. A cluster member is actuallyknown as ordinary node and it is a member of both cluster groups. To address the problem of delivering data packets among the mobile nodes, the numerous path routing is used. The cluster head selection is based on the given below parameters.

3.2.1. Transmission range and energy

The transmission range is thus calculated by using the formula

$$T_r = \sqrt{\left({}^{(dn_d / dn_c)} /_{cover\ age\ area} \right)} \tag{1}$$

Where dn_d is the desired node degree and dn_c is the current node degree of network, Coverage area equals the area covered by the cluster.

$$dn_d = S + 1,$$
$$S = nodedensity * d\left(C, N\right) \tag{2}$$

$$d\left(C, N\right) = \sqrt{\sum_{i=1}^{n}\left(N_i - C_i\right)^2} \tag{3}$$

C = cluster head, N-node.

The total energy E_t consumed

$$E_t\left(s_i, d\right) = \begin{cases} s_i E + s_i \varepsilon_{fs} d^2, d \le d_0 \\ s_i E + s_i \varepsilon_{mp} d^2, d > d_0 \end{cases} \tag{4}$$

Where $d_0 = \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}$

Where E represents the energy consumed to transmit or receive 1 bit message; ε_{fs} is the amplification coefficient of free-space signal and ε_{mp} is the multi-path amplification coefficientfading signal, its value depend on the route amplifier model and d represents the distance between transmitter and receiver; s_i is the bit amount of sending information.

3.2.2. Mobility

Mobility or stability is avital factor in deciding the clusterheads. ToRemove a frequent clusterhead changes this proposed methodis popular to select a clusterhead that does not update fast. If the clusterhead updates fast means the nodes may be split from clusterhead and as a result of a re-affiliation occurs. It can increase computation and processing, which is not anattractive feature. The permanence of the link will also improve the solidity of the cluster. Each link's stability can be recognized by the displacement of the node and velocity of itsdisappoint. Each link's duration can be estimated by,

$$LD = \frac{-\left(ab + cd\right) + \sqrt{\left(a^2 + c^2\right)^2 - \left(ad - bc\right)^2}}{a^2 + c^2} \tag{5}$$

Where, $a = v_i \cos \theta_i - v_j \cos \theta_j$, $b = x_i - x_j$, $c = v_i \sin \theta_i - v_j \sin \theta_j$, $b = y_i - y_j$ and v_i, v_j are speeds of mobility. To determine the node's stability, some information from GPS is required. LD (Link Duration) is calculated and then reversed. Stability of the link between nodes,

$$LN_s = e - LD \tag{6}$$

Smaller value of N_s gives more stable link.

3.3. Optimal Numerous path Routing

It is assumed that the graph of nodes is a connected graph that means all nodes are connected with the probability of almost one. Any node of the network can establish connectionnetwork to any other node. Whenever a node *A* wants to establish a connection to node *B*, then it has to first find the route to be. The routing process depends whether the node *B* is in the same cluster nodes are *A* or neighbour of another cluster in partitioning. Optimal path is selected based on the cluster head and node minimum distance also defined as cost and minimum energy consumption of nodes. It is selected based on Johnson's algorithm. This method conforms to satisfying wants of optimal path detection in conditions of cost and energyconsumption. It also collects the information about the nodes energy level so as to maintain the continuous connection for communications. Approach initially started with the route finding by forwarding a RREQ packets to its nearest neighbour nodes and waits for the RREP Packets to satisfy the parameters like cost for network transmission in each and every route can be identified. For this cost detection Johnson's Algorithm is used. Cost of network depends on network partitioned hops and the TTL -Time To Live fields. From the hop count lesser count nodes are selected and low cost route to destination get efficient communication and also lesser Time to Live. Memory capacity of data's to be shared and cost of routing path is calculated from source to destination. The efficient path detectioneliminates the rules in shortest path. The network has a loop based designs than its performance end energy will reduced. That loopwants to be avoided. The proposed mechanism measures the nodes closer in the low cost path. If the node entry is frequent in the routing table then it has beeneliminated.

Johnson's algorithm used in method process as following steps [24, 25]:

Step 1: intially, it insert a new node q with zero weight edges from it to all other nodes.

Step 2: Then runs the Bellman-Ford (BF) algorithm starting from the new vertex q' and to discover for each vertex v the minimum costh(v) of a path from q' to v. This BF used to check for negative weight cycles. If this step identifies a negative cycle, the algorithm is terminated.

Step 3: Next the edges of the original network nodes are recalculate its weight of path using the values computed by the BF algorithm: at edge from u to v in network, has length $w(u, v)$ is given the new length $w(u, v) + h(u) - h(v)$.

Step 4: Finally, q' is pruned, and Dijkstra's algorithm is used to discover the minimum cost paths from each node s to every other vertex v in the network. The detail johnson's optimal (shortest) path algorithm is given below

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Algorithm 1: johnson's optimal (shortest) path detection

Input:(q', v, cost, dist, n) q': new node, v: Initial vertex; Cost: Weight; n: Number of vertex;

Output: optimal path for routing

Start LEACH ();

Send RREQ (SourceSeqNum, Hop Counter, TTL, DestinationSeqNum);

Receive RREP (SourceSeqNum, Hop Counter, TTL, DestinationSeqNum)

Route_Path_Cost_Analysis ()

{

Maximum Cost= Maximum TTL Value + Maximum Hop Counts

Minimum Cost= Minimum TTL Value + Minimum Hop Counts}

If cost == negative cost

Terminate

Else

Costs of Each Path==stored path cost

Dijkstra's_Route (Path 1, Path 2, Path 3, Path 4 …Path n);

```
If (Node==Twice && Path==Shortest)
    {
Loop Detected
Remove a path from the list
    }
If battery is low==Update Route// Check battery level of each node
Else Route is ok
Suggested Shortest Path (High Energy Nodes, closer to intermediate, no looping, no traffic);
Prefer optimal path to the node seeking communication
Update routing table
Exit
    }
```

The optimal routing is improved the transmission packet delivery ratio and reduced delay.

3.4. Localization scheme

In this phase, modified firefly algorithm is proposed to enhance theLocalization accuracy and reduce node degree in WSN.The Localization algorithms will be created andapplied on each individual sensor node in place ofmiddle base station (BS)accepted in centralised techniques. Distance measurement from the neighbouring beacons or previously localised nodes is used to localize the target nodes. The Localization scheme is based on modified firefly algorithm.

3.4.1. Modified firefly algorithm

In the firefly algorithm, aimlessly generatedsolutionswill be considered as fireflies.Then the brightness is allocatedbased on their performanceon the objective function. The firefly algorithm is designed based on the following rule (i.e) a firefly will be involved to a brighter firefly. There is no brighter firefly means it will travel randomly.In thismodified firefly, the random movement of the brighter firefly is changedby producing random directionswith the meaning ofdecide the good pointer for direction to indicate the brightness increases. If such a direction is notspawned means it will stay behind in its presentpoint. Furthermore the task of attractiveness is changed in such how that the impact of the target method is enlarged.

The brightest firefly is a firefly with current global best results.Considered, if this brightest firefly moves randomly as in the standard firefly algorithm means follows on the direction its brightness may decrease. In that particular iteration, it escorts to the decline of the performance of the algorithm. However, this brightest firefly if allowed to travel only in a way means it will improves the brightness and it will not minimize aperformance of this algorithm during provisions of global good result for that particular iteration.

The alteration of proposed method is as depends on it. The movement direction of the brightest firefly is determine by randomly generate m' unit vectors and it denoted as $u_1, u_2, ..., u_m$. After that C choose as direction, among the randomly generated m' directions throughout that the brightness of the brightest firefly can increase if the firefly travels therein direction.

$$x : x + \alpha U \tag{7}$$

Where α is a random processlength.

Considered, if such path doesn't live among the arbitrarilygiven result means the brightest firefly can keep its current position of network. Furthermore, rather than taking $A_0^i = 1$ for each firefly *i*, which rely on the intensity of the firefly means it is enhanced to allot a sourceattractiveness, which in turn depends on thetargetmethod.Singlepotential way to allot the ratio of the firefly's intensity. Assume firefly *i*, located at *x′* is brighter than a firefly *j*, if is located at *x* point. The firefly located at *x* will travel towards firefly *i*, as knownbelow equation, and A_0 is given by

$$x = x + A_0 e^{-\lambda r^2}\left(x' - x\right) + \alpha \in \tag{8}$$

Where $A_0 = \frac{I_0'}{I_{0'}}$

Where I_0' means the intensity at $r = 0$ forfirefly *i* and I0 is the intensity at $r = 0$ forfirefly *j* and $I_0 \neq 0$. In simulation, to remove the singularity case when $I_0 = 0$, A_0 can also be given as $e\ I_0' - I_0$

If then get $A_0 = I_0'$ and if the intensity is large, the node travels of firefly*j* in the direction of *i* could be long. Though, relying on the result space it is improved to adjust A_0 point. During either case itshould be directly proportional to the strength at the sender node, I_0'.

Range-based single-hop Localization in a network of a total of n+m sensor nodes assesses the coordinates of n target nodes using a possibility information about the position of m anchor nodes and the d_{ij} is pair-wise distance data transmission between the i anchor node to the j target node. Then the 2D Localizationissue, a total of 2n unknown coordinates are to be calculated using the anchor node coordinates. If there is a maximum of N target nodes then using M anchor node seen their position and find the unknown node position. The Localization of step by step process given below

1. Deploy the sensors nodes in random way manner.
2. Deploy the beacons randomly
3. Determine a real distance like the actual distance between the anchornode and sensor nodes
4. Allocated measured distance like the distance obtained by the beacons using limittechniques. It makes a noise in original distance.
5. Identify a many sensors are within the transmission range of three or more beacons nodes in network.
6. Each and every sensor that can be pointedand Firefly algorithmis applied to minimize the objectivefunction it indicates a noise of errormethod given by the Equation (9)

$$\sum_{i=1}^{n} e^i = \sum_{i=1}^{n}\left(R_i - \sqrt{\left(a_i - a_m\right)^2 + \left(b_i - b_m\right)^2}\right)^2 \tag{9}$$

Here R_i is the inexact ranging distance. (a_i, b_i) is the corresponding beacon node positions (a_m, b_m) is the position occupied through the element, *n* is the number of beacons having transmission coverage over that sensor.

7. This algorithms given the closer values of the coordinates (a_m, b_m) such that error isminimized.
8. It is also applied to the nearest neighbour sensor in a particular distance

9. In node list, localized sensor nodes are removed and act as beacons node
10. The Localization error is computed following all the *Nl* nodes assessed their coordinates and it calculates the mean of squares of distances between actual node locations (a_i, b_i) and the after node moved locations $\left(\hat{a}_i, \hat{b}_i\right)$, $i = 1, 2 \ldots Nl$ is determined by Firefly algorithm. This is computed as Equation (10).

$$El = \frac{1}{Nl \sum_{i=1}^{l} \left(\left(a_i - \hat{a}_i\right)^2 \left(b_i - \hat{b}_i\right)^2 \right)} \tag{10}$$

11. All the steps from 3 to 9 will be continued until either all unknown nodes get localized or nomore nodes could be localized further. It is evident that the performance of the Localization algorithm if observed starts from values of M_{Nl} and *El* where $M_{Nl} = M - Ml$ is mentioned the number of not localized nodes. The lower values of N_{Nl} and *El* represent the better performance.

The modified firefly algorithm based Localization improved the network lifetime and reduced the node degree.

4. RESULTS AND DISCUSSION

In this section, the proposed EFLOR method performance is evaluated and its performance results are compared to existing methods such as Effective Localization based Optimized Energy Routing (ELOER) and Anonymous location-Aided Routing in Suspicious MANETs (ALARM). NS 2.34 Network Simulator is used to simulate present algorithm. In this execution, 100 sensor nodes move in a 1300 meter × 1100 meter square range for 50 milliseconds simulating time. Each and every nodehas a same transmission range of 250 meters. Proposed simulation settings and parameters are shortened in table 1.

Table 1
Simulation Settings and parameters

No. of Nodes	100
Area Size	1300 × 1100
Mac	802.11
Radio Range	250m
Simulation Time	60 sec
Traffic Source	UDP
Packet Size	80 bytes
Mobility Model	Random Way location
Transmitter Amplifier	150 pJ/bit/m^2
Package rate	5 pkt/s
Protocol	LEACH

4.1. Performance evaluation

The performance of present system is simulate depends on the following parameters.

4.2. Energy consumption

The average energy consumed by each node during the simulation time,energy units is J-Joules.

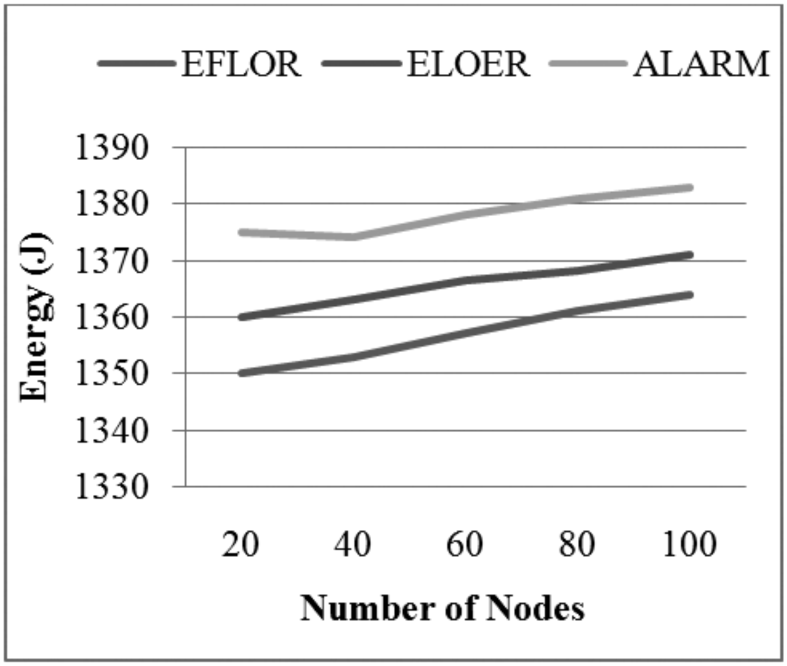

Figure 2: Comparison of Energy consumption vs. Number of Nodes

Fig 2 shows that the graphical representation of energy consumption for different number of nodes in WSN. The EFLOR algorithm has low energy consumption when compared with the existing system ELOER, ALARM. The energy for each and every node is calculated and cluster formation is done based on the energy values.

End-to-end delay: The end-to-end-delay is measured data packets delay from the sources to the destination node.

Fig 2a shows the end to end delay packet transmission in Existing ELOER, the existing ALARM and proposed EFLOR method, if it Obvious that the delay of EFLOR is lesser than ExistingELOER and ALARM. In EFLOR, the event data routing is efficient than compared to the event data routingtransmission using existing methods. It has stable routes.

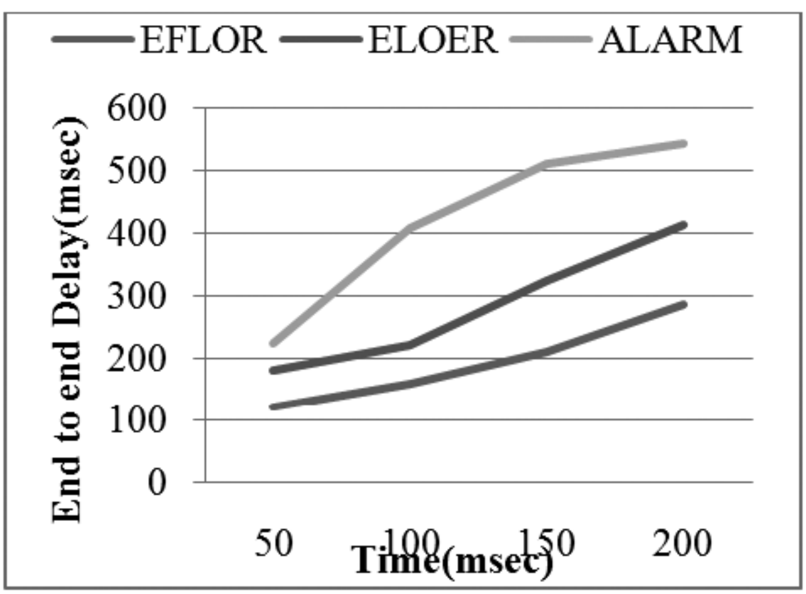

Figure 2a: Time Vs End to end delay

Communication Overhead: Communication overhead contains a certainlimits for control bits and data bits transmitted and delivered per data bits. Control bits include the cost of locationchanges in the searching path and destination searches and resend during the routing process.

Fig 3 shows the graphical representation of no of nodes vs. communication overhead of ELOER, ALARM and proposed EFLOR. If it obvious that the communication overhead of EFLOR is much less than that in Existing ELOER, ALARM. Network is designed with100 nodes; the communication overhead of present approach is considerably lesser than the existing approaches. Changes the network is designed with200 nodes, the communicationoverhead increased compared than existing ELOER, ALARM methods the proposed EFLOR has less communication overhead.

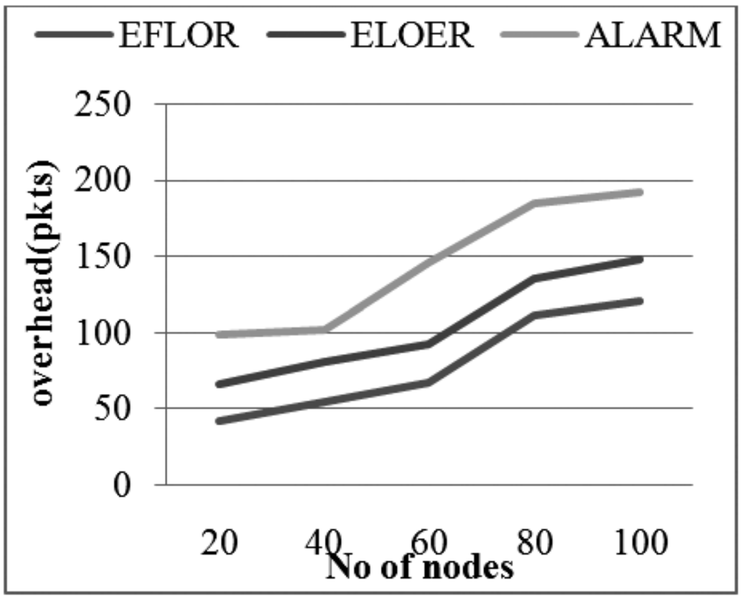

Figure 3: No. of Nodes Vs Overhead

Network Lifetime: It means the nodes stable to work in how long depend on energy of each node.

Fig 4 shows the lifetime of the Network in ExistingELOER, the ALARM and proposed EFLOR with variety of data effective time. Figure shows, the lifetime of both three schemes minimizebases a number of

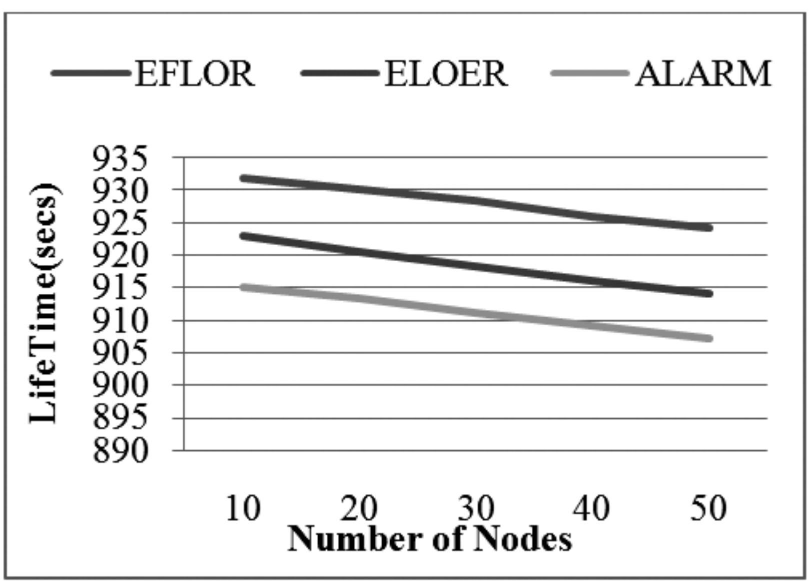

Figure 4: comparison of Network lifetime vs. Number of Nodes

node maximizein condition. Node count in the WSNincreases the packet traffic in nodeELOER, the ALARM and proposed EFLORis increased and that of the nodes energy consumption high. It is noted that Network lifetime of the WSN in EFLORunmodified the node count maximize because it is unstable. Main reason is data effective time is very small, almost all the questionsget in concert the wanted event data in proposedEFLOR. The Present EFLORis high network lifetime when compared with the existing systems.

Packet Delivery Ratio: The delivery rate is the as the ratio of numbers of packets received by receivertosent by sender. The best routing methods employing conditions forpacket delivery guaranteedindicates “reasonably” extract receiver and neighbourposition and collisions free.

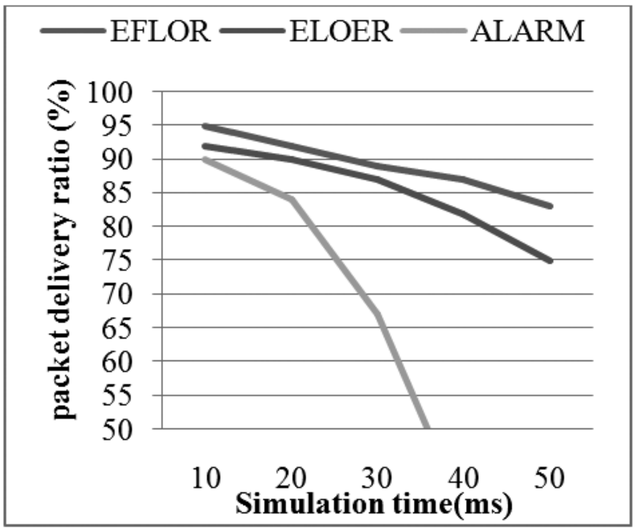

Figure 5: Throughput Vs Packet Delivery Ratio

Fig 5 indicates the results of packet delivery ratio for the simulation time 1-50millisecs for the 200 nodes present in network. Proposed EFLOR scheme reacheshigher packet delivery ratio than ELOER and ALARM scheme since it contains numerous path routing and cluster based features. Number of packets which is effectively received at the destination without loss of any packets or failure for proposed EFLOR is high which shows higher packet delivery ratio results.

Node degree: It is avitalrole to calculate the performance of topology control algorithms with time. Network node degree is maximize, means the more collision available. Mustbe kept node degree as small range.

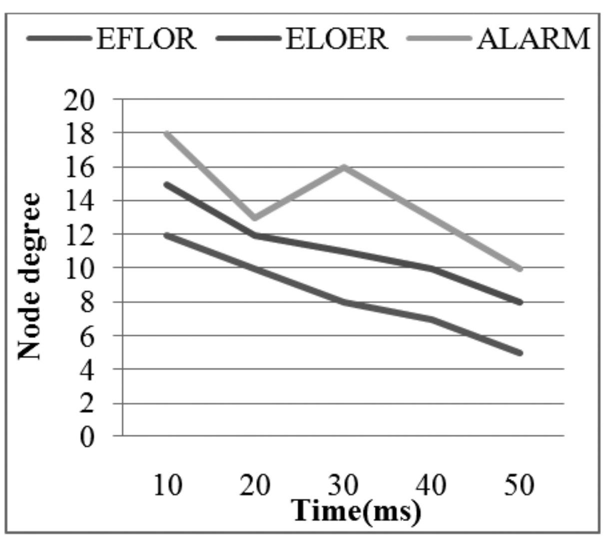

Figure 6: Speed Vs Node degree

Figure 6 shows the comparison of node degree. It is obviously shown that the node degree of EFLOR has lesser than ELOER and ALARM.

Network connectivity ratio: It indicates the connectivity between nodes in particular region. Connectivity of node is maintained as different to changing the speed of node.

Fig 7 reports the connectivity ratio for different the mobility. In results, EFLOR scheme has Maximum connectivity ratio than the ELOER and ALARM method because of location update of node calculations.

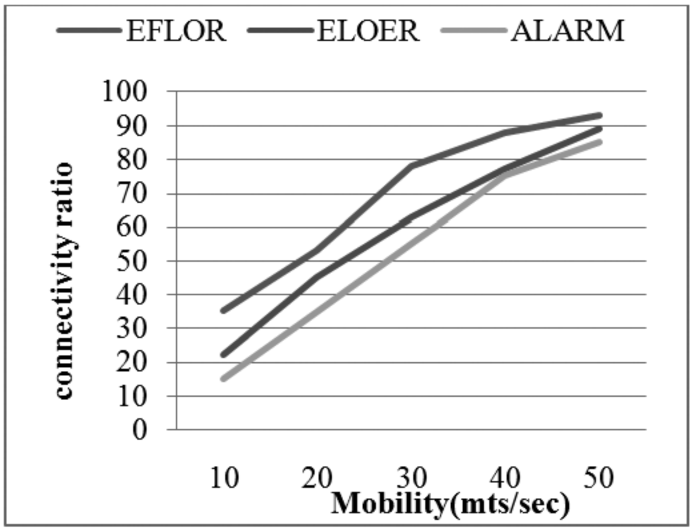

Figure 7: Mobility Vs Connectivity Ratio

5. CONCLUSION

Due to high dynamic nature of WSN, node location is not able to obtain quickly. To resolve this several schemes proposed node location procedure. But this does not contain numerous path routing and cluster enhancement. In this work, Energy efficient Firefly algorithm based Localization with Optimal Routing (EFLOR) is proposed to enhance the packet delivery rate depends onposition update of mobile nodes and numerous path routing. Initially, cluster enhanced numerous path routing is to overcome the problem of network unbalancing and node failures. Secondly, numerous path routing is predicted and route request packets are broadcasted to attain group of node disjoint paths. Last, nodeposition is update to achieve high packet delivery rate. The experimental result shows that the EFLOR has achieved high packet delivery ratio, higher network lifetime, connectivity ratio of node and minimum energy consumption, delay and communication overhead compared than existing schemes. In future, implement power aware routing procedure with proposed scheme to consume minimum power.

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