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Abstract—Though tremendous work has been done in the field of wireless sensor networks, due to the two challenging aspects (i.e. energy consumption and routing). This paper provides a survey of various techniques to address the challenges in wireless sensor networks. And comparative study provides comparison between all existing techniques based on the parameters (i.e. energy and network lifetime). We classify the surveyed approaches based on their methodologies used into three categories: Cluster based, Virtual MIMO based and Data Aggregation.

Keywords—Clustering, Data Aggregation, Multihop Routing Virtual Multiple Input Multiple Output, Wireless Sensor Networks.

I. INTRODUCTION

Recent technology improvements that have been developed in small size nodes, low-cost, battery power devices, which are capable of local processing and efficient wireless communication. Such nodes are called as sensor nodes. These sensor nodes are efficient in computing in various applications, such as office buildings, industrial plants, and reading temperature of a particular region. Each sensor will be having a limited lifetime and hence the processing of data may lose some sensed data due to battery power, collision while communicating between the nodes and having multipath links to reach the destination. We can place the sensor nodes randomly in the environment or we can use a Grid based approach to place the sensor node.

A sensor node is can be made up of four basic components in Fig 1. They are as follows (a) Sensing unit a sensor used to sense the environment conditions like temperature, pressure, etc. The sensed parameters are converted into digital form using ADC (Analog Digital Converter). (b) Processor unit includes a processor such microcontroller and memory. (c) Transceiver unit includes wireless transmitter and receiver sections. (d) Power unit uses batteries that provide the necessary power to remaining units.

Where the entire sensor can change their battery power according to environmental aspects, when the sensor node is an active state, the battery power will be 75-100% battery and it will be sensing the environment and it will be transmitting the sensed data to the destination. When the sensor node is in the inactive state, the battery power will be 10-40% of battery and it will send only connectivity messages (Hello message) to the other neighboring nodes into maintaining connectivity.

II. RESULTS AND DISCUSSION

This paper is organized as follows. Section 2 includes a discussion about the hierarchy of minimizing energy consumption approaches; section 3 gives us a comparative study on various intelligent techniques of cluster forming, creating virtual MIMO and data aggregation. Finally section 4 gives the conclusion of the paper.
II. CLASSIFICATION BASED ON REDUCING ENERGY CONSUMPTION APPROACHES

Minimizing Energy Consumption

Cluster Based Approach
Virtual MIMO Approach
Data Aggregation Approach

Figure 2: Hierarchy of Minimizing Energy Consumption Approaches

Here to reduce the energy consumption of sensor network it follows the different kinds of approaches. The first thing is Cluster Based Approach and followed by creating Virtual MIMO and finally Data Aggregation Approach.

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III. CLUSTER BASED APPROACH

Normally, in order to achieve energy efficient and scalability in WSN we will create clusters. So that in a particular region there may be a large number of disjoint cluster also possible. And a new technique is called a K-hop Overlapping Clustering Algorithm (KOCA). This KOCA technique allowed us to create an overlapping multihop cluster. To create overlap multihop clusters it includes various advantages that are node localization, intercluster routing and covers the entire sensor network. Moreover, the KOCA technique it creates the equal size clusters, so that load for each cluster balanced. But this technique does not follow any remedial action for Cluster Head failure [1]. In a cluster based sensor network, a single cluster consists of a large number of sensor nodes. To make the sensor network as energy efficient we have to concentrate on single sensor node energy dissipation. So to minimize the energy dissipation, optimal sensor state planning mechanism followed. This planning mechanism describes an optimal topology that includes in which sensor to be turned on, and which one is to be turned off.

For that defined the problem as Integer Linear Programming then implemented the Tabu search heuristic that produces an accurate solution. This technique improves the network lifetime and covers the entire sensor area covered. But this method does not include data compression to reduce the amount of unwanted data [2].

Figure 3 shows that cluster formation with the Master Cluster Head (MCH) and Slave Cluster Head (SCH). And shows the corresponding transmission scheme in between the clusters to pass the data [9]. The communication cost is the important factor. Because actually most sensor nodes will forward the data to sink or observer. So that the entire node involves gathering and forwarding data to the sink, this consumes energy.

To concentrate on this, a technique called HEED (Hybrid Energy Efficient Distributed clustering). This HEED protocol selects a Cluster Head (CH), who actually involves collecting data from neighbors, performing data aggregation and forwarding data to sink. This technique ensures that connectivity of clustered networks and improves the network lifetime. But this scheme allows unsynchronized nodes can execute the HEED protocol, this will affect the cluster quality and there is no fault tolerant mechanism followed. This is one of the design issues in the HEED protocol [3].
IV. VIRTUAL MULTIPLE INPUT MULTIPLE OUTPUT APPROACH

To improve the network lifetime and minimizing energy consumption, MIMO incorporate with the cluster. This concept includes with the LEACH (Low Energy Adaptive Clustering Hierarchy) Protocol to perform multihop transmissions in the cluster with the help of MIMO. By proper selection of Cluster Head (CH) and cooperative node, this scheme achieves the energy efficiency and reliability. But this technique requires three nodes for data compression and forwarding of data [4]. For the distributed and cooperative Wireless Sensor Networks, communication architecture proposed. This architecture developed from the semi analytic technique that includes Space Time Block Code (STBC) along with MIMO. But in this approach for short distance performance of Virtual MIMO is worst compared to SISO [5].

There are a large number of transmission schemes; Single Input Single Output (SISO), Single Input Multiple Output (SIMO), Multiple Input Single Output (MISO) and Multiple Input Multiple Output (MIMO). To compare which gives better performance in terms of energy efficiency. To compare this transmission schemes, a technique is called Alamouti diversity schemes. This technique shows that MIMO is better compared to all and tremendous energy saving. But circuit complexity of MIMO is high [6].

Figure 4: Packets exchanged between two clusters

Figure 4 shows that packets are exchanged between the two clusters. Each cluster consists of one MCH and one SCH. Before transmitting a packet to neighbour cluster both MCH and SCH have to establish a Channel Probing Request (CPREQ) [9].

Normally it is not easy to implement MIMO in sensor networks. Because MIMO requires complex modules as well as it consumes more energy. For that purpose a technique is called cooperation of nodes. So that each node equipped with single antenna from that it can form MIMO. With that cooperation of nodes it should have a proper selection of head and its neighbors based on the parameters are energy, delay and data rate constraints. Results shown that achieved good system performance. But this approach suitable only for single hops transmission only [7].

V. DATA AGGREGATION APPROACH

In general, it is very difficult to minimize energy consumption of each node in a sensor networks. So that combining the cooperative MIMO along with the data aggregation schemes. By using these two techniques, it developed a new energy model. That includes the factors are data generated by the nodes and the distance between them in a cluster based sensor networks. These results shows that average energy consumption of per cluster can be analyzed.

To improve the energy efficiency of the network, two aggregation schemes is followed. This aggregation scheme supports both the centralized and distributed. Those are CAS and DAS. And finally result show, compared to DAS, CAS is more energy efficient. This combined approach improves the network lifetime, but this is not suitable for large sized clusters. But this data aggregation approach consumes more energy [8].

VI. CONCLUSION

Sensor Networks hold a lot of promise in applications such as gathering and sensing information in remote locations. Survey has been done on various issues related to sensor networks like energy efficiency; routing and also various schemes proposed are also briefly described. As a result of the comparative study clearly shows that, all the existing mechanisms are less performance in energy efficient and routing. By enhancement, we can achieve better performance compared to all the existing techniques.

REFERENCES


