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An Adaptive Cluster Based Routing Protocol for WSN

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----------**ABSTRACT**----------
The Wireless sensor networks (WSN) consisting of a large number of sensors that are effective for gathering data in a variety of environments, as the sensor operate on battery which is of limited power. To support high scalability and better data aggregation in fixed base station communication, sensor nodes are often grouped into disjoint, non overlapping subsets called clusters. Clusters create hierarchical WSN which incorporate efficient utilization of limited resources of sensor nodes. These clusters are formed by specialized cells. Each cluster is managed by a special node called cluster head and advanced node. An algorithm for better cluster head selection based on the node energy and the distance from base station to the cluster head for the efficient transmission and to reduce energy consumption by the sensor nodes is proposed in this paper. And the same algorithm is compared with the LEACH algorithm in terms of energy consumption.

Keywords - **Wireless sensor network, clusters, cluster head, advanced node, LEACH**

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I. INTRODUCTION

Wireless Sensor Network (WSN) (fig. 1) contains hundreds or thousands of sensor nodes which can be networked in many applications and have the ability to communicate either among each other or directly to an external base-station [2]. The fig 2 shows the schematic diagram of sensor node architecture where each sensor node comprises sensing, processing and transmission, mobilizes, position finding system, and power units also shows the communication architecture of a WSN [4]. Each sensor node bases its decision on its mission, the information it currently has, knowledge of its computing, communication, and energy resources and have capability to collect and route the data either to other sensors or back to an external base station or stations which may be a fixed or a mobile node capable of connecting the sensor network to an existing communication infrastructure or to the Internet where users have access to the reported data [5].WSNs need to be stable in design and structure to transfer data among the wireless sensors safely and without any problems, because of their use in critical areas and real time systems. Moreover, consuming less energy and increasing the lifetime of the wireless sensor nodes are the main objectives in designing the WSN, because of the limitation of the power resources and the difficulties of replacing the batteries of the wireless sensors [3].
The architecture of WSN varies for an individual sensor node and the entire network. Energy efficiency, size reduction and minimum cost are the main concern for sensor node architecture [8].

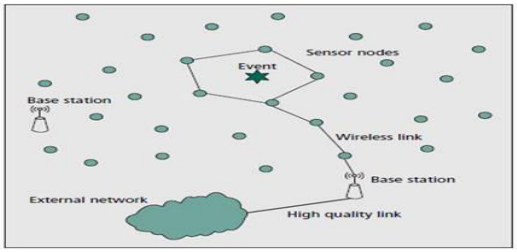

Fig. 1: Wireless Sensor Networks

Section II gives the brief description of the existing routing protocols. **Section III** dealt with the description of the proposed algorithm. **Section IV** is dealt with the implementation of the proposed algorithm. **Section V** gives Performance evaluations. **Section VI** is dealt with simulation results of the proposed algorithm. Future research is explained in **Section VII**, and finally, **Section VIII** gives the conclusion of the paper.

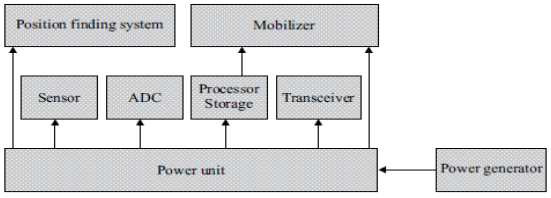

Fig. 2: Sensor node Architecture

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II. RELATED WORK

Routing in sensor networks has attracted a lot of attention in the recent years and has introduced unique challenges compared to traditional data routing in wired networks.

[W. Heinzelman, A. Chandrakasan][1] proposed, LEACH (Low-Energy Adaptive Clustering Hierarchy), a Clustering-based protocol utilizes randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic networks, and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base stat ion. In addition, LEACH is able to distribute energy dissipation evenly throughout the sensors, doubling the useful system lifetime for the networks [1].

[Raghunandan.G.H and Sagar Metri][5] Proposed, Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation and wireless communications capabilities. Evolution in wireless sensor network has broadened its pervasive and ubiquitous applications in numerous fields. These applications often require accurate information collecting as well as uninterrupted, prolonged active service. Routing protocols have significant impact on the overall energy consumption of sensor networks. Suitable Energy-efficient routing algorithms are required to the inherent characteristics of these types of networks are needed. Due to resource limitations in wireless sensor networks, prolonging the network lifetime has been of a great interest. Most of the energy of sensor nodes is utilized for transmission of data to the base station. Thus, it makes them to deplete their energy much faster. In this paper, Centrality based Cluster approach is used along with a movable base station to reduce the energy consumption of cluster heads. According to the simulation results, the proposed scheme has proved its efficiency in the network lifetime, residual energy of network. The proposed scheme also shows improvement in performance of WSN compared to other routing scheme.

III. PROPOSED ALGORITHM

Wireless sensor networks are fast growing and an existing research area which has attracted considerable research attention in the recent past. In hierarchical routing algorithms, CHs are responsible for gathering, compressing and forwarding the data to the base station. Thus, they are responsible for conveying the entire information of the members of that cluster. It is also important to form the clusters for efficient transmission of the data in WSN [4]. In the proposed algorithm clusters will change for every round. It allows sensors to distribute the sensing task by partitioning the space in a meaningful way. Here algorithm cell of the sensors is the subset of the plane in which all points are closer than to any other sensors. After organizing nodes into clusters, the cluster head (CH) is selected at the beginning of each round based on certain criteria [4]:

1. CH's residual energy: if the sensor in the cluster has more energy than others, then that sensor is selected as cluster head (CH).
2. Distance from base station to CH: The more distant the CH is from the base station, the more energy is required for data communications. Hence more preference is given to that CH.
3. Apart from cluster heads, there will be advanced nodes which will be having second highest energy.

A. Data propagation in WSN

1. Initially, the sensor node senses the event and transmits it to the Cluster Head.
2. The Cluster Head processes the data and transmits it to the Advance node.
3. Then advanced node transmits this processed data to the based station.

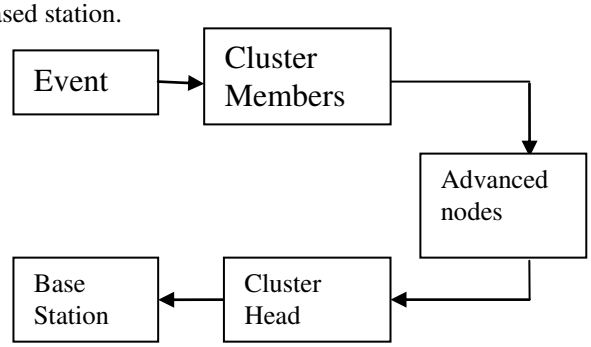

Fig. 3: Data propagation in WSN

IV. IMPLEMENTATION

The algorithm must be energy efficient so that it does not drain resources away from the primary intended use of cell phones for voice/data communication. We are calculating the total energy consumption of all nodes for various cluster radii. Our energy model for sensors is based on the first order radio model described in fig 4.

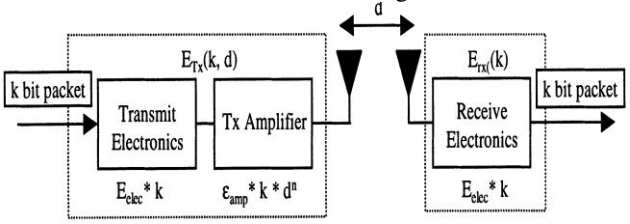

Fig4: Radio energy dissipation model

Table 1: Radio Characteristics

Operation	Energy dissipated.
Transmitter Electronics(ETX) Receiver Electronics(RTX) ETX=RTX= *Eelec*	50nJ/bit
Transmit Amplifier	100pJ/bit/m^2

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In our work, we assume a simple model where the radio dissipates *Eelec*= 50 nJ/bit run the transmitter or receiver circuitry and amp = 100 pi/bit/m2 for the transmit amplifier to achieve an acceptable EbNo (see Fig 4 and Table 1). These parameters are slightly better than the current state-of-the-art in radio design. We also assume r2 energy loss due to channel transmission.

Thus, to transmit a k-bit message a distance d using our radio model, the radio expends:

$$E_{TX}(k,d) = E_{TX-elec}(k) + E_{TX-amp}(k,d) \quad \ldots\ldots\ldots (1)$$

$$E_{TX}(k,d) = E_{elec} * k + \in_{amp} * k * d^2$$

And to receive this message, Radio expends:

$$E_{RX}(k) = E_{RX-elec}(k) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$E_{RX}(k) = E_{elec} * k$$

For these parameter values, receiving a message is not a low cost operation; the protocols should thus try to minimize not only the transmit distances but also the number of transmit and receive operations for each message.

V. PERFORMANCE EVOLUTION

Hundred sensors are randomly distributed in 100x100 boundaries as shown in fig.5. The sensor field is located on rectangular coordinates. A base station is located at the centre. All the nodes start with an initial energy of 0.5J. Therefore, total energy of the network is 50J. Cluster head and advanced node is selected randomly, after the completion of first round based on the above criteria mentioned in proposed algorithm. Fig.6 shown below is the clustering of sensor nodes. Here clustering is based on proposed algorithm. In this partition of cells in such a way that points inside a polygon are closer to that cell than any other cells thus one of the vertices of the Polygon is the farthest point of the polygon to the site inside it. Therefore proposed algorithm can be used as one of the sampling method in determining WSN coverage; with the sensors act as the sites, if all polygons vertices are covered then the field is fully covered otherwise coverage holes exist [6].

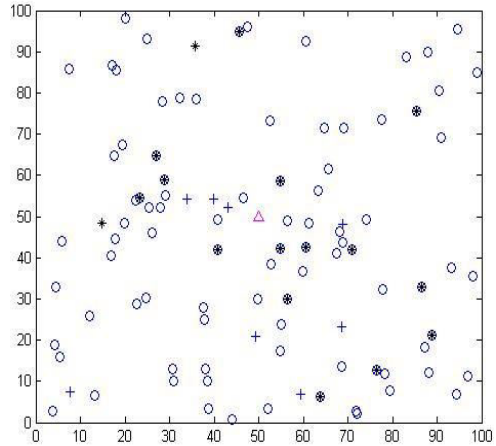

Fig. 5: Randomly Distributed Sensors

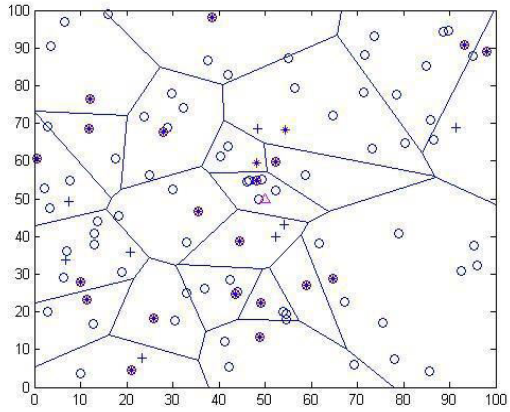

Fig. 6: Clustering of Sensor Nodes

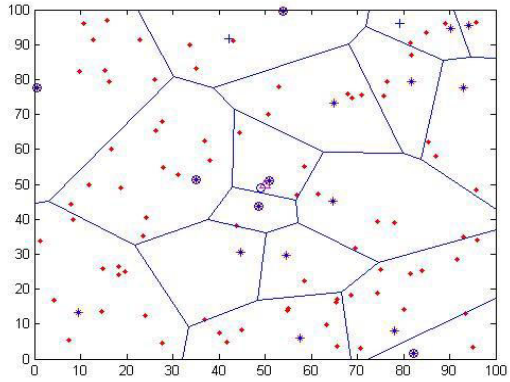

Fig.7: WSN after 1500 rounds.

We have performed simulation for 1500 rounds.Fig.7 shown is the WSN after 1500 rounds. In this figure red color nodes are the dead nodes. The node is considered to be dead when there is no energy in it for the transmission. Blue color nodes are the alive nodes. In the table below shown consists of parameter details used for proposed algorithm.

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Table 2: Parameters Detail

Parameter name	Values
Network area	100*100
BS Location	50*50
Number of nodes	100
E_o(Initial Energy)	0.5J
Packet Size	400bits
Eelec	50nJ/bit
E_{tx}=Erx	50nJ/bit
E_{fs}	10pJ/bits/m2
E_{mp}	0.013pJ/bits/m2
EDA	5nJ

VI. SIMULATION RESULTS

In the simulation process, we evaluate the performance of proposed algorithm in MATLAB simulator. 100 nodes are randomly distributed in a 100 x 100 Sq.m network.

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Simulation was performed for 1500 rounds. We compare our proposed algorithm with LEACH. We compute the plot for networks lifetime and remaining energy of the network. Lifetime is considered as the time when the first node dies. Fig.8 shows the number of alive nodes with respect to the operation of the network in rounds. The sensors start dying after 863 rounds in the proposed method, and in the LEACH algorithm nodes start dying approximately around 689 rounds. Therefore, proposed algorithm improves the overall network lifetime.

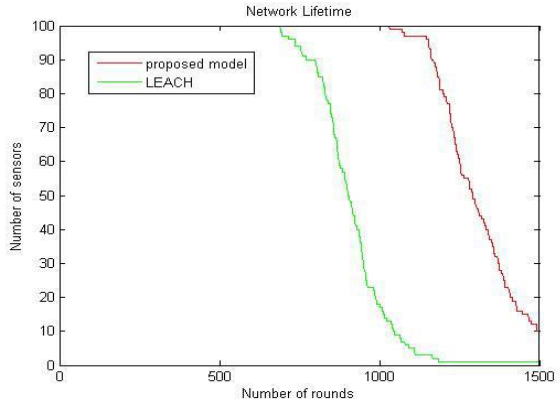

Fig.8 : Network Lifetime

Fig.8 describes the network lifetime of the proposed model is greater than the LEACH. Residual energy of the network in each round gives the rate of total energy consumption, which can be a good metric to measure the energy efficiency of the algorithms.

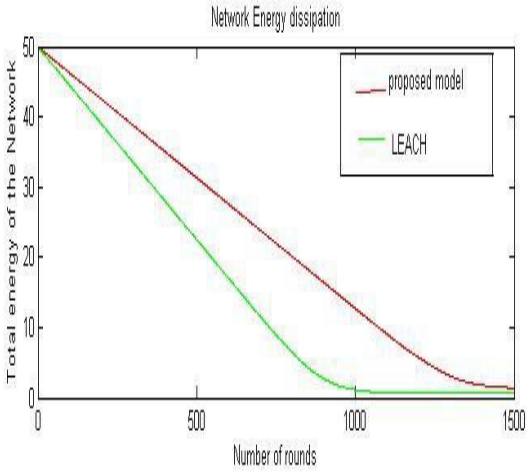

Fig. 9: Energy of the network

Residual energy of the network in each round gives, rate of total energy consumption, which can be a good metric to measure the energy efficiency of the algorithms. Residual energy plot is shown in fig.9.In the proposed algorithm (fig 9) the residual energy of network is much more than LEACH.

VII. FUTURE WORK

Future works in routing techniques focus on different directions. In comparison with the above mentioned routing protocols, the energy consumption is high in the LEACH algorithm when compared to the proposed algorithm. There is a need to decrease the energy consumption of the every sensor node. Also, prolonging the network lifetime has been of a great interest due to resource limitations in wireless sensor networks.
There needs to be a significant research done to improve the lifetime of the wireless sensors. Works on reducing the energy consumption by the nodes need to be done in a more efficient manner.

VIII. CONCLUSION

Power consumption is an important factor for network lifetime in wireless sensor networks. In clustering hierarchy, the cluster head decision is a major challenge. If network is taken as a whole, then the power consumption can be optimized by the rotation of this cluster head inside the individual clusters. In this paper, a new technique is proposed to select cluster head among some of the wireless sensor nodes based on net distance with base station. The proposed technique resulted in the increased lifetime of the whole network, and increased the number of nodes, which will remain alive for the maximum period of time.

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Biographies and Photographs

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