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AN IMPROVED PEGASIS PROTOCOL TO ENHANCE ENERGY UTILIZATION IN WSN

Sunita Rani[1], Er.Tarun Gulati[2]

Electronics and Communication Department,

M.M. University, Mullana (Ambala), Haryana , INDIA

Abstract- Wireless sensor network is an ad hoc network. Each sensor is defined with limited energy. Wireless sensor node deployed into the network to monitor the physical or environmental condition such as temperature, sound, vibration at different location. Each node collected the information than transmit to the base station. The data is transfer over the network each sensor consume some energy in receiving data, sending data. The lifetime of the network depend how much energy spent in each transmission. The protocol play important roll, which can minimize the delay while offering high energy efficiency and long span of network lifetime. One of such protocol is PEGASIS, it is based on the chain structure, every chain have only one cluster head, it is in charge with every note's receiving and sending messages who belong to this chain, the cluster head consumes large energy and the times of every round increasing. In PEGASIS, it take the advantage of sending data to it the closet neighbor, it save the battery for WSN and increase the lifetime of the network. The proposed work is about to select the next neighboring node reliably. For this it will combine few parameters such as Distance, Residual Energy and Response time. The proposed system will increase the overall communication and increase the network life.

Keyword: WSN, energy, node.

I. INTRODUCTION

Wireless Sensor Networks [1], with the characteristics of low energy consumption, low cost, distributed and self organization, have brought a revolution to the information perception [2].

The wireless sensor network is composed of hundreds of thousands of the sensor nodes that can sense conditions of surrounding environment such as illumination, humidity, and temperature. Each sensor node collects data such as illumination, humidity, and temperature of the area. Each sensor node is deployed and transmits data to base station

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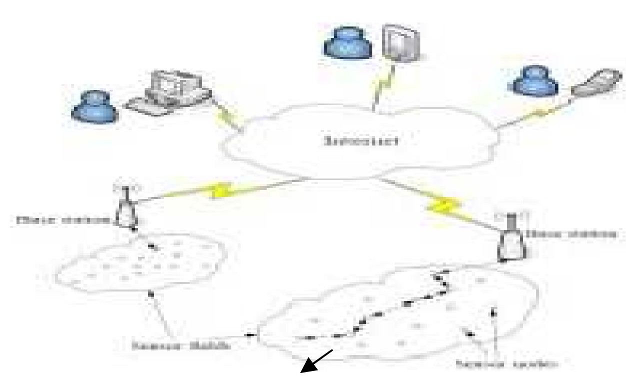
(BS). The wireless sensor network can be applied to variable fields. For example, the wireless sensor network can be used to monitor at the hostile environments for the use of military applications, to detect forest fires for prevention of disasters, or to study the phenomenon of the typhoon for a variety of academic purposes. These sensor nodes can self-organize to form a network and can communicate with each other using their wireless interfaces. Energy efficient self-organization and initialization protocols are developed in [3], [4]. Each node has transmit power control and an omni-directional antenna, and therefore can adjust the area of coverage with its wireless transmission. Typically, sensor nodes collect audio, seismic, and other types of data and collaborate to perform a high-level task in a sensor web. For example, a sensor network can be used for detecting the presence of potential threats in a military conflict. Most of battery energy is consumed by receiving and transmitting data. If all sensor nodes transmit data directly to the BS, the furthest node from BS will die early. On the other hand, among sensor nodes transmitting data through multiple hops, node closest to the BS tends to die early, leaving some network areas completely unmonitored and causing network partition. In order to maximize the lifetime of WSN, it is necessary for communication protocols to prolong sensor nodes' lifetime by minimizing transmission energy consumption, sending data via paths that can avoid sensor nodes with low energy and minimizing the total transmission power.

II. ARCHITURE OF WIRELESS SENSOR NETWORK

Figure.1 shows a typical schematic of a wireless sensor network (WSN). After the initial deployment (typically ad hoc), sensor nodes are responsible for self-organizing an appropriate network infrastructure, often with multi-hop connections between sensor nodes [5]. The onboard sensors then start collecting acoustic, seismic, infrared or magnetic information about the environment, using either continuous or event driven working modes. Location and positioning information can also be obtained through the global positioning system (GPS) or local positioning algorithms. This information can be gathered from across the network and appropriately processed to construct a global view of the monitoring phenomena or objects. The basic philosophy behind WSNs is that, while the capability of each individual sensor node is limited, the aggregate power of the entire network is sufficient for the required mission.



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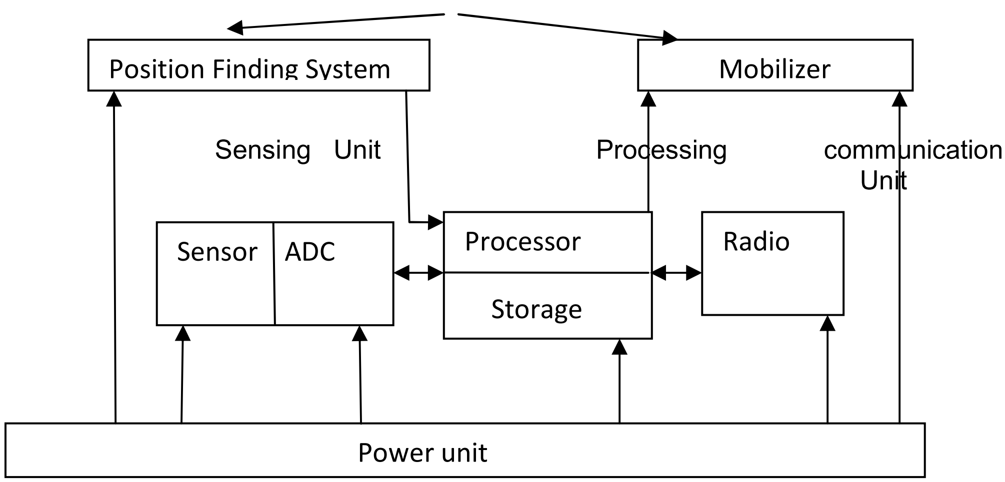

Fig. 1 Schematic of a Wireless Sensor Network Architecture

In general, the wireless sensor networks are deployed for monitoring at a large area so the wireless sensor networks need many sensor nodes. If the sensor node consumes completely energy, it is wasted. We do not consider to recharge and to reuse sensor node. Because of these reasons, the value of the sensor nodes must be inexpensive to practical use. Deployed in harsh and complicated environments, the sensor nodes are difficult to recharge or replace once their energy is drained. Meanwhile the sensor nodes have limited communication capacity and computing power. So how to optimize the communication path, improve the energy-efficiency as well as load balance and prolong the network lifetime has became an important issue of designing routing protocols for WSN. Hierarchical-based routing protocols [6] are widely used for their high energy-efficiency and good expandability. The basic idea of them is to select some nodes in charge of a certain region routing. These selected nodes have greater responsibility relative to other nodes which leads to the incompletely equal relationship between sensor nodes. LEACH (Low Energy Adaptive Clustering Hierarchy) [7], PEGASIS (Power-Efficient Gathering in Sensor Information System) [8] are the typical hierarchical-based routing protocols. As an enhancement algorithm of LEACH, PEGASIS is a classical chain-based routing protocol. It saves significant energy compared with the LEACH protocol by improving the cluster configuration and the delivery method of sensing data.

III. POWER CONSUMPTION MODEL FOR WSN

In order to understand the necessity of routing protocols and their benefits we briefly describe the power consumption model for WSN devices. The communications channel can be modeled by using the long distance path loss model [9] and ignoring more complex effects such as fading and multi-path. Thus, the power required by a node to transmit over a distance of d meters can be expressed as:

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$$P_T(d) = P0 \times (d0 / d)\alpha \quad (1)$$

Where P0 represents the power of the signal received at distance d0 from the source and α is the path loss exponent which is dependent on the propagation environment and can take values between 2 and 5. Also, using the path loss model and the Friis model the power received at distance d from the node can be expressed as:

$$P_R(d) = Ptx / (\beta \times d\alpha) \quad (2)$$

where P_{tx} is the RF power delivered to the antenna of the transmitting node and β is parameter specific to the characteristics of the transmitting and receiving antennas. Therefore we can determine that the power required to make a single hop transmission between two nodes is equal to $P_T + P_R$. The power required to make a multi hop transmission between n nodes is $(n-1) \times (P_T + P_R)$.

IV. PREVIOUS WORK

In this section we briefly review the related work on the analysis of PEGASIS protocol.

Cosmin Cirstea [10], This paper provides an up to date evaluation of routing protocols as well as a description of state of the art routing techniques for Wireless Sensor Networks (WSNs) that enhance network lifetime through efficient energy consumption methods. We study the tradeoffs between energy and communication overhead and highlight the advantages and disadvantages of each routing protocol with the purpose of discovering new research directions.

Stephanie Lindsey et. al. [11], proposed PEGASIS (Power-Efficient Gathering in Sensor Information Systems) Protocol which is a near optimal chain-based protocol that is an improvement over LEACH. In PEGASIS, each node communicates only with a close neighbor and takes turns transmitting to the base station, thus reducing the amount of energy spent per round.

Dali Wei et. al [12], This paper proposes a distributed clustering algorithm, Energy-efficient Clustering (EC), that determines suitable cluster sizes depending on the hop distance to the data sink, while achieving approximate equalization of node lifetimes and reduced energy consumption levels. We additionally propose a simple energy-efficient multihop data collection protocol to evaluate the effectiveness of EC and calculate the end-to-end energy consumption of this protocol; yet EC is suitable for any data collection protocol that focuses on energy conservation. Performance results demonstrate that EC extends network lifetime and achieves energy equalization more effectively than two well known clustering algorithms, HEED and UCR.

Ossama Younis et. al [13], Proposed HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in 0(1) iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network. We prove that, with appropriate bounds on node density and

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intracluster and intercluster transmission ranges, HEED can asymptotically almost surely guarantee connectivity of clustered networks. Simulation results demonstrate that our proposed approach is effective in prolonging the network lifetime and supporting scalable data aggregation.

Deng Zhixiang et. al. [14], performed work. In this paper use for reference of the ideas used in both of the two protocols of reducing power dissipation, a three-layered routing protocol for WSN based on LEACH (TL-LEACH) is given. Then, this improved LEACH protocol is simulated and the simulation results show that TL-LEACH protocol is with greatly improved WSN lifetime than LEACH protocol.

Indu Shukla [15], In this paper we have discussed PEGASIS protocol. PEGASIS protocol forms a chain of sensor nodes, where each sensor node only communicate with their neighbors. Sensor nodes are deployed in harsh physical environment. Sensor nodes have very limited computation capability because they are limited by the battery power. It has been a challenge to maximize the use of energy of these sensor nodes to extend the network lifetime. This paper also includes the implementation of PEGASIS protocol.

Jian Wan et. al [16], In this paper, we present a review of recent routing protocols in WSNs and classify them into three categories based on the network structure in WSNs. Then we describe the existing routing protocols and discuss their advantages and disadvantages of each routing algorithm. Finally we conclude this paper with open research issues and challenges.

Tao Liu et. al [17],This paper proposes a new type of routing protocol for WSN called PECRP (Power-efficient Clustering Routing Protocol), which is suitable to long-distance and complex data transmission (e.g. patient-surveillance or chemical detection in agriculture), and for fixed sensor nodes of WSN. PECRP combines the advantages of some excellent cluster-based routing protocols together, such as HEED (Hybrid Energy efficient Distributed Clustering Approach), PEGASIS (Power Efficient Gathering in Sensor Information Systems) and so on. PECRP improves the mechanism in electing CHs (cluster heads) of LEACH, and elects more appropriate nodes to be CHs, which could prolong the lifetime of WSN obviously. In data transmission, PECRP uses multi-hop transmission that is called “circle domino offect based on distance to BS (Base Station)” to balance the energy consumption in nodes. This paper proves the rationality that multi-hop transmission can prolong the lifetime of WSN in narrow sense situation based on mathematical proofs.

Zheng Gengsheng et. al [18], This paper proposes a two layer hierarchical routing protocol called Chain Routing Based on Coordinates-oriented Clustering Strategy (CRBCC), which gives a good compromise between energy consumption and delay. First, CRBCC makes balanced clustering according to y coordinates where each cluster has approximately equal number of nodes. Second, CRBCC makes chain routing by simulated annealing algorithm (SA) inside the cluster and elects chain leader in the order of x coordinates. Third, CRBCC makes chain routing again by SA method among chain leaders. Simulation results show that CRBCC performs better than PEGASIS in terms of energy efficiency and network delay.

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Hao Wu et. al. [19], proposes a Chain-based Fast Data Aggregation Algorithm Based on Suppositional Cells (CFDASC) to solve this problem. In this algorithm, Author attributed each node to one suppositional cell according to the node location information. The nodes which are in one suppositional cell act as the cluster head of data collection in turn, then the head gathers and transmits data along the cells chain to the sink node. As a result, it accelerates the data aggregation process. simulation show that COSEN noticeably gives a good compromise between energy efficiency and latency.

Hyunduk Kim et. al. [20], proposes DERP (Distance-based Energy-efficient Routing Protocol) is proposed to address this problem. DERP is a chain-based protocol that improves the greedy-algorithm in PEGASIS by taking into account the distance from the HEAD to the sink node. The main idea of DERP is to adopt a pre-HEAD (P-HD) to distribute the energy load evenly among sensor nodes. In addition, to scale DERP to a large network, it can be extended to a multi-hop clustering protocol by selecting a “relay node” according to the distance between the P-HD and SINK. Analysis and simulation studies of DERP show that it consumes up to 80% less energy, and has less of a transmission delay compared to PEGASIS.

M. Tabibzadeh et. al.[21], propose a hybrid protocol, which Author will call collectively Chain-based LEACH (CBL) that improves the Low-Energy Adaptive Clustering Hierarchy (LEACH) to significantly reduce energy consumption and increase the lifetime of a sensor network. Our protocol uses LEACH and the advantages of Power-Efficient Gathering in Sensor Information Systems (PEGASIS) and avoids their disadvantages. LEACH technique improves energy efficiency of a sensor network by selecting a cluster-head, and having it aggregate data from other nodes in its cluster, and PEGASIS is a near optimal chain-based protocol that Author used for communication and extra aggregation between cluster-heads that are neighbors and takes turns transmitting to the sink.

Wenjing Guo et. al. [22], proposes a routing protocol for the applications of Wireless Sensor Network (WSN). It is a protocol based on the PEGASIS protocol but using an improved ant colony algorithm rather than the greedy algorithm to construct the chain. Compared with the original PEGASIS, this one, Pegant, can achieve a global optimization. It forms a chain that makes the path more even-distributed and the total square of transmission distance much less. Moreover, in the constructing process, the energy factor has been taken into account, which brings about a balance of energy consumption between nodes. In each round of transmission, according to the current energy of each node, a leader is selected to directly communicate with the base station (BS). Simulation results have show that the proposed protocol significantly prolongs the network lifetime.

Young-Long Chen et. al. [23], propose in order to reduce energy consumption, Author first show ideal energy mathematical model of PEGASIS topology, since the distance between nodes is the same, this energy mathematical model is the longest network lifetime of WSNs. To achieve this objective, Author have proposed Intra- Grid PEGASIS topology architecture, which is an architecture based on PEGASIS topology; in this architecture, the sensor area is divided into several network grids, meanwhile, the nodes of each network grid is deployed in random, then the nodes within the network grid are connected, finally, all the network grids are connected.

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Yongchang Yu et. al. [24], propose EECB (Energy-Efficient Chain-Based routing protocol) that is an improvement over PEGASIS. EECB uses distances between nodes and the BS and remaining energy levels of nodes to decide which node will be the leader that takes charge of transmitting data to the BS. Also, EECB adopts distance threshold to avoid formation of LL (Long Link) on the chain.

Feng Sen et. al. [25], propose EEPB (Energy-Efficient PEGASIS-Based protocol) is a chain-based protocol which has certain deficiencies including the uncertainty of threshold adopted when building a chain, the inevitability of long link (LL) when valuing threshold inappropriately and the non-optimal election of leader node. Aiming at these problems, an improved energy-efficient PEGASIS-based protocol (IEEPB) is proposed in this paper. IEEPB adopts new method to build chain, and uses weighting method when selecting the leader node, that is assigning each node a weight so as to represent its appropriate level of being a leader which considers residual energy of nodes and distance between a node and base station (BS) as key parameters.

Young-Long et al. [26], propose the PEGASIS topology architecture with the PBCA (phase-based coverage algorithm) to find the redundant nodes which can enter to sleep mode. Therefore, our proposed algorithm can reduce the energy consumption of nodes and extend the network lifetime. Simulation results show that the performances of our algorithm outperformance the LEACH topology architecture, the PEGASIS topology architecture, and the LEACH with PBCA topology architecture in terms of energy consumptions, number of nodes alive, and sensing areas.

V. CONCLUSION

In this paper, we describe PEGASIS, it is chain based protocol that is near optimal for a data-gathering problem in sensor networks. PEGASIS outperforms LEACH by eliminating the overhead of dynamic cluster formation, minimising the distance non leader-nodes must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round. Due to the energy constraints, wireless sensors usually have a limited transmission range, making multi hop data routing towards the PN (processing node) more energy efficient than direct transmission (one hop). A primary design goal for wireless sensor networks is to use the energy efficiently. The proposed system will improve the existing PEGASIS protocol.

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