A STUDY ON ROUTING OPTIMIZATION IN WIRELESS SENSOR NETWORKS USING FUZZY LOGIC

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Abstract: It is great importance to investigate the optimization problem of routing path, so it is necessary to design energy optimized routing protocol to enhance the lifetime of sensor networks. In this paper, we present a routing protocol based on fuzzy logic for the selection of best sensor node. This show that network lifetime can be improved to great extent by employing the optimized routing protocol and also the rate of power consumption decreases and quality of service factor improves.

Keywords: Wireless sensor networks, Routing protocol, Fuzzy logic.

Introduction: Wireless sensor networks comprises of number of sensor nodes that are communicated with each other through radio-interface to collect the information. The recognition of Wireless Sensor Networks (WSN) are increased due to the advancement in wireless communications, information technology and electronics area. The wireless sensor networks are composed of a number of tiny sensors and which are depending upon four parts: sensor, processor, transceiver, and battery. The Sensor collect information from nearby area and processor will change the analog information into digital information. These sensors sense and detect a range of environmental parameters such as temperature, pressure, air pollution etc. Then transceiver transmits the converted data to the base-station directly, or through next sensor. Wireless Sensor Network (WSN) consists of huge number of sensor nodes and a data sink. Such sensors collect data and throw them to the data sink via radio transmitter [9].

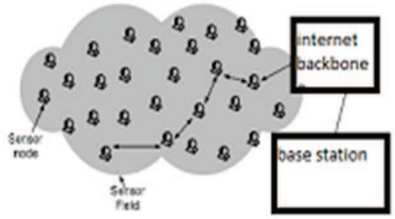

Figure 1-Wireless sensor network architecture

The matter in wireless sensor network is well known for its limited energy and computational capability. Wireless sensor network can be used in various applications like military, biomedical, and environmental effects. It is very necessary to detect the route.

Routing is a difficult issue in WSNs due to the natural characteristics that discriminate these networks from other wireless networks like mobile networks or cellular networks. Many algorithms have been proposed for the routing in WSNs.Power consumption, mobility, scalability and QoS are the other most considerable issues in designing routing protocols in WSN. Low Energy Adaptive Clustering Hierarchy (LEACH) [10] cluster-based algorithm which was used randomized rotation of the cluster heads collection. LEACH algorithm has done the operations into two stages- set-up stage and steady stage. The set-up stage has the process of electing the cluster leader and each sensor node works in a cluster by choosing the cluster leader which needs the minimum communication power. In the steady stage, all the sensor nodes send data to their corresponding cluster leader and cluster leader collects the data and then send condensed data to the data sink. To enhance the sensor network lifetime, we uses the fuzzy logic lo which will optimizes the routing path (depending on the metrics: distance, remaining battery power and link usage, traffic load energy, number of packets delivery, residual energy etc.

Related Work: YEE et al. [1]has proposed that the energy optimized routes were determined using either the minimum energy path, maximum residual energy path, path with minimum number of hops to sink etc.Sensorsall along routing paths with minimum energy link cost were used and reduced their energy fast, the shorter network lifetime. A number of routing protocols had been proposed to minimize the energy consumption in order to prolong the network lifetime. Many proposed routing protocols uses shortest path for data transmission. By using shortest path will deplete nodes energy quickly than the other routing path nodes. As a result nodes in these paths pass away much faster and cause network partition.

Tarique and Ran [2] presented a fuzzy logic based approach for energy-aware routing in wireless sensor networks and improve LEACH protocol using Fuzzy Logic (LEACH-FL)Algorithm. Experimental results showed that the level of algorithmic problem is miserable and the searching time is reduced and the proposed algorithm performed the other algorithm in

terms. They had used a Fuzzy Logic System (FLS) as a decision means for next hop node selection process. The transmission rate and energy were parameters for choosing the next-hop node in packet transmission

Mohammad and Abbas et al.[3] proposed that the sensor lifetime elongation problem, they has optimized the distances, energy and link usage to distribute data for a fixed sensor bed where the only mobile thing is the sink. The applications for WSN is the resource scarcity of nodes, most important factor is its poweravailability and the battery life of sensor networks is acted as the network life. To enhance the sensor network lifetime, we develop the fuzzy logic that optimized the routing path (depending on the metrics: distance, remaining battery power and link usage).

S.Swapna and Nanda et al. [4] has described that the dual fuzzy logic clustering protocol DFLCP model has developed a better and efficient distribution of the cluster leader by quantify the different factors in fuzzy inference system using Mamdani.It was quite obvious to examine that the DFLCP model with fuzzy logic is capable of enhancing the death time of the first and last sensor node in comparison to LEACH algorithm. The total wireless sensor network lifetime was enhanced to 80%. The most appropriate cluster leader was chosen using dual levels of fuzzy inference system. The eligible sensor nodes were chosen depending on their power and association with number of nodes in the transmission area.

Manoj et al. [5]has proposed that the faster improvement in sensor technology had made possible WSN that have wide range application. By choosing the correct sensor for an application a number of characteristics were important. The wireless sensor networks have energy requirement, network re-configurability, and sustainability to environment hazards. The process and protection of such nodes is a critical issue.

Marwa and Imane et al.[6] had proposed that the Routing and clustering in wireless sensor networks are the most challenges of WSN. They presented a survey of the most important area of routing in WSNs based on soft computing paradigms. In order to have longer network life time we have to overcome the scarcity in energy resources and preserved the processing of the sensor nodes. Power management approaches efficiently reduce the sensor nodes energy consumption individually in each sensor node and the adaptive efficient routing method had great importance.

YEE et al. [1] proposed that an energy-aware routing algorithm for cluster-based wireless sensor network have been proposed in which a cost function is defined between two sensor nodes in terms of energy conservation, delay optimization and otherQoSmetrics. There are some verysimple QoS metricsto lengthen the lifetime of the sensornetworks. These include:Trafficloaddistribution:focus of eventsin some particular areas is more than the otherareas.By using shortest path will cause implosionalong the path, souniform distribution of traffic isneeded.

Haifeng and YanYing et al.[7] had proposed that the different QOS metrics

Distance of Node to the Shortest Path.*:* Insensor nodes, theenergy consumption for data transmission depended onthe square of the distance between the source node andthe destination. If all nodes were on the procession from data source node to the Sink, therate of energy consumption for data transmission would beminimized. So, the distance of node to the shortestpath (DCSP) should be used as one of energy optimizedparameters.

Distance of Node to Sink: For data transmission, single-hopor multihopforwardinmethods couldbe used within the communication system. A forwarding scheme is asingle-hop if each sensor in a data forwarding path usedat most one of its one-hop neighbors to forward a data packetto destination. A forwarding scheme wasmultihop if the same data was forwarded throughmultipleneighbors of each sensor until the data was reached its destination.

Tarique et al.[8] has proposed that the different QOS metrics.

Transmission energy: The cost of link from one node to another node, the energy needed totransmit a data packet among these nodes. Lower the value of transmission energy gives lower link cost.

Remaining energy: It gives the energy level of any node. Nodes having less value of remaining energy were avoided to be elected next-hop. Consequently,its lower value resulted in a higher link cost.

Energy consumption: Energy consumption rate in wireless sensor networks depends on the routing protocols used.

Link Usage: They used a linear function as a link usage MF. The more the path is used the more it has ability to forward to the packet.These all gave a solution that optimizes the routing path according to all the above mentioned QoSmetricsby a fuzzy logic based routing.

3.Proposed Approach: The optimization problem of routing path can be done with the help of fuzzy logic.Fuzzy logic was derived from fuzzy set theory [11]. Fuzzy logic based system has done its workwith the help of four steps denoted as fuzzification, fuzzy inference device, fuzzy based rule anddefuzzification.

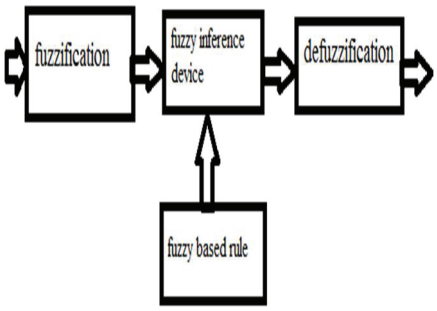

Figure 2-Fuzzy logic system

The sensors are familiar with their locationinformation. The aim of our fuzzy is to establish thevalue of cost for a link between two sensor nodes sothat the life of a sensor network is maximized.The optimal path from the available metrics are: traffic load, battery usage and number of packetsforwarded to link. Optimizing thepath maximizes the life of the network.The protocol has the ability to be implemented in both the reactive and proactive manner. In reactive routing, when a node wants to transfer data it generates routing uncertainty and asks for its single hop to calculate the routing path. On the other hand, proactive routing, update the neighboringnodes by periodical manner.When a data wants to be sent the protocol, it choosesthe optimalpath through the fuzzy logic. Finally, it adjust thetransmit power according to the distance of the receivernode to forward the data. By using the fuzzy logic we canintegrate the different types of metrics (traffic load, batterypower and link usages) Therefore, the lifetime ofa node depends on: (1) the traffic load the node is routing, (2)the energy consumed rate, (3) the residual energy on the node.There is a link between the values of these parameters (trafficload, residualenergy, energy consumption rate.The first step of designing fuzzy logic needs the membership function (MF), which gives the input output relations. MFs have different values for the different QoS metrics.

There are some parameters used in fuzzy logic that are required to optimized routing path. They are distance of node to the shortest path, distance of node to sink, transmission energy, remaining energy, energy consumption, Link usage, number of packets delivered, centrality etc.Centrality gives the information about the complexity of networks which is used for the designing purposes of networks. Moreover, many other techniques like adaptive Neuro-fuzzy hybrid models and various machine learning techniques such as Bayes Net, Naive Bayes and decision trees can be used for optimization of routing. So, the lifetime of wireless sensor networks can be improved as great extent and also the quality of service of the networks.

Conclusion: It shows that thelifetime could be improved by a fuzzy model for energy optimize drouting in wireless sensor networks.The problem of optimization of routing paths can be solved with the help of different metrics or parameters. The fuzzy model used is most adaptive and efficient approach for routing optimization in wireless sensor networks. Furthermore, Adaptive Neuro-fuzzy hybrid models, and various machine learning techniques such as Bayes Net, Naive Bayes and decision trees can also be used for real time implementation of routing optimization of wireless sensor networks.

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