Review of Energy Based Routing Protocols in Wireless Sensor Network

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Abstract— Routing between the source and destination with optimality has becoming primary part of several research works. Many of the techniques have been proposed till now which works individually to acquire the optimized routing. This study provides a concise review to the routing and related design issues. Along with this a brief review to the energy efficient routing protocol is also given in this work. A comparison among routing protocol is also derived in this. The previous research work that has been done in order to enhance the energy efficiency of the network is also defined in this paper.
Keywords—Gateway nodes.

I. INTRODUCTION

Wireless Sensor Network is a collection of multiple sensor nodes and these nodes are coupled to each other for implementing the data transmission. The major role of these tiny sensors is to sense the physical conditions from its surroundings such as temperature, humidity etc [1]. the sensor nodes are comprised of some paramount components. Some of these components are optical components such as source for energy creation, GPS, mobility supervisor. WSN has the potential to access remote places, real-time working, and also easy to use [2]. WSN has a range of relevance in dissimilar domains such as in military activities like surveillance, reconnaissance and target acquisition, and geophysical activities like study of volcano, environmental activities like prevention from forest fire and in the field of medical like monitoring health data or civil engineering such as structural health measurement or artificial retina [3].
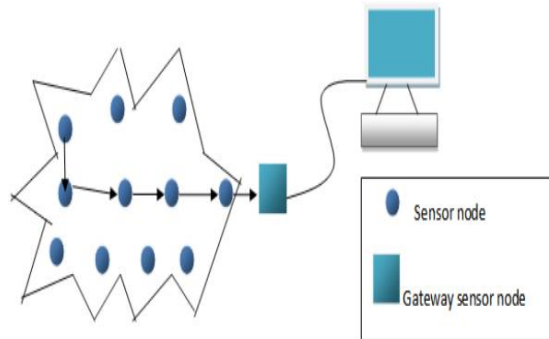

Figure 1 General Layout of WSN [25]

Sensor nodes operate on the basis of the assigned battery power or energy [4,5]. Power transmission and distribution of sub networks includes some pivotal parts like transformers and circuit breakers that are monitored continuously in order to curtail the probability of disruptive outages of power (i.e. when power is supply is not available or equipment is closed. Because of fast growth in trend of substation equipment and infrastructure, this becomes a serious issue for engineers and substations managers to diminish the probability of power consumption and expenses. Nowadays this monitoring is done by using real-time measurements and periodical physical inspections with the help of exorbitant wired sensors. Low powered wireless sensor network are very popular therefore some companies are trying to find out the advantages of large scale wireless sensors over low power sensors for these kinds of applications [6].

Routing is concept that is developed to reduce the energy consumption of the nodes for data transmission. Routing creates a shortest path from source node to destination node in order to avoid the access energy consumption. Thus by implementing the effective routing strategy the energy consumption and lifespan of the sensor network can be improved or enhanced [7].
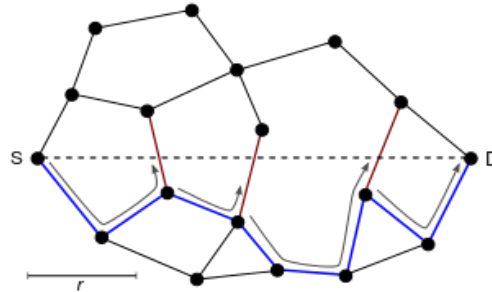
Figure 2 Example of Routing [1]

1.1 Design Challenges for Routing

This section highlights some of design issues related to the routing process in wireless sensor network. Some of the major issues are as follows:

a. Scalability: In case if the network gets expanded, routing strategy or protocol should be capable enough to handle the performance efficiency level. The scalability refers to the process when the number of sensor nodes in the network gets increased. Thus it can be said that the routing protocols should be efficient enough and compatible to large scale network [8].

b. Fault Tolerance: Fault tolerance refers to the situation when the nodes keep operating in case of node failure. But in WSN the nodes stop working when they run out of energy or gets damage. Thus the performance of the network should not be dependent to few nodes only.

c. Production Cost: It is another major factor that has an impact on routing strategy in a network. The nodes that are used in sensor network should not be so expensive. Thus in this way the nodes deployment cost can be managed [9].

d. Energy Constraints: Energy is the major concern of WSN. Large scale networks have low amount of energy. Therefore routing strategy should be designed in such a way that energy consumption should be optimized and data transmission should be justified.

II. ROUTING PROTOCOLS

2.1 Pegasis

This protocol is designed to overcome the problem of data gathering that was faced by the conventional protocols. In this the communication from the node is done on the basis of distance and the data is transmitted to the nearest node so that it can further pass it to the base station. Each node in the network will have equal load hence this protocol supports even distribution of nodes [10]. The network of the sensor nodes in the network chain form chain while communication and hence there is random placement of each node. In this protocol greedy algorithm is used for building up the chain between the sensor nodes on the basis of the knowledge these nodes have. The protocol works better than the conventional protocols like LEACH as it removes overhead of dynamic cluster formation. The transmission numbers are lessened by overcoming the problem of overhead of dynamic cluster formation. The further advantage of the protocol is that it works better with large networks as it uses single transmission to base station per round [11].

PEGASIS is based on following assumptions:

- All the information regarding network is contained in sensor nodes
- Each and every node is static
- Nodes have knowledge about the location of all other nodes.

PEACH (Power-efficient and adaptive clustering hierarchy):

The overhead transmission is the base for PEACH protocol. In this the process of cluster creation is done without any requirement of access transmission of data packets. This protocol works on the basis of overhead transmission and the formation of clusters in the network is done without any extra transmission of packets. The advantages of this protocol are increased power-efficiency, more scalability and it offers adaptive clustering hierarchy. The PEACH protocol works as a probabilistic protocol and it offers multilevel clustering [12]. The protocol works well in all cases like when the location of sensor node is known and unknown. The location of the sensor nodes is known by employing sensors like GPS. The number of data packets is reduced which further reduces the cost of the network which is also one of the advantages of the protocol [13].

EEABR (Energy Efficient Ant-Based Routing):

The protocol works like the behavior of real ants that is the routing path is formed by the pheromone trial laid. In this protocol there is no particular destination, each node should have communication with all the other nodes in the network and a table is formed in which the routing of each node with its nearest node is stored. This protocol can be cumbersome for large networks and the networks having large number of nodes because here each node will need to have large memory for storing the information about its neighboring nodes. The advantage of this protocol is that it can be easily modified if there is need to save memory of the network. The memory can be saved if the transmission of nodes is done only to the sink, in this case the table will have information about only the neighboring nodes which will reduce the amount of information to be stored in the nodes memory. The sink in the network is selected not only the basis of distance but also in terms of energy of the node [14].

DEEC (Distributed Energy Efficient Clustering)

Distributed Energy Efficient Clustering is used for heterogeneous wireless sensor network. In this algorithm two parameters are calculated one is energy left on each node and second is average energy of network after that ratio between these two parameters is find out, now on the basis of this ratio cluster head is selected [15]. Early energy on each node as well as energy left on node decides the number of rotations of node. The nodes which have high remaining and initial energy is much suitable for cluster head candidate node as compare to the nodes with low energy..

SOP (Self-organizing protocol):

This is a protocol that follows the architecture similar to LEACH and it supports multi-hopping. The routing between the source node and the destination node is done by finding out some intermediate [16] nodes in the network. The transmission is done by the communication between the various nodes present in the network until the data is reached to the destination node. The merit of this protocol is that it reduces the consumption of transmission energy and along with that it have some de-merits like high latency and delay in data packets [17].

TEEN (Threshold energy Efficient Network)

TEEN is developed by modifying the traditional LEACH protocol. This is specifically designed for temperature sensing applications. It has a backlog that it is not compatible to the large scale networks. There is high energy consumption in TEEN protocols and the formation of clusters is also unbalanced because of random selection of the cluster heads. TEEN is not capable to enhance the network lifetime tyo a satisfactory level. To recapitulate, it can be said that it was advancement in the conventional LEACH protocol but it could not generate desired results for improving the network lifetime [18].

HEED (Hybrid Energy Efficient Distributed Network)

HEED is designed to improve the lifespan of the network along with its performance efficiency. HEED is one such protocol designed for the same purpose. The parameter of residual energy is used in this protocol for selecting cluster head. The distance is the second parameter which is considered in the case of collision between two nodes having same value of residual energy. The HEED protocol is applicable on homogeneous nodes; these are the nodes having same energy value in a network. The prime objectives of forming HEED protocol are: first to increase the lifetime of the network by segmenting the consumption of energy, second is repeating the process of clustering for fixed number of times, third is the formation of cluster heads in a well distributed manner and the forth is to minimize the control [19].

Table 1Comparison of Routing Protocols

Sr. No.	Protocol	Advantages	Disadvantages
1.	LEACH	Enables communication within network	Do not works well with large network areas
2.	PEGASIS	Overcomes the disadvantage of data-gathering	Less scalable
3.	PEACH	power-efficient, offers multilevel clustering	no overhead on cluster head selection
4.	HEED	Improved lifetime and efficiency	Not applicable on heterogeneous network
5.	TEEN	Lesser energy consumption & response time. Suitable for time critical applications	Not adaptable for some application where data requirement is regular, practical implementation is difficult
6.	EEABR	Changes in algorithm are easy to make and can help save memory	Not suitable for large networks

7.	SOP	Decreases consumption Of transmission energy	Increases network latency and delay in data packets.

III. RELATED WORK

Gurbinder Singh Brar [1] in this paper the author had projected a novel routing protocol that was directional transmission based energy responsive routing protocol known as PDORP. With the help of Power Efficient Gathering Sensor Information System (PEGASIS) and DSR routing protocol the routing becomes smoother which was the best feature of the PDORP. To generate and restart the cluster based WSN the genetic paradigm and the Bacterial Foraging Optimization (BFO) was applied in which during the network establishment the network was optimized. The simulation results had demonstrated that the hybrid method was used to evaluate the presentation that had offered minimum bit error rate, minimum delay, reduced energy consumption and improved quantity that indicates the improved QoS and the network lifetime was also expanded. Furthermore, with the help of soft computing mechanisms the presentation of both the routing protocols was compared and estimated by adopting the computation model.

Kumar, R., et al. in [2] in this paper the author had projected a novel hybrid ABCACO paradigm by merging both the paradigms such as ABC and ACO to resolve the Nondeterministic Polynomial (NP) strict and finite issues of wireless sensor networks. The novel projected paradigm that was ABCACO paradigm was alienated into three major sections that were: (i) assortment of optimal number of sub regions and further sub region sections, (ii) cluster head was chosen by applying ABC paradigm, (iii) effective data transmission by applying ACO paradigm. To transmit the data a hierarchical clustering mechanism was utilized in this paper, due to this the information data was broadcasted to the sub cluster heads through the member nodes and afterward to the selected cluster heads from the sub cluster heads on the basis of any threshold value. The finest path to transmit the data to the base station was detected by the cluster heads by applying ACO paradigm. For the forest fire detection and monitoring the framework was deliberated by the projected method. The output results had illustrated that the stability interval is 60% advanced by the ABCACO paradigm and the throughput of the system was 31% enhanced comparative to the LEACH and WSNCABC.

T. H. Feiroz Khan et al. [3] in this paper the author had projected a novel capable mechanism that was AMWMN. The presentation of the novel AMWMN mechanism was examined with the help of three protocols such as Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV) routing and the Ad hoc On-Demand Distance Vector (AODV) routing. The simulation results were obtained by the Network Simulator in which the presentation of the parameters such as Packet Delivery Ratio, Packet Loss Ratio and Delay were compared. Afterward the finest protocol was rated that was capable of routing in the AMWMN.

Kwnagcheol shin et al. [4] in this paper the author had proposed an idea of a milestone node that broadcasts the evaluated the information of future location of the sink to the nodes that were situated in the area of the latest sink's track. With the help of this information the data packets were routed effectively from the nodes to the mobile sink. To enhance the data packet delivery ratio the periodic broadcast method among the projected predictive routing protocol was also used to broadcast the information of the sink to the whole network. The output of this protocol had demonstrated that during preserving high data packet delivery ratios the utilization of the energy was decreased comparative to the traditional routing protocols like ALURP and Elastic.

Y.-C. Wang et al [5], in this paper the author had projected a centralized and a distributed heuristics to manage the nomadic routes of the mobile sensor. In this projected method the random number of mobile sensors and the positions of the event in every round were permitted having in mind the idea of energy balancing. The mobile energy of the mobile sensors was aimed to decrease by the centralized heuristic mechanism as maintain their energy utilization balanced. For the movable sensors a grid structure was applied by the distributed heuristic mechanism for the event locations. The simulation results had demonstrated that the proposed mechanism were more effective than the traditional mechanisms. The much usual multi round sensor dispatch issue was defined and the resolutions for energy effectiveness were also offered in this paper.

H. AlAmri et al. [6] in this paper the author had projected a novel routing protocol for Ad hoc networks that was known as On-demand Tree-based Routing Protocol (OTRP). The concept of hop-by-hop routing like AODV having an effective path detection paradigm known as Tree-based Optimized Flooding (TOF) was collected in this protocol to enhance the scalability of the ad hoc networks as there was no past information regarding the target. To obtain this in the proposed protocol with the help of branching nodes that were a restricted set of nodes which selectively flooding the network the path detection overheads were decreased. The simulation results had demonstrated that the

projected protocol was far better than the AODV, DYMO, and OLSR protocols that had decreased the overheads and also enhanced the traffic.

S. Lindsey et al. [9] in this paper the author had proposed a novel method that was the Power-Efficient Gathering in Sensor Information Systems (PEGASIS). This protocol was a chain-based protocol that was the advanced version of LEACH. In this novel projected method every node broadcasts its information data or the message to the nearer adjacent node and the turns were taken by that node to transfer that data to the base station as decreasing the energy consumption at each round. The output of this protocol had demonstrated that the presentation of the PEGASIS was improved comparative to the LEACH as 100% to 300% if 1%, 20%, 50%, and 100% of nodes were died for various network sizes and the topologies.

B.Niu, J. Liu et al.[10] in this paper the author had illustrated that the Co-evolutionary Structure-Redesigned-Based Bacteria Foraging Optimization (CSRBFO) mechanism. On the basis of the real phenomena that nearly all the living beings were liable to oblige among one another to more efficiently complete the job. A basic loop was utilized to reinstate the nested loop to achieve the less calculated complications as preserving the vital research ability of standard Bacterial Foraging Optimization (BFO) and also the step of reproduction of BFO was removed. Therefore, the projected Co-evolutionary Structure-Redesigned-Based Bacteria Foraging Optimization (CSRBFO) mechanism had a couple of major steps that were: (1) chemotaxis and (2) elimination & dispersal. The exploration and the exploitation were predicted to be balanced with the grouping of the both co-evolutionary strategy and convergence status evaluation. The simulation results had demonstrated that the projected CSRBFO mechanism offers improved results than the comparison paradigms as the 7 well-known heuristic paradigms on 24 benchmark operations were compared.

IV. CONCLUSION

This section of paper concludes that the routing plays a vital role to manage the energy consumption of the network. The nodes consumes high amount of energy in case if the source node and destination node is located at farther distance from each other and data packets have to cover a long distance in order to reach the destination node. In this case routing will be performing by selecting multiple next hops until the data packets reaches to the destination. The next hop selection criteria relies upon multiple parameters such as distance, energy etc. Thus in future, advancements can be done on next hop selection criterion.

V. REFERENCES

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