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Energy Efficient Routing Scheme for Wireless Sensor Network

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Abstract – Now days Wireless Sensor Network(WSN) is one of the most emerging fields there are large amount of research going on how we can efficiently uses WSN in various area. WSN consist of various components in that communication is most important because while communication between nodes lots of energy wasted for communication there are various Energy efficient saving scheme are proposed One of the technique is clustering. A cluster-based approach is used to minimise energy expenditure in WSN. In this paper, a uniform cluster concept is proposed to minimise data transmission distance of sensor nodes in WSN. The residual energy is calculated for selecting the appropriate cluster head nodes and the average distance between sensor nodes. To increase the lifetime of sensor node in WSNs and for increasing energy efficiency, new efficient energy saving schemes EECBS (Energy Efficient Cluster-Base Scheme) is proposed and developed. Lifetime of WSN is increased effectively by using the uniform cluster and balancing the network load among the clusters. The proposed EECBS algorithm achieves less energy expenditure and better WSN life-time, as it find the dead nodes from the sensing region and these dead nodes are energize with the solar power and again moved to active node for next operation.

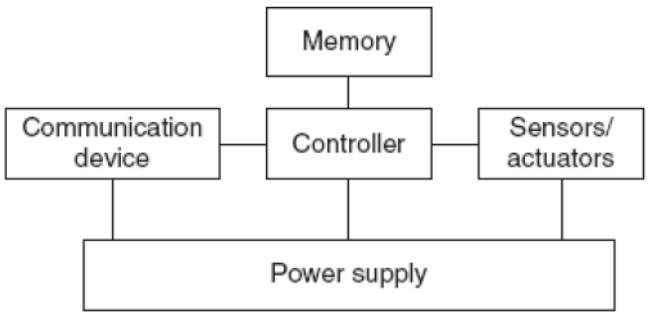
Key Words: *Cluster Head, Base Station, Wireless Sensor Network,*

1 INTRODUCTION

Now days, there has been a speedy growth in wireless communication technique. economical and low power wireless micro sensors are widely used in wireless and mobile environment [1],[3],[4],[5]. A wireless sensor network (WSN) is a network of large number of sensor nodes deployed over a large area for identify physical phenomena like temperature, humidity, vibrations, seismic events, and so on, where each node is have limited processing, storage and communication capabilities. All sensor nodes are used for identifying an event and routing the data in wireless networking. These sensor nodes are consisting of three basic components: a sensor component, a processing component and storage component. A wireless communication system are deployed in sensing area to monitor specific event and collect the data. Then the sensor nodes send the data to base station (BS) by using wireless transmission method. WSNs are used in various applications like health care system, battlefield surveillance system, environment monitoring system, human behaviour monitoring, agriculture monitoring and so on. The characteristics of sensor networks and application requirements have a forceful impact on the network design objectives in term of network capabilities and network performance [2].

1.2 Sensor node Architecture:

A basic sensor node comprises five main components
Controller A controller to control all the process , capable of executing various operation .
Memory Is required for storing information and programs usually, different types of memory are used for programs and data.
Sensors and actuators Is devices that can observe or control physical parameters of the environment.
Communication Device For shearing information over wireless network communication device is used .
Power supply some forms of batteries are necessary to provide energy. Sometimes, some form of recharging by obtaining energy from the environment is available as well (e.g. solar cells).



1.2. NETWORK CHARACTERISTICS

Wireless sensor networks (WSN) have the following unique characteristics and constraints:
Data duplications: The data sensed by multiple sensor nodes typically have a certain level of correlation or duplication.

Close deployment of sensor node: Sensor nodes are usually closely deployed and can be several orders of magnitude higher than that in a MANET.
Application specific: A sensor network is usually made for a specific application.
Self-configurable: Sensor nodes are usually randomly set and have capability of easily configure them into a communication network.
Unreliable sensor nodes: Since sensor nodes are randomly set there are more chance of physical damages or failures of sensor node

2 RELATED WORK

Efficient energy saving scheme should be designed to provide proper energy use and improve the lifetime of system. In WSN, a cluster based approach is used to reduce energy expenditure. In this paper, author provide uniform cluster concept to reduce data transmission of sensor nodes in WSN. So that the sensor node clusters to create equal distribution, and taken into account the residual energy for selecting the relevant cluster head nodes and the average distance between sensor nodes [4]. A sensor network is composed of a large number of sensor nodes, which are densely placed. The location of sensor nodes need not be pre-determined. This allows random deployment in inaccessible area or disaster relief operations. On the other hand, this also means that sensor network system must have self-configure capabilities. Another unique feature of sensor networks is the cooperation of sensor nodes with each other . Sensor nodes are equipped with an on-board processor. Instead of sending the gather raw data to the base station directly sensor nodes process that data using computational unit and transmit only the useful data. Wireless Sensor Networks (WSNs) consist of very small nodes with, some properties such as computation, sensing and communications capabilities. Many routing, protocols
have been designed for WSNs where energy is the main design issue. In this paper, author present a small survey on routing techniques in WSNs[11]. And also state the design challenges for routing protocols in WSNs followed by a complete survey of different routing techniques. Overall, the routing approach are classified into three type based on the how network are structure: Flat, Hierarchical, Location based routing. Minimizing energy consumption and maximizing network lifetime are important goal to design routing protocol. Energy-efficient sensor network consists in finding minimum path from one sensor node to other sensor node so that network lifetime is boost. In this paper, author address the how we can optimally use sensors in cluster based sensor networks. Typically, any sensor can be turned off, turned on, or selected as a cluster head; also discus a different power expenditure level is associated with each of these states. And look for an optimal solution that boost network lifetime while ensuring simultaneously full area coverage and sensor connectivity to cluster heads[11]. LEACH (Low Energy Adaptive Clustering Hierarchy) [11] is most popular hierarchical routing protocol for sensor networks in which most nodes transmit data to cluster heads, and the cluster heads process the data and forward it to the base station. LEACH assumes that each node has a radio-link powerful enough to directly communicate with the base station or the nearby cluster head. Nodes that have been cluster heads cannot become cluster heads again for P rounds. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster to transmit its data. Clustering sensor nodes is an effective control approach. In this paper, authors propose a novel distributed clustering approach for long-lived ad-hoc sensor networks. The proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. HEED stands for Hybrid Energy-Efficient Distributed Clustering. HEED is one of the most effective cluster-based routing protocols in WSN. HEED has four primary objectives [15]
(i) Prolonging network lifetime by distributing energy consumption
(ii) Terminating the clustering process within a constant number of iterations
(iii) Minimizing control overhead
(iv) Producing well-distributed cluster heads.
It is a distributed, energy efficient clustering approach which makes use of two parameters to cluster the network; the sensor residual energy as a primary parameter and Communication like node degree and node proximity as a secondary parameter [14]. The HEED operation for clustering is divided into three phases; the initialization phase in which the sensors put their probabilities to become CHs, the main processing phase in which the sensors go through many steps to elect the CHs and the finalization phase in which each sensor join the least communication-cost CH or announce itself as a CH . The re-clustering in HEED is triggered dynamically at the beginning of each round which is a predefined period of time; the round in HEED can be in the range of seconds, minutes or even hours depending on the application at hand [14]. The HEED clustering operation is invoked at each node in order to decide if the node will elect to become a cluster head or join a cluster. A cluster head is responsible for two important tasks:
(1) intra-cluster coordination, i.e., coordinating among nodes within its cluster
(2) Inter-cluster communication, i.e., communicating with other cluster heads and/or external observers.
Simulation results demonstrate that proposed approach is effective in improving the network lifetime and data aggregation. Hierarchical routing techniques can help in reducing energy expenditures. Clustering is most useful

for applications that require large amount of scalability. Routing protocols can also implement clustering. Clustering can be very effective in one-to-many, many-to-one, one-to-any, or one-to-all communication. The main operation in sensor node clustering is to elect a set of cluster heads from the set of nodes in the network, and then cluster the rest of nodes with these cluster heads. Cluster heads are liable for arrangement among the nodes within their clusters and gather all data and communication with each other. SECA (Saving energy clustering algorithm) [12] is used to provide effective energy consumption in WSNs. In order to make an best distribution for sensor node clusters, authors find the average distance between the wireless sensor nodes and take into consideration residual energy for selecting the best cluster head nodes. The lifespan of WSNs is increased by using the uniform cluster selection and balancing the network load to clusters. The main advantage of SECA is that the energy expenditures is reduced and better network lifetime can be achieve.

3. PROPOSED WORK

3.1 Framework for EECBS:

A wireless sensor network (WSN) is a network of large number of sensor nodes deployed over a large area for check physical phenomena like temperature, vibrations, seismic events, any change and so on. Sensors have the power of sensing, processing, and wirelessly transmitting collected data back to the base stations. Sensor itself supports all necessary operations with limited battery power. Those operations that consume more power are transmitting and receiving data, running applications. Among all others operation, data transmission consumes most energy. In a sensor network, the network lifetime is crucial for applications. Energy expenditure of every sensor directly affects the network lifetime. Those sensors which are close to base stations (BS) require more energy since they should relay data for more sensors, and liable to reduce their lifespan. In Wireless Sensor Networks (WSN), energy is critical resource and constraint of such networks. There are number of researches already done on reduce the energy expenditure of WSN in order to boost the lifetime of entire network. In addition to this method, this approach is further extended by adding the energy efficient routing protocol called EECBS. Hence in this project basically the current approach of protocols with EECBS is explored. EECBS is Energy efficient version of HEED, the cluster heads are probabilistically selected on the basis of their residual energy and sensor nodes join the cluster according to their power level. EECBS consumed energy using sliding window approach, where if cluster head didn't received any acknowledgement from non-cluster node within sliding window time, then it remove that nodes from that cluster as it is consider as dead nodes. In our proposed scheme, the dead node from the system is identifying and this dead node is again recharged by the solar energy. The greatest gift of nature to our universe is sun energy. This solar energy which is the greatest and most tapped form is the energy from sun. In this approach, use of solar energy based upon the geographical areas where no. of sensor nodes are deployed and radiation levels of the areas, so that it makes the system energy efficient. And by using the uniform cluster location and balancing the network loading among the clusters, the lifetime of WSNs will be extended.

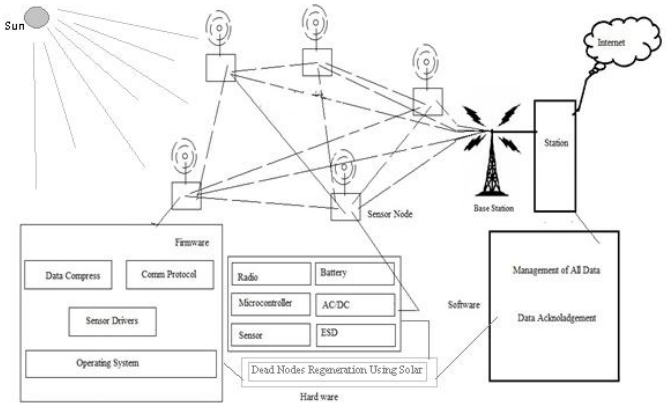


Fig 3.1. System architecture

3.2 EECBS Algorithm:

Assumption of proposed system

- Sensor nodes are densely deployed.
- Sensor nodes may be dead by different condition.
- The structure of a sensor network may changes very frequently.
- Sensor nodes mainly use for broadcast communication.
- Sensor nodes are limited in power, processing capacities, and memory.
- Sensor nodes may not have global ID

Step 1:

Node The forwarding strategy employed in the routing protocols requires the following information:
1) The position of the destination of the packet and
2) The position of al neighboring node. Where,
Node= ({x,y}, v)
X= x co-ordinate of position
Y= y co-ordinate of position
V= velocity of node

Step2:

Mobility Prediction (MP):

Mp={node_position,velocity_node, Tl,c,Predicted_position }
Given the position of node i and its velocity along the x and y axes at time Tl, its neighbors can calulate the current position of i.

Step3:
Anonymity:
A={ δ, Pr}
This rule adapts the beacon generation rate to the frequency With which the nodes change the characteristics that govern their motion. Where ,δ-denote any adversarial strategy for breaching the anonymity of the system. Pr -denote the adversary's probability of winning Game 1 using strategy.
$\sum$ Be the set of all possible adversarial strategies
A δ: = 1-2(Pr [b'=b] δ – 0.5
A:=$\min_{\delta\epsilon} A\delta$
With the above definition of interval indistinguishability, we introduce the notion A of anonymity in sensor networks.

Step4:
Minimum Transmission Energy (MTE):
MTE={Bk, P, EXT, Lk}
For 3 nodes A, B and C, A would transmit to node C through B iff (ETX – total transmit energy)
Where,
Bk(n)- backlog Size
P- is a design parameter.
All the users in the set Bk(n), whose cardinality |Bk(n)| = Bk(n) is referred to as backlog size, thus attempt transmission during frame k. To make this possible, the FC allocates a frame of Lk(n) slots, where Lk(n) is selected based on the estimate ˆBk(n) of the backlog size Bk(n) (estimation of Bk(n) is discussed.
$L_k(n) = [pB_k(n)]$
Where k is the upper nearest integer operator, and ρ is a design parameter. Note that, if the backlog size is *B*, the Probability β (j,B,L) that j ≤ B sensors transmit in the same slot in a frame of length L is binomial

Step5:
Cluster Finding:
C={R, K}
If there are n sensor nodes in the wireless sensor networks, C can be calculated by
C=$\sum_{i-1}^{n} Xi$ / n
Where Xi is the coordinate of sensor node I, Let R be the average distance between C and all sensor nodes, which can be calculated by
R=$\sum_{i-1}^{n} |Xi - C|$ / n
Where k is the number of clusters and i = 1, 2,..., k. The initial value k must be decided in the initial set-up phase.

According to the definition of optimum number of clusters in LEACH, k can be calculated by
k= [$\frac{\sqrt{n}}{\sqrt{2\pi}} \frac{\sqrt{\epsilon fs}}{\sqrt{\epsilon mp}}$ M / $(D)^2$ to BS]
Where M is the side of the given square field, the dto BS is the average distance from the cluster head nodes to the BS which is defined in LEACH. However, the cluster head nodes are selected by creating some clusters in our proposed algorithm

4. EXPERIMENTAL ANALYSIS

4.1 Energy Consumption: Amount of energy used in a process or system. It should be minimum. In addition, the energy consumption for data collection and aggregation of cluster head nodes is considered:

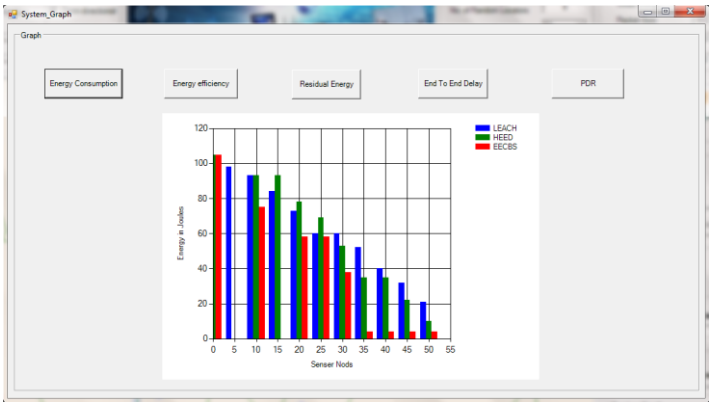


Fig. 4.1 Comparison of Energy Consumption by LEACH, HEED, EECBS

4.2 Energy Efficiency: It is simply efficient energy use. The goal is to reduce the amount of energy required to provide products and services. Efficiency generally refers to how far one can get the particular output for the given input with as much less wastage as possibl

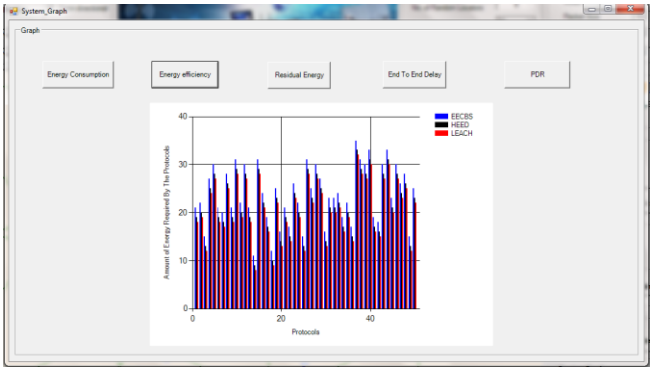


Fig. 4.2 Comparison of Energy Efficiency between LEACH, HEED, EEC

4.3 Residual Energy: Residual is used to describe what remains of something when most of it has gone. The higher value of end to end delay means the better performance of the protocol.
Residual energy = Total energy – Used energy.

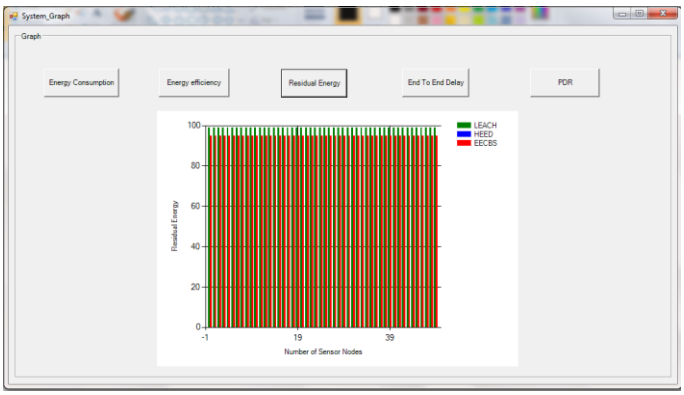


Fig. 4.3 Comparison of Residual Energy between LEACH, HEED, EECBS

4.5 Packet Delivery Ratio:-

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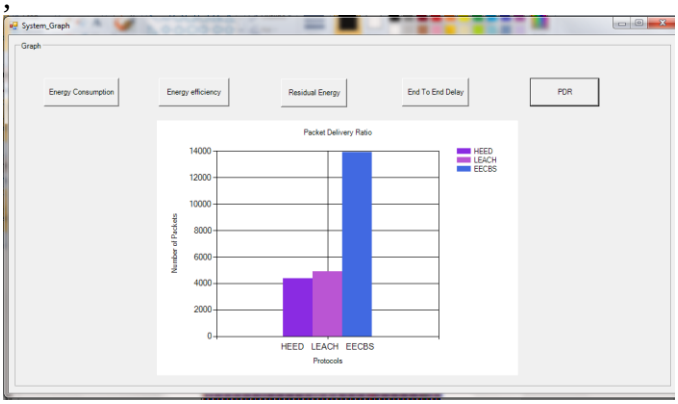

Fig. 4.3 Comparison of PDR between LEACH, HEED, EECBS

CONCLUSIONS

One of the most important issues in the WSNs is how to save the energy. To make the wireless sensor node energy efficient , new energy efficient power saving algorithm must be developed. In the proposed scheme, the average distance between the sensor nodes is evaluated and for cluster head selection the amount residual energy and the distance is used. By using the uniform cluster concept and balancing the network load equally among the clusters, the lifetime of WSNs will be increase. To best of our knowledge the proposed EECBS algorithm looks promising with the low energy use and best network lifetime of WSN. The mechanism of identifying dead nodes from the sensing location and on the basis of solar power on different scenario is consider from this an algorithm is develop for variation in the recharging cycle of the battery of the dead sensor node, and therefore there is increase in the battery lifetime. Compared to other network structure, WSNs are still at an initial stage of development and a lot of work needs to be done in order to take them to the highest level. Along with further optimization of the routing protocols, in future the plan is to expand on this study and try various types of sensor batteries, and adjust different conditions such as pressure and humidity and see their effect on the battery lifecycle. Also different newly propose routing protocols and algorithms will be inspected and correlate as other approaches to save the energy in Wireless Sensor Networks.

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