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Improving Energy Efficiency in WSN Using Tree Based Energy Balancing Routing Protocol

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ABSTRACT: Wireless sensor networks (WSNs) have become a hot research topic in recent year. Applications include military, liberate, environment monitoring, and smart homes. The use of WSN has foreseen big changes in data gathering, processing, routing of information and dissemination for different environments and applications. A WSN is composed of hundreds or even thousands of small, inexpensive sensor nodes which communicate with one another wirelessly. Sensor nodes naturally do not have very much computational authority, limiting the kinds of networking protocols and security mechanisms they can employ. Scientists have proposed numerous conventions, for example, LEACH, HEED, PEGASIS, TBC and PEDAP. The energy efficient routing protocol of General Self Organized Tree Based Energy Balance Routing protocol (GSTEB) used to improve the energy efficiency and to reduce the energy consumption, balance the network lifetime. Simulation results show that GSTEB a fitter performance than other protocols in balancing energy spending, thus prolonging the lifetime of WSN. This protocol to improve the energy efficiency compared to other protocol like LEACH. Simulation results show that GSTEB a better performance than other protocols in balancing energy utilization, thus prolonging the lifetime of WSN.

KEYWORDS*:* Energy-balance, network lifetime, routing protocol, wireless sensor network**.**

I. INTRODUCTION

A Wireless Sensor Network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions such as warmth, echo, anxiety, etc. and to cooperatively pass their data through the network to a main location. In Wireless Sensor Network the group of nodes form a network. It have a source and destination node. The source node want to send the information to the destination node. First it selects the path by interconnecting the rely nodes and pass the information to the destination via the gateway. A WSN have deployed for various purposes like military application, surveillance in volcanic or remote regions, etc. Wireless Networks collect and disseminate from the fields where ordinary networks are unreachable for various environmental and strategic reasons. The energy consumption rate for sensors in a wireless sensor network varies greatly based on the protocols the sensors use for communications. A critical constraint on sensors networks is that sensor nodes employ batteries. A second constraint is that sensors will be deployed unattended and in large numbers, so that it will be difficult to change or recharge batteries in the sensors. Therefore, all systems, processes and communication protocols for sensors and sensor networks must minimize power consumption. There are lot of energy efficient routing protocol in wireless sensor network. Because battery replacement is not possible in WSN. Therefore they introduce energy efficient routing protocol for improving energy efficient and to reduce the energy consumption.

In the proposed system to improve the energy efficiency in WSN using GSTEB protocol. In WSN not only to minimize the total energy consumption but reduce the small amount of energy consumption with the use of efficient routing protocol. To compare the energy efficient compared to the existing routing protocol. The parameters considered are energy, delay, packet delivery ratio, throughput, jitter. The rest of the paper is organized as follows. Section II presents several energy efficient routing protocol related to the work. Section III justifies the necessity of energy

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efficiency. Section IV describes the implementation of protocol and compared the parameters to the existing protocol. In Section V presents and analyze the obtained results. Finally, Section VI concludes the paper.

II. BACKGROUND AND RELATED WORK

In the networking literature, there are several works that proposed either to improve the energy efficiency using various method. The following section deals with most representative work related to proposed work.

A. Energy Efficient Routing Protocol

There are various energy efficient routing protocol used over the battery replacement in WSN. A main task of WSN is to periodically collect information of the interested area and transmit the information to BS. A simple approach to fulfilling this task is that each sensor node transmits data directly to BS. However, when BS is located far away from the target area, the sensor nodes will die quickly due to much energy consumption. On the other hand, since the distances between each node and BS are different, direct transmission leads to unbalanced energy consumption. To solve these problems, many protocols have been proposed. Of the protocols proposed, hierarchical protocols such as LEACH, HEED, PEGASIS, HEERP, TAEERP, TBC and PEDAP can achieve satisfactory solutions. The following literature review deals with the literature works related to this project.

Energy-Efficient Communication Protocol For Wireless Sensor Networks[1].In LEACH, for the entire network, Wireless distributed micro sensor systems will enable the reliable monitoring of a variety of environments for both civil and martial application. We look at announcement protocols, which can have considerable bang on the overall energy dissipation of these networks. Based on our findings that the conservative protocols of direct communication, minimum-broadcast-energy, multi hop steering, and static clustering may not be finest for sensor networks, we propose LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol that utilize randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network. This position is self-elected at different time intervals. The decision to become a cluster-head depends on the amount of energy left at the node. In this way, nodes with more energy remaining will perform the energy-intensive functions of the network. Each node makes its conclusion about whether to be a cluster-head independently of the other nodes . In addition, we discuss a conventional clustering approach to routing and the drawbacks of using such an approach when the nodes are all energy-constrain. Using a direct communication protocol, each sensor sends its data straightforwardly to the base station.

HEED: A Hybrid, Energy-Efficient, Distributed Clustering approach for Ad-hoc sensor Networks[2].In the authors proposed a HEED to periodically selects cluster heads according to a hybrid of the node residual energy and asecondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in 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 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.

Hierarchical Energy Efficient Routing Protocol for Wireless Sensor Network[3]. In HEERP, However the data transferred in a simple WSN is not on the basis of priority, therefore high priority data which needs immediate attention may get delayed due to congestion as a result the throughput, reliability and quality of data is affected. This paper proposes "Hierarchical Energy Efficient Routing Protocol for Wireless Sensor Network" (HEERP) through prioritization which provides a congestion free energy efficient path to urgent data packets, as a result of which the best path always remains available for the transmission of critical or high priority data. Simulation results show that HEERP results in low end to end delay, low packet delay variation time or jitter resulting in transfer of high quality sample, low packet loss ratio and high throughput and low utilization of energy as compared to simple WSN, resulting in maximized lifetime of the network.

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A Chain Oriented Sensor Network For Efficient Data Collection[4].In COSEN, the general for most of the applications in wireless communication we focus on bandwidth efficiency and higher throughput. Energy efficiency comes as secondary concern because devices are connected to the mains or come with a sufficiently capable or/and rechargeable power source. But they have a tiny irreplaceable power unit or rechargeable source. These tiny sensors gain popularity with the advances of MEMS (Micro- Electro-Mechanical Systems) based sensor technology, low-power electronics, and low-power radio design. The energy restriction of battery operated sensor nodes certainly makes this task difficult and complicated because once deployed in the target field, it is not feasible to change the battery periodically. The applications in wireless communication we focus on bandwidth efficiency and higher throughput. Most of the protocols can be classified as either data-centric or hierarchical or location-based. Data-centric routing protocols mainly utilize attribute-based query and involve naming of desired data.It consider about the delay of the network. Our protocol shows better performance than both LEACH and PEGASIS in terms of energy consumption and network delay. Moreover, we find in the simulation that our protocol takes higher number of rounds than that of PEGASIS before the first sensor dies. Furthermore, COSEN is simple and easy to implement. Here for the sake of simplicity we describe a two-layer hierarchical chain based protocol.

A Balanced-Clustering, Energy-Efficient Hierarchical Routing Protocol in WSN[5].In BCEE, Wireless Sensor Networks together hundreds or thousands of sensor nodes to accurately monitor a distant environment. Considering harsh resources constraint, it requires forceful wireless communication protocols that are energy efficient and can provide longer life span, in particular for routing protocol.
It requires robust wireless communication protocols that are energy efficient and can provide longer lifetime, especially for routing protocol. A number of routing protocols have been proposed to reduce energy consumption, especially hierarchical routing algorithm. A balanced clustering, energy efficient hierarchical routing protocol is proposed, called BCEE, aiming at equilibrate energy consumption highly to whole network and prolong network lifetime effectively.
The results show that our protocol offers significant reductions of energy consumption and prolongs network lifetime hugely. Also the produced clusters exhibit several appealing characteristics. This approach can be applied to the design of several types of sensor network protocols that require scalability, prolonged network lifetime, fault acceptance, and load balancing.

TBC for Energy Efficient Wireless Sensor Networks[6].In TBC, Wireless sensor networks are widely used for gathering data in an independent fashion. Since sensors are power forced devices, it is quite important for them to reduce the energy utilization. In this paper we propose a new tree-based clustering (TBC) approach for energy efficient wireless sensor networks. Here the nodes in a cluster form a hierarchy with the root as the cluster-head, while the tallness of the tree is decided based on the distance of the member nodes to the cluster head. Computer simulation shows that the anticipated scheme effectively reduces and balances the energy consumption among the nodes, and thus appreciably extends the network lifetime compared to the existing schemes such since LEACH, PEGASIS, and TREEPSI. It low-cost and low-power wireless micro sensor nodes have become popular. Wireless sensor network (WSN) consists of tiny sensor nodes forming an ad hoc distributed data sensing and propagation network which collects the information on the surrounding environment. The limited energy at each node affects the lifetime of the full network, and as a result energy efficiency has been a critical design issue for the protocols and algorithms developed for WSN. Among various approaches proposed for energy efficient WSNs, the clustering approach in which data are gathered by one representative sensor of each group of sensors allows good scalability for the sensor network consisting of hundreds or thousands of nodes.

Traffic Aware Energy Efficient Routing Protocol[7].In TAEERP, WSN consisting of a large number of small sensors with low-power transceivers can be an effective tool for gathering data in a variety of environment. As sensor nodes are deployed in sensing square, they can help people to monitor and collective data. Researchers also try to find more proficient ways of utilizing limited energy of sensor node in order to give longer life instance of WSNs. Network lifetime, scalability, and load balancing are important necessities for many data gathering sensor network application. Therefore, many protocols are introduced for better performance. These sensor nodes are usually deployed randomly and densely in hostile environment. They collaborate to observe the surroundings and send the information back to the

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network manager (or base station) when abnormal events occur. It is desirable to make these nodes as energy-efficient as possible and to rely on their large numbers in order to obtain high quality results.

III. SYSTEM DESIGN

Wireless Sensor Network are deployed the large amount of nodes in the environment. To collect the information from number of nodes to send the data to the Base Station (BS). In the data transmission are having two kinds, there are the Single hop Communication and Multi hop Communication. Major requirements of Wireless Sensor Network are the energy consumption, network lifetime, scalability and robustness. Many energy efficient protocols are introduced to improve the energy efficiency and balanced the network lifetime. Researchers are introducing the many kind of protocol for energy consumption. In the Wireless Sensor Network the energy consumption is the emerging technique in the research field. It provide the various network parameter like throughput, delay, jitter, lifetime.

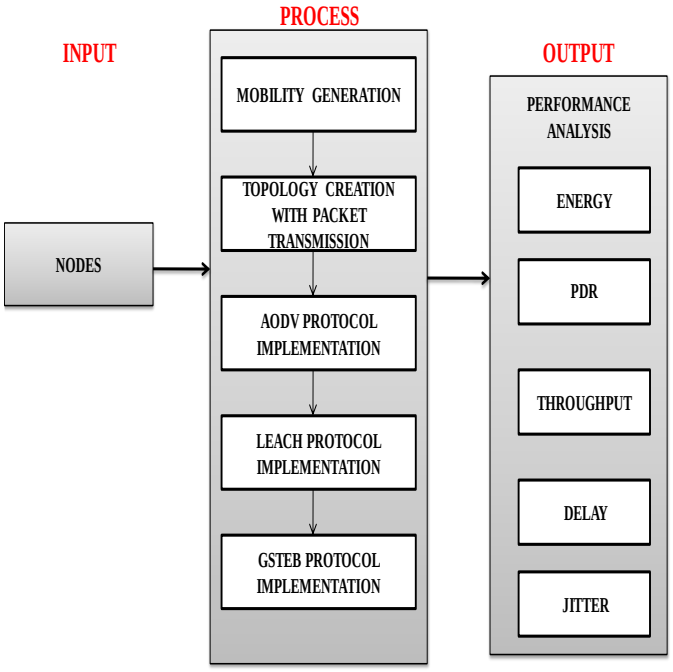

Fig 1 System Design

Wireless Sensor Network are provide the various kind of protocols. These protocols are used in the application of Environmental monitoring, Disaster recovery, Military Surveillance, Medical Monitoring.WSN of spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure etc. and to agreeably pass their data through the network to a main location. In the sensor networks are contain too much of data for the process. Therefore, automated methods of aggregating are introduced. This method used to avoid the information overload. The data aggregation is also known as data fusion. The existing protocols are not suitable for improving energy efficiency and energy consumption. It prolongs the network lifetime in contrast to plane multi-hop routing and static routing but still it has problems. Cluster heads are elected randomly, so the optimal number and distribution of cluster heads cannot be ensured. The cluster head elected based on the energy, highest node energy

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chosen on the cluster head, after that communication the cluster head emitted some energy, so remaining energy of the other nodes are concentrated and the cluster head elected by the remaining energy of the nodes.
Therefore, those nodes with less remaining energy may be chosen as the cluster head which will result that these nodes may die first. The cluster heads communicate with the base station in single-hop mode which makes LEACH (LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY) cannot be used in large-scale wireless sensor networks for the limit effective communication range of the sensor nodes. The proposed General Self Organized Tree Based Energy Balanced Routing Protocol (GSTEB) is used to improve the energy efficiency and balancing the network lifetime. The network collects information periodically from a terrain where each node continually senses the environment and sends the data packet to the base station. Normally the network lifetime has two definitions. First one is the time from the start of the network operation to the death of the first node in the network. Second one is the time from the start of the network operation to the death of the last node in the network. Here the access points are used in the proposed protocol to reduce the energy consumption and compared to the existing protocol to prove the better performance of the protocol. To improving the act of network, there are different metrics are, namely, Energy, Throughput, Packet delivery ratio, End to end delay, Jitter, Packet drop failure.

IV. IMPLEMENTATION OF GSTEB

This module evaluates the network lifetime and it has two kinds of step to implement this protocol. The two steps are following:

I. Tree construction
II. Data transmission

Tree construction

The BS can transmits all the information to all other nodes in the network environment, which results in much less energy consumption. In order to equilibrium the network load node with the largest residual energy is chosen as cluster head.
The cluster head collects all the data of all sensors and transmits the aggregated data to BS over longer distance. By using the control of BS, the energy waste can be reduced and thus the process may be much simpler. And we provide better network life time.

Data transmission

Each sensor node in the network it collects the information to generate a DATA_PKTs which needs to be transmitted to BS (base station). In a time slot, only the member nodes are trying to send their DATA_PKTS. For which cluster head is available in that time, then the nodes are send the data to that node after that the node aggregated all the nodes finally transmitted to the base station so it can be reduce the energy consumption and balance the network lifetime.

V. SIMULATION AND PERFORMANCE EVALUATION

In this section, an NS-2 simulator is used to investigate the performances of GSTEB protocol and compare it to Adaptive protocols.

A. Network models and Parameters

The parameters and the values are the energy, throughput, delay, packet delivery ratio, jitter for the performance analysis of GSTEB protocol. The mobility of the node in the network are achieved by using the NS2 tool.

B. Simulation Environment Topology Formation Using Network Simulator

The large amount of nodes deployed in the simulation environment. In the number nodes one node act as the cluster head and another nodes other than cluster head act as the member nodes. The cluster head collects all the information from their member nodes and finally aggregated data sends to the base station (BS). Here the environment is created using 50 nodes.

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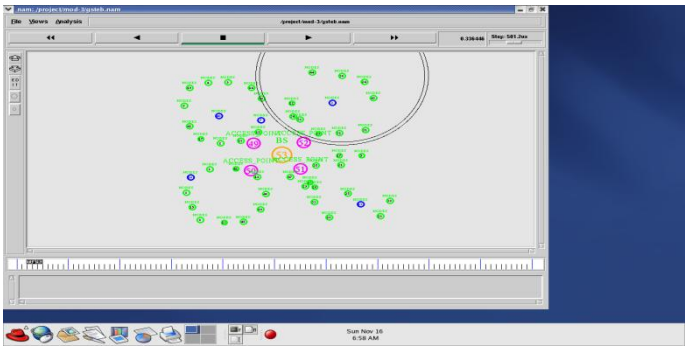

Fig 2 Nodes Creation Using Ns2

C. GSTEB IMPLEMENTATION

The neighbor node selection based on the residual energy. After the nodes selection, the other nodes are transmit the packet to the access point and finally the access point transmits to the base station. After the neighbor node selection.

The access point act as the root node, the root node collects all the information from the cluster head, the cluster head collects all the information from the neighbor nodes and finally the access point transmits the information to the BS (base station). So this kind of way we can reduce the energy consumption compared to the LEACH protocol.

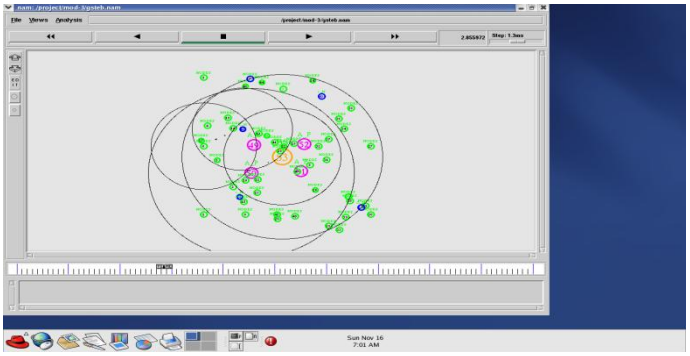

Fig 3 Implementation Of Gsteb Using Ns2

1 . Energy Used

The metric is measured as the percent of energy consumed by a node with respect to its initial energy. The initial energy and the final energy left in the node, at the end of the simulation run are measured. The percent energy consumed by a node is calculated as the energy consumed to the initial energy. And finally the percent energy consumed by all the nodes in a scenario is calculated as the average of their individual energy consumption of the nodes.

Energy used by the vehicles are calculated as follows:

$$\boldsymbol{Ec = \frac{ie - fe}{ie}} \quad ----------(1)$$

$$AEC = \sum_{i}^{k} Ec/N_i \quad ----------(2)$$

Where

Ec – Percentage of Energy consumed

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ie – Initial energy
fe – final energy
AEC – Average Energy Consumed by the WSNs
N_i – Number of nodes

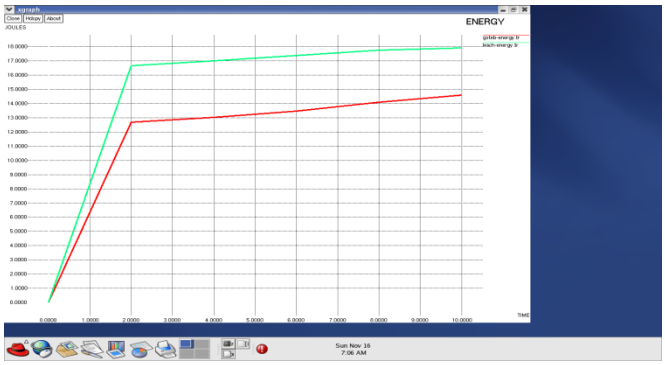

Fig 4 Comparison Graph for ENERGY

2. Throughput

It is a measure of the amount of data transmitted from the source to the destination in a unit period of time (second). The throughput is measured in total bits received per second. Also to be noted is that this metric only measures the total data throughput, ignoring all other overhead, over the network. The throughput of a node is measured by first counting the total number of data packets successfully received at the node, and computing the number of bits received, which is finally divided by the total simulation runtime. The throughput of the network is finally defined as the average of the throughput of all nodes involved in data transmission.

$$Throughput = \sum \frac{t(nodes)}{N} - - - - - (3)$$

Where
t(nodes) – throughput of nodes involved in data transmission
N- Number of nodes

C . Packet Delivery Ratio

PDR can be derived from the ratio of the number of received packets by the number of transmitted packets to be received and sent from/to the server respectively. And the PDR is calculated as follows:

$$pdr = \frac{n(rp)}{n(tp)} - - - - - - - - - - (4)$$

Where
Pdr- packet delivery ratio
n(rp) – number of received packets
n(tp) – number of transmitted packets

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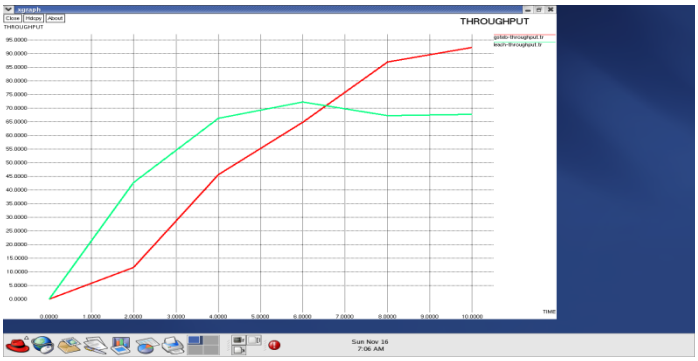

Fig 5 Comparison Graph for THROUGHPUT

3 . Delay

The end-to-end delay is the time taken for a data packet to reach the destination node. The delay for a packet is the time taken for it to reach the destination. And the average delay is calculated by taking the average of delays for every data packet transmitted. The parameter comes into play only when the data transmission has been successful.

$$pd = rt_{destn} - tt_{source} \quad ---------- \quad (5)$$

$$d = \sum \frac{pd}{n(rp)} ---------- (6)$$

Where
pd - packet delay
rt_{detn} – receive time at destination
tt_{source} – transmit time at source
d – average delay
n(rp) – total number of received packets

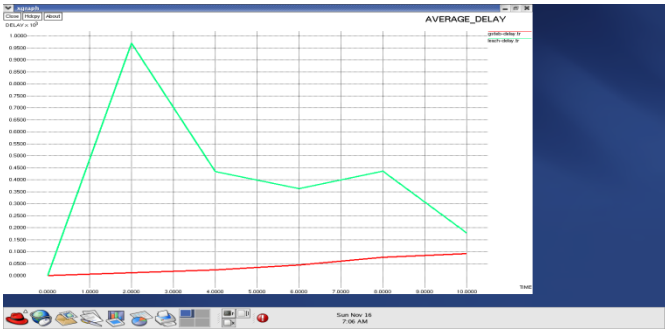

Fig 6 Comparison Graph for DELAY

VI. CONCLUSION

This brief aims at reducing the energy consumption by using GSTEB protocol. The simulations show that when the data collected by sensors is strongly correlative, GSTEB outperforms LEACH. Because GSTEB is self organized protocol, it only consumes a small amount of energy in each round and to balancing the energy consumption. When lifetime is defined as the time from the start of the network operation to death of the first node in the network. Simulation results show that when lifetime is defined as the time from the start of the network, GSTEB prolongs the lifetime of the network by more than 100% compared with LEACH.

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BIOGRAPHY

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