Design an Algorithm for Improved QoS in RASeR in MWSN

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***Abstract*—**This paper presents an optimized routing protocol named RASeR (Robust Ad-hoc Sensor Routing) for mobile wireless sensor networks (MWSN). RASeR involves the maintenance of hop count through a gradient field using global TDMA MAC layer which keep on updating from time to time. On the basis of this hop count the data is transferred through the blind forwarding technique from source to sink. Blind forwarding technique has the advantage that it can pass the messages through the network in a multipath manner. Network load and large energy consumption are the main problems that occurs in RASeR protocol causing packet loss and hence lowering the signal quality. Fireflies is the optimization technique used in this research paper to cop up with the Energy constrain and network load issue in RASeR.

***Keywords*—** *WSN, MWSN, RASeR,, Routing Protocols, firefly algorithm.*

I. INTRODUCTION

Wireless sensor network (WSN) is grabbing great attention of researcher in the field of mobile computing and communications [1, 2]. In WSN various environmental conditions can be sensed by the nodes and the sensed data is transmitted to the Base station. BS act as the collector of that data. The data collected at the BS is an access point for the human interface or act as a gate to other networks[3, 4]. With the use of various sensor nodes together in WSN performs concurrent data acquisition over a large area. Nowadays, WSNs are used in various fields like biomedical applications, monitoring forces and equipment, traffic control, energy management, forest Fire detection, flood detection, Vehicle tracking and detection, machine failure diagnosis and Precision Agriculture [5–7]. More energy is used during, the environment sensing and the data processing in WSN so the routing protocols are introduced [8]. The main emphasis in WSN applications is to design and develop the energy efficient routing protocols. In various situations nodes needs to be movable which can cover a large area as compared to the wired network. These movable nodes create the mobile wireless sensor network.

The ability of the sensor nodes to communicate wirelessly enables the nodes to distribute in a large area whenever and wherever required. Generally, Wireless sensors are deployed in inaccessible terrain. Therefore lifetime of the WSN nodes and energy consumption are very important factors. Many hardware and software enhancement has been implemented in recent years to improve the network performance. Many techniques have been employed to achieve the required network performance such as enhancement in hardware design, cross-layer design technique and implementation of various types of routing protocols but these techniques can have their own limitations. In MWSN as the nodes are movable, there is no fixed path between the source and the sink so the successful data transfer is a difficult task. The routing protocols help to forward data successfully from the source towards the sink.

II. RASER

Robust Ad-hoc Sensor Routing (RASeR) is a novel data routing protocol in mobile wireless sensor networks (MWSNs). It is designed according to the new technologies used in MWSN to cope up with the various challenging conditions i.e. high reliability and low-latency even in highly mobile scenario. Robust Ad-hoc Sensor Routing allows each node to transmit one at a time in an order which is already defined that is a single time slot is assigned to each node for transmission which is large enough to transmit a single packet [9]. The order in which the time slot of the node occur is fixed and repeated cyclically. A cycle is defined as the time it takes for each node to transmit and a slot is the time it takes to transmit a single packet. Each cycle consists of up of m time slots, where m is the defined as the number of nodes in the network. GTDMA is contention free that is no collisions can occur, which reduces the chances of packet loss. Since the length of the time slot and numbers of nodes are set before deployment, the protocol can be uniquely optimized for each new transmission, making RASeR highly adaptable. The main reason behind the use of GTDMA is to facilitate the constant maintenance of the gradient field. By using the GTDMA it is assured that each node will broadcast in a strict order in a deterministic manner, which also allows for the gradient to be refreshed with the highest possible frequency. In this way the routing protocol depends on MAC layer which already uses a GTDMA scheme. In GTDMA MAC, one of the biggest concerns is the latency that nodes will suffer by waiting for their assigned time slots before transmit of the data. As there is no requirement for the selection of forwarding nodes, no collision avoidance mechanism and no retransmissions so end-to- end delay is also kept low. In addition, in the case where only small packet sizes are required, the cycle time will remain low and the packet latency will also be low. With the help of GTDMA MAC, each node has the ability to send once in a cycle. During every time slot nodes are required to send a packet of data or Beacon packet if the node has no data to transmit. A beacon packet is nothing but the first two fields of the data packet, namely node identification and hope count. This allows each node to listen for the transfer of any node in the range before reaching its own time slot.

RASeR uses the blind forwarding technique to forward data towards the sink, so the decision to forward data is made at the receiving node on a hop by hop basis. In other words, when a node transmits, its broadcast is overheard by all of its neighbors. Each neighbor can then compare the hop count contained in the received packet with its own. If the hop count of the current node is less than the hop count that is received then the data packet is forwarded. But if the hop count of the current node is more than the hope count received then the data packet is dropped. RASeR has some additional features that include Reverse flooding i.e. communication form sink to source is also possible, second feature is supersede mode i.e. only newest data packets are kept in queue and redundant information packets are dropped and the third feature is energy saving sleep cycles which can set nodes to sleep mode if they do not have any data to send which reduces the energy consumption to some extent.

III. RESEARCH GAPS

In WSN, multi-hop routing is an effective mechanism for data collection. In multi-hop routing, the selection of forward node for sending data plays a vital role. In the WSN the major problem is to conserve energy and improve the network lifetime. In this research the above defined problem will be taken care of. Energy is the main factor that needs to be saved in order to increase Network lifetime in the wireless sensor network. Less is the energy consumption more will be the network lifetime. Energy consumption can be categorized as Useful and wasteful. The energy that is required for transmission and reception of the sensed data is called as useful energy consumption. Wasteful energy consumption can be due to one or more of the following facts. One of the major sources of energy waste is idle listening, that is, (listening to an idle channel in order to receive possible traffic) and secondly reason for energy waste is collision (When a node receives more than one packet at the same time, these packets are termed as collided), even when they coincide only partially. All packets that cause the collision have to be discarded and retransmissions of these packets are required which increase the energy consumption. The other reason for energy wastage is overhearing (a node receives packets that are destined to other nodes). The fourth one occurs as a result of control-packet overhead (a minimal number of control packets should be used to make a data transmission). Finally, energy wastage is over-emitting caused by the transmission of a message when the destination node is not ready. Considering the above-mentioned facts, a correctly designed protocol must be considered to prevent these energy wastage. Complexity is one of the biggest disadvantages of large scale wireless sensor networks.

- It is more difficult to configure than wired network.
- Gets distracted by various elements like Blue-tooth.

IV. FIREFLIES OPTIMIZATION

To conserve energy and enhance the network lifetime optimization techniques are used. The firefly algorithm (FA) is a metaheuristic, which is inspired by the behavior of fireflies. Most of the fireflies produce short and rhythmic flashes. These flashes are generated by a process of bioluminescence may serve as an element of warning signals [10]. In the firefly algorithm, the objective function of a given optimization problem is based on the differences in light intensity. It helps fireflies move to lighter and more attractive places for optimal solutions. All fireflies are characterized by their intensity of light relative to the objective function. Position of each firefly is changed iteratively. The firefly algorithm has three rules:

- All fireflies are unisex and will be attracted to more attractive and bright fireflies, regardless of sex.
- A firefly's attraction is proportional to the brightness, which decreases as the distance of the second fire increases. If nobody is brighter than the other, it will move randomly.
- Determination of the brightness is dependent on the value of the objective function.

Attractiveness and light intensity are the two major factors in the fireflies algorithm. One firefly is attracted towards the other if it is brighter. Attractiveness is dependent on the light intensity. The attractiveness and light intensity are inversely proportional to the distance from the light source. Thus the light and attractiveness is decrease as the distance increase. According to this algorithm more no of resources are allocated where the intensity(load) is more which reduces the wastage of resources and hence increases the energy efficiency and network life time.

V. PERFORMANCE METRICS

In this research different scenarios are taken into consideration with varying number of nodes against constant No of rounds. Performance metrics are the parameters on the basis of which we analyse the performance of the network. These parameter include packet delivery ratio, average end-to-end delay, overheads, throughput, average energy consumption which are discussed below.

1. Packet Delivery Ratio: PDR is defined as the ratio of the number of packets successfully received Prx to the number of packets transmitted Ptx.

PDR = Prx/Ptx.

Where Prx is the number of packets received and Ptx is the number of packets transmitted.

2. Average End-to-end Delay: Delay is defined as the difference in the time of occurrence of any two events , these two events are the time at which a packet is generated and the time at which the packet is successfully delivery to the destination.

3. Throughput: Throughput is defined as the number of data bits transmitted successfully per sec to the destination in the predefined time.

4. Average Energy Consumption: It is the energy consumed in transmitting and receiving the message packets in a mobile wireless sensor network.

5. Overhead: While designing routing protocols overheads are also an important factor to be taken care of. More the number of packets more can be the congestion in the network that directly affects the throughput. So overheads should be as less as possible. Overheads can be defined as the ratio of number of bits in the control packets to the number of bits in the data packets. Control packets are used to share information about the network topology and helps in discovering the routes in the network.

VI. METHODOLOGY

Input: Wireless Sensor Network Nodes

Step 1: Nodes deployment over an area of 400*400

Step 2: Sink node will broadcast message in network.

Step 3: Nodes in network acknowledge sink node about the message.

Step 4: Calculate Cartesian distance for distance measurement.

Step 5: If target node (sink) is within NTA(Node Transmission Area)

Step 6: Source send data packet to neighbour node and update hop count, that will be one grater than that of neighbor node.

Step 7: Data packet will be send to sink in same fashion.

Step 8: Calculate result against parameters like, data send, overheads, power consumption, throughput etc.

Step 9: Generate and validate results.

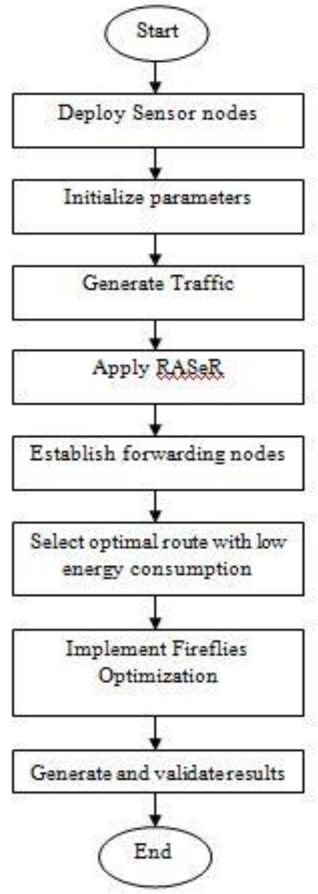

Fig 1: Flow chart

VII. RESULTS AND DISCUSSION

In this research paper the effect on various QoS parameters such as Packet Delivery Ratio, Overheads, Average End -to-End Delay, Throughput, Average Energy Consumption have been observed by varying the no. of nodes i.e. 20,40,60,80 and 100 nodes at the constant number of rounds.

Average Energy Consumption:

Figure 2. shows that the average energy consumption in RASeR and Optimized-RASeR. From the graph it is clear that the average value of Energy consumption in Optimized-RASeR is less where as in case of RASeR it is more. As more no of resources are allocated where the intensity (load) is more which reduces the wastage of resources. Hence Optimized-RASeR shows better results.

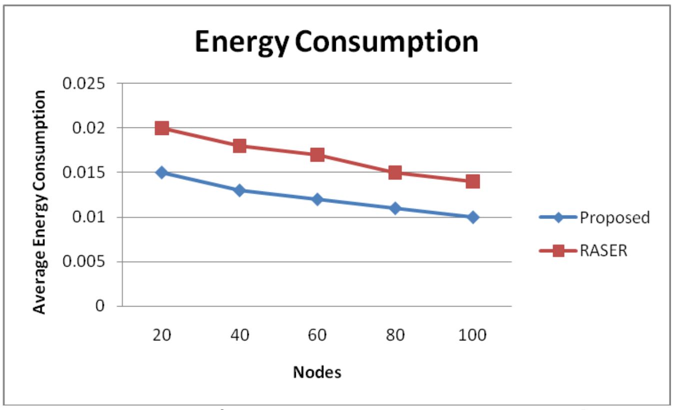

Figure 2 Comparison of Avg. Energy Consumption in RASeR and RASeR with fireflies Optimization

Throughput:

Figure 3. represents the relation between RASeR and Optimized RASeR. From the graph it is clear that the average value of throughput in RASeR is less whereas in case of Optimized-RASeR it is more. According to this figure the proposed results shows improvement because allocation of resources is more where load is more.

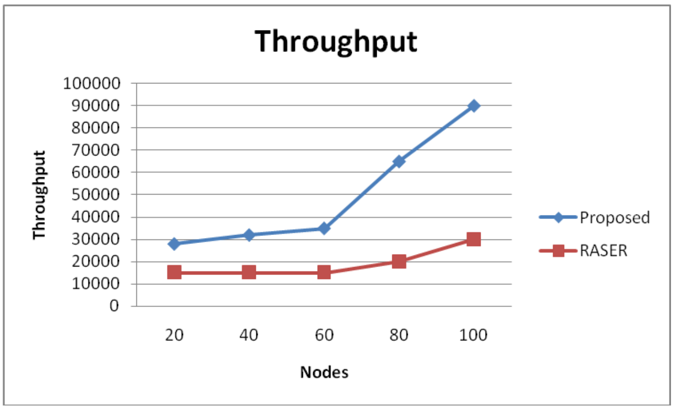

Figure 3. Comparison of Throughput in RASeR and RASeR with fireflies Optimization

Average End-To-End Delay:

Figure 4. shows the graphical results of the existing RASeR protocol and Optimized RASeR protocol. From the graph it may be seen that the average value of Average End-to-End Delay in RASeR is more whereas in case of Optimized-RASeR it is less. Where intensity (load) is more allocation of resources is more so network load reduces as a result delay reduces.

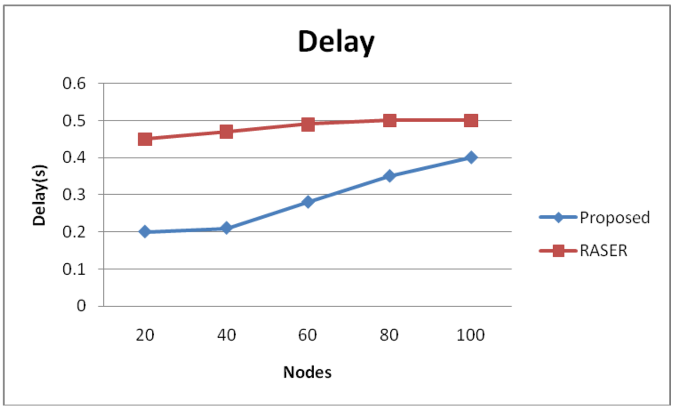

Figure 4.Comparison of Delay in RASeR and RASeR with fireflies Optimization

Overhead:

Figure 5. compares the overhead in RASeR and Optimized RASeR. The result is plotted against the overhead bits and number of varying nodes. As the packet drop is less because resources are allocated according to load intensity; the re-transmission attempts for sending the message to receiver are less as a result overheads are less. It is clear from the figure that Optimized-RASeR shows better results as compared to existing protocol.

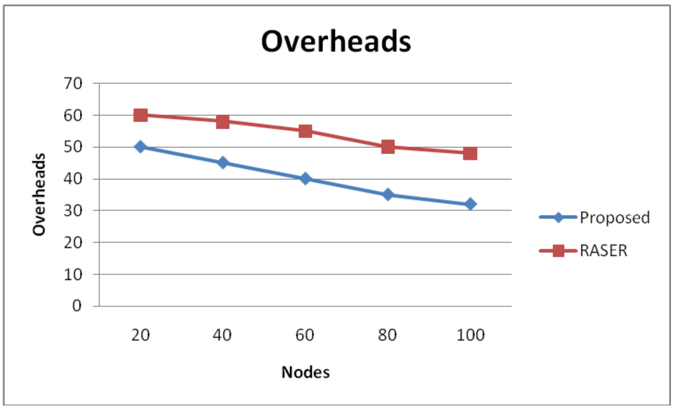

Figure 5. Comparison of Overheads in RASeR and RASeR with fireflies Optimization

Packet Delivery Ratio:

Figure 6. shows the PDR in existing RASeR and Optimized RASeR the values are plotted against no. of nodes and packet delivery ratio. According to this figure the proposed results shows improvement in packet delivery ratio. As more no of resources are allocated where the intensity (load) is more which reduces the wastage of resources so the packet drop is less, so the Packet delivery ratio is better in optimized RASeR compared to the existing protocol.

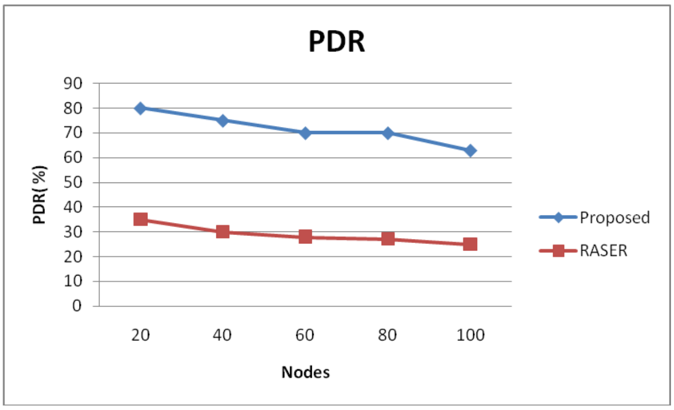

Figure 6. Comparison of Packet Delivery ratio in RASeR and RASeR with fireflies Optimization

VIII. CONCLUSION

In this research paper the optimized RASeR protocol is implemented on the basis of Fireflies optimization scheme. According to this algorithm more no of resources are allocated where the intensity(load) is more which reduces the wastage of resources and hence increases the energy efficiency and network life time.So by using the proposed methodology the QOS parameters such as packet delivery ratio, throughput, overheads, average end-to-end delay, average energy consumption are quite improved as shown in the result section.

IX. REFERENCES

[1] D. Estrin, R. Govindan, J. Heidemann, and S. Kumar, "Next Century Challenges: Scalable Coordination in Sensor Networks," in Proc. ACM MobiCom '99, August 1999, pp. 263–270.

[2] K. Bult et al., "Low Power Systems for Wireless Microsensors," in Proc. International symposium on low power and design (ISLPED) , August 1993, pp. 17–21.

[3] Kandris, D.; Tsioumas, P.; Tzes, A.; Nikolakopoulos, G.; Vergados, D. Power conservation through energy efficient routing in wireless sensor networks. Sensors, 2009, 9, pp. 7320–7342.

[4] Jin, Z.; Ping, Y.; Wang, Z.; Ping, L.; Guang, L. "A survey on position-based routing algorithms in wireless sensor networks Algorithms" 2009, 2, pp. 158–182.

[5] Hayes, F.H. Ali, "Proactive Highly Ambulatory Sensor Routing (PHASeR) protocol for mobile wireless sensor networks", Pervasive and Mobile Computing, Volume: 21, 2015, pp: 47-61

[6] Tubaishat, M.; Zhuang, P.; Qi, Q.; Shang, Y. Wireless sensor networks in intelligent transportation systems. Wirel.Commun.Mob.Comput. 2009, 9, pp. 287–315.

[7] Wood, A.; Stankovic, J.; Virone, G.; Selavo, L.; Zhimin, H.; Qiuhua, C.; Thao, D.; Yafeng.w; Lei, F.; Stoleru, R. Context-Aware wireless sensor networks for assisted living and residential monitoring. Network 2008, 22, pp. 26–33.

[8] Alemdar, A.; Ibnkahla, M. Wireless Sensor Networks: Applications and Challenges. In Proceedings of the 9th International Symposium on Signal Processing and Its Applications, Sharjah, United Arab Emirates, 2007; pp. 1–7.

[9] T. Hayes, F.H. Ali, "Robust Ad-hoc Sensor Routing (RASeR) protocol for mobile wireless sensor networks", Ad Hoc Networks, vol: 50, 2016, pp: 128-144.

[10] Sankalap Arora, Satvir Singh," The Fireflies Optimization Algorithm :Convergence Analysis And Parameter Selection. International Journal of Computer Applications (0975 – 8887) Volume 69– No.3, May 2013: pp.48-52