Energy Aware Wireless Sensor Routing using Grasshopper optimization on QoS parameters

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Abstract- In today's research domain, wireless sensor networks gained more attention and also supporting huge variety of applications in every field. Multimedia applications which are regarded as quality-of-service aware, requires energy and communication resources. Now-a-days wireless sensor networks are designed in such a way that they support delay-sensitive and time critical applications. In this paper, we proposed an energy efficient routing protocol. This proposed routing protocol is QoS aware and heterogeneously clustered which optimizes the cluster size according to sink distance and bandwidth. these two parameters analysis by grasshopper optimization and see the effect on QOS parameters.

Keywords- wsn, QOS, grasshopper, optimization stability

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a network formed by a large number of sensor nodes where each node is equipped with a sensor to detect physical phenomena such as light, heat, pressure, etc. WSNs are regarded as a revolutionary information gathering method to build the information and communication system which will greatly improve the reliability and efficiency of infrastructure systems. Compared with the wired solution, WSNs feature easier deployment and better flexibility of devices[1]. The research on Wireless Sensor Networks (WSNs) started back in the 1980s, when the United States Defence Advanced Research Projects Agency (DARPA) carried out the distributed sensor networks (DSNs) program for the US military and it is only since 2001 that WSNs generated an increased interest from industrial and research perspectives[2]. The WSN is built of nodes that can be defined as devices that are capable of detecting a change from a few to several hundred or even thousand, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has four basic components: a sensing unit with an internal antenna or connection to an external antenna, a processing unit, a communication unit for interfacing with the sensors and a power unit, usually a battery or an embedded form of energy harvesting as shown in figure 1.1.

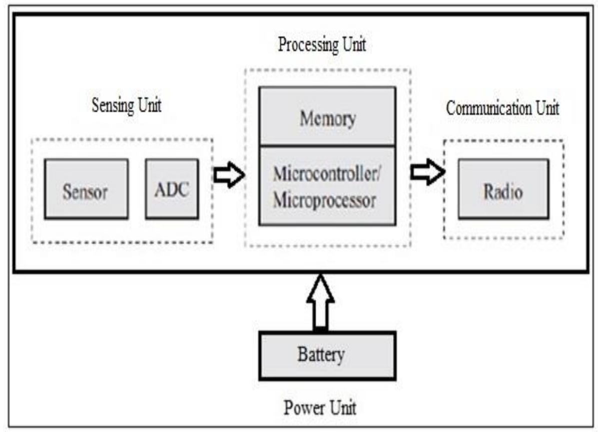


Fig.1: Components of a Sensor Node

A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed, and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding [3].

Quality of service [4,5] is the level of service provided by the sensor networks to its users. In Wireless Sensor Networks, the efficacy of application relies on not only the transmit ability but also the monitorability. So, the QoS of the Wireless Sensor Network is relying on the specifics of the application, such as the monitorability of events, the covered area of the network, the energy consumption of network, etc.[6]. QoS refers to an assurance by the Internet to provide a set of measurable service attributes to the end-to-end users/applications in terms of delay, jitter, available bandwidth, and packet loss. These two QoS perspectives can be demonstrated via a simple model [7] shown in Fig.2.

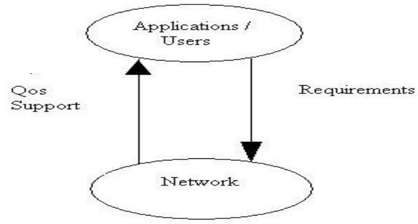


Fig.2: A simple QoSModel[7]

WSN is being used in various real-time and critical applications, so it is mandatory for the network to provide good QoS. Though, it is difficult because the network topology may change constantly and the available state information for routing is inherently imprecise. Sensor networks need to be supplied with the required amount of bandwidth so that it is able to achieve a minimum required QoS. Traffic is unbalanced in sensor network since the data is aggregated from many nodes to a sink node. QoS mechanisms should be designed for an unbalanced QoS constrained traffic. Many a time routing in sensor networks need to sacrifice energy efficiency to meet delivery requirements. Even though multi-hops reduce the amount of energy consumed for data collection the overhead associated with it may slow down the packet delivery. QoS designed for WSN should be able to support scalability. Adding or removing the nodes should not affect the QoS of the WSN.

There are many QoS parameters out of which four fundamental QoS parameters are given as below:

- ***Throughput*** is the effective number of data flow transported within a certain period of time, also specified as bandwidth in some situations. In general, the bigger the throughput of the network, the better the performance of the system is. Those nodes that generate high-speed data streams, such as a camera sensor node used to transmit images for target tracking, often require high throughput. In order to improve resource efficiency, furthermore, the throughput of WSAN should often be maximized.
- ***Delay***is the time elapsed from the departure of a data packet from the source node to the arrival at the destination node, including queuing delay, switching delay, propagation delay, etc. Delay-sensitive applications usually require WSANs to deliver the data packets in real-time. Notice that real-time does not necessarily mean fast computation or communication [8,9]. A real-time system is unique in that it needs to execute at a speed that fulfills the timing requirements.
- ***Jitter***is generally referred to as variations in delay, despite many other definitions. It is often caused by the difference in queuing delays experienced by consecutive packets.
- ***The packet loss rate***is the percentage of data packets that are lost during the process of transmission. It can be used to represent the probability of packets being lost. A packet may be lost due to e.g. congestion, bit error, or bad connectivity. This parameter is closely related to the reliability of the network.

II. LITERATURE REVIEW

M.S. Palwinder, S. Satvir (2017) presented BeeSwarm, an SI-based energy efficient hierarchical routing protocol for WSNs. Evaluation of simulation results shows that BeeSwarmperforms better in terms of packet delivery, energy consumption and throughput with increased network life compared to other SI based hierarchical routing protocols. **S. Saman et-al (2016)** introduced an innovative clustering protocol of load balancing which increases network lifetime in comparison with protocols LEACH, TCAC and DSBCA by 73%, 52%, and 21%, respectively and improves the energy efficiency and load balancing. **T. Hayes and F. H. Ali (2016)** presented a geographic routing protocol, LASeR, designed for use in MWSNs. The protocol uses location awareness to maintain an up-to-date gradient metric in highly mobile environments and the results highlight both the high performance of LASeR in various challenging environments and its superiority. **Z. Hong et al (2016)** proposed a clustering-tree topology control algorithm based on the energy forecast (CTEF) for saving energy and ensuring network load balancing. The results show the efficiency of CTEF has a longer network lifetime and receives more data packets at the base station**. J.Y. Chang and T. H. Shen (2016)** adopted a dynamic sorting algorithm to reduce the data transmission distances of the sensor nodes and results demonstrate the superior performance of this scheme in the energy consumption, network lifetime, throughput, and transmission overhead. **K. Lingxuet-al (2016)**proposed a novel heterogeneous adaptive relay chain routing (ARCR) protocol, which when applied to large scale one-dimensional long chain network resulted in an effective practical solution for long distance oil and gas pipeline while it can also perform well on other long and narrow regions, such as highway, railway. **G. Teng et-al (2016)** Stated that Energy efficiency is focused on in the traditional routing protocols, while the quality of service (QoS) (i.e., delay, reliability, robustness) becomes important in practical application. Routing protocols should not only ensure energyefficiency but also realize QoS performances. The authors analyzed and summarized some performance trade-off mechanisms and methods that have existed in the routing protocols of Wireless Sensor Networks. **G. Chirihaneet-al (2016)** Proposed a novel hierarchical approach, called Hierarchical Energy-Balancing Multipath routing protocol for Wireless Sensor Networks (HEBM) which aims to fulfill the following purposes: decreasing the overall network energy consumption, balancing the energy dissipation among the sensor nodes, extending the lifetime of the network. The results show that HEBM protocol increases the profit of energy, and prolongs the network lifetime duration. **A. E. Zonouzet-al (2016)** presented a comprehensive CF-based routing approach for hybrid WSNs with a mixture of EHSNs and BSN's. The proposed routing approach integrates end-to-end path reliability, RE in BPSNs and cost of communication paths to provide satisfactory QoS to applications running on the WSN and the results showed that the average end-to-end path reliability can increase significantly in comparison to random location selection for the same number of EHSNs. **Z. Miao et-al (2014)**proposed a load balanced clustering (LBC) algorithm, 3-layer framework for mobile data collection in WSNs, which included the sensor layer, cluster head layer, and mobile collector layer and the results shown that LBC-DDU achieves over 50% energy saving per node &60% energy saving on cluster heads comparing with data collection through multi-hop relay to the static data sink, and 20% shorter data collection time compared to traditional mobile data gathering..**M. E. Joseph and O. S. George (2014)**presented appropriate metrics of QoS for WSN which involve service, reliability, and availability which ultimately facilitating in archiving qualitable service and presented the three significant mathematical quality factors namely, availability, reliability, and serviceability. Experiments incorporating these three phenomenon (reliability, availability and serviceability—RAS)are run to demonstrate how to attain QoS which effectively improve reliability of the overall WSNs and also found that effects of traditional metrics (delay, throughput, jitter e.t.c.) place a lot of burden on the QoS of the overall system thus decreasing performance.

III. PROPOSED FLOWCHART

1. The first step is deploying the Wireless sensor.

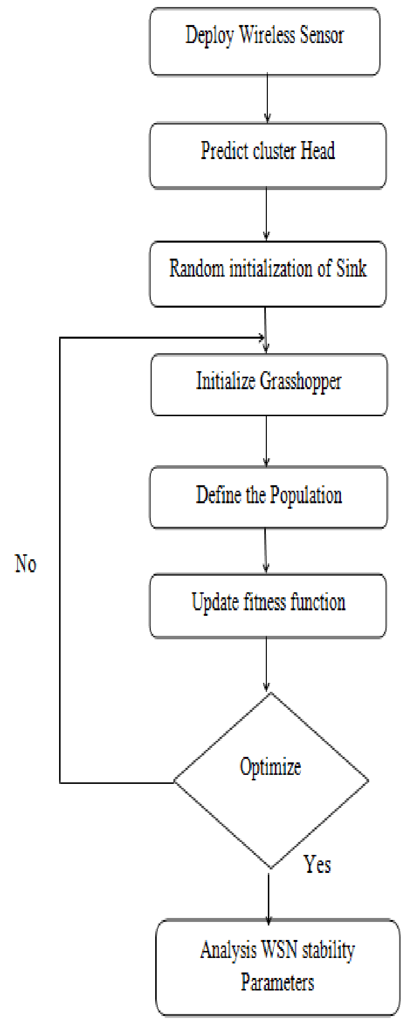
2. And then predict the cluster head.

3. After prediction, randomly initialize the sink.

4. Initialize Grasshopper and Define the population.

5. After updating the fitness function, start the optimization.

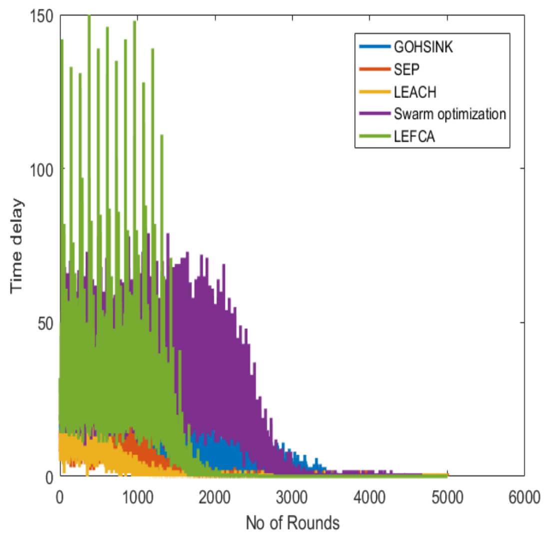
6. If optimization is done, then start analyzing WSN stability parameters, otherwise go to Step 4.



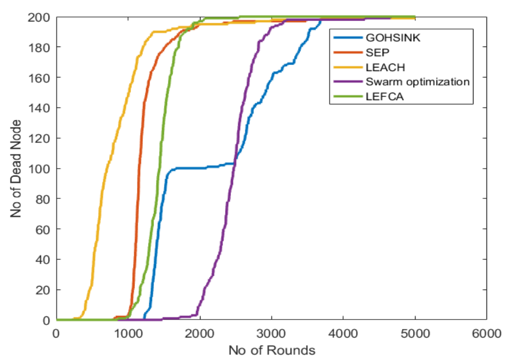
Flowchart 1: Optimize routing by the dynamic size of the cluster according to sink

IV. RESULTS AND ANALYSIS

Graph 1 represents the Comparison of swarm intelligence based routing and grasshopper base routing on time delay. It shows a comparison of five techniques i.e., GOHSINK, SEP, LEACH, Swarm optimization, and LEFCA. From the graph, it is seen that the maximum time delay is seen in LEFCA, but maximum time delay is up-to 2000 number of rounds after that it is zero till 5000 number of rounds. In swarm optimization, the time delay is above 50 but less than 100, it is decreasing as the number of rounds increasing. GOHSINK, SEP, LEACH has an almost similar time delay.

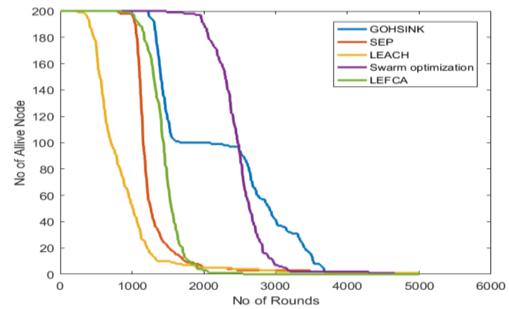


Graph1: Comparison of swarm intelligence based routing and grasshopper base routing on time delay



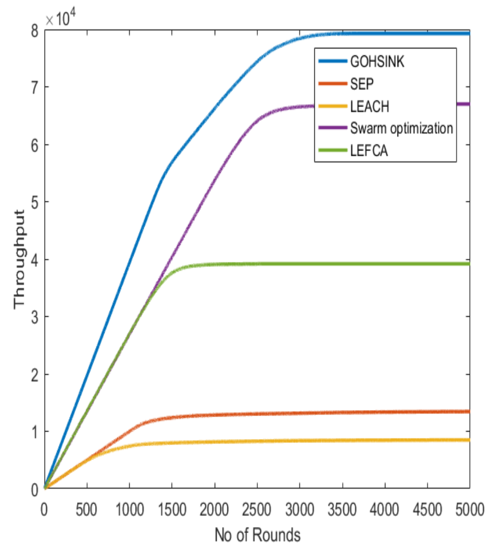
Graph 2: Comparison of swarm intelligence based routing and grasshopper base routing on Dead nodes

Graph 2 depicts the comparison of Swarm intelligence based routing and grasshopper base routing on dead nodes. In all the five techniques number of dead nodes is also increasing as the number of rounds is increasing. Firstly, in the case of LEACH number of dead nodes are started as the number of rounds are started but in other cases, the dead nodes are started at 1000 number of rounds. Except forGOHSINK, the number of dead nodes continues to increase but in GOHSINK the number of dead nodes is stable for almost 1000 number of rounds from 1000 number of rounds to 2000 number of rounds.



Graph 3: Comparison of swarm intelligence based routing and grasshopper base routing on Alive nodes

Graph 3 shows the comparison of swarm intelligence based routing and grasshopper base routing on Alive nodes. In all the cases, the number of alive nodes is decreasing as the number of rounds is increasing. In GOHSINK, the number of alive nodes is stable for 1000 number of rounds i.e., from 2000 to 3000 after that it again starts decreasing. From 2000 number of rounds LEFCA, LEACH, and SEP show zero number of alive nodes, on the other hand, Swarm optimization shows zero number of alive nodes from 3000 number of rounds. In last, GOHSINK shows zero number of alive nodes from 4000 number of rounds.



Graph 4: Comparison of swarm intelligence based routing and grasshopper base routing on Throughput

Graph 4 shows the comparison of swarm intelligence based routing and grasshopper base routing on Throughput. The throughput is continuously increasing in all the cases the number of rounds is increasing. The least throughput is in the case of LEACH, followed by SEP. LEFCA and Swarm optimization show similar throughput till 1500 number of rounds, after that in LEFCA throughput remains constant till

5000 number of rounds. But Swarm optimization shows a sharp increase and remains at same value from 2500 number of rounds to 5000 number of rounds. Maximum throughput is seen in the case of GOHSINK as compared to others.

V. CONCLUSION

In wireless sensor networkmain challenge is to improve the stability of network. Stability of network depend on many factors i.e., number of nodes and other is quality of service (QOS). The quality of service depends on how effective packets reach to destination. In this paper analysis of QOS is on the basis of sink base cluster size using grasshopper optimization.

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