A NOVEL APPROACH TO IMPROVE NETWORK LIFETIME IN WSNs

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Abstract - Wireless sensor networks are a rapidly developing area with diverse applications. Smartness and interoperability of network keep it in high demand and hence comes the need for the efficiency of the system. The most important limitation on sensor node is the low power consumption. Sensor nodes carry inadequate, generally irreplaceable power sources. Most of the energy is consumed for the data transmission and it depends on the size of the packet and distance travelled. Apply the clustering and modulation techniques to the network, it leads in improving the lifetime of the WSNs.

Keywords—WSN, Energy efficient, Optimization technique, Network Lifetime;

I. INTRODUCTION

The Sensor Network can be described as a collection of sensor nodes, which co-ordinate to perform some specific action. Unlike traditional networks, sensor networks depend on dense deployment and coordination to carry out their tasks. Sensor Networks consisted of a small number of sensor nodes that were wired to a central processing station. However, nowadays, the focus is more on Wireless Sensor Networks.

In Figure 1 shows Wireless Sensor Network Architecture. Wireless sensor networks are consisting of numerous light weight and tiny sensor nodes with limited power, storage, communication and computation capabilities. Wireless sensor networks are being employed in civilian applications like habitat monitoring to mission critical Applications.

Figure 1 Wireless sensor networks Architecture

1.1 Characteristics of the WSNs

• Minimum Power consumption
• Ability to cope with node failures (resilience)
• Heterogeneity of nodes
• Mobility of nodes
• Communication failure
• Scalability to large scale of deployment
• Ability to withstand in unfavorable environmental conditions
• Cross-layer design
• Ease of use

1.2 Major Challenges

- **Mobility and topology changes** Due to the mobility of Sensor node network topology would be changed dynamically.
- **Energy constraints** Limited battery power of small tiny sensor nodes.

II. RELATED WORK

According to this work (Optimizing Physical Layer Parameters for Wireless Sensor Networks) Energy consumption in a node for sensing, actuating and data processing is less compared to the energy expended for communication that is transmission or reception of data.

According to this work (Multilevel Clustering Architecture for Wireless Sensor Networks) the nodes to transmit the data directly to the base station, a novel scheme of clustering was proposed. Clustering provides resource utilization and minimizes energy consumption in WSNs by reducing the number of sensor nodes that involve in the long distance communication.

According to this work (Energy Efficient coverage of wireless sensor networks using Ant colony optimization with three types of pheromones) TDMA slots were proposed along with scheduling algorithms to improve the network lifetime. This caused all the nodes to be active only during their allotted time period.

III. SIMULATION USING NS2

It is an imitation of actual objects in the world and it was founded in 1989 and it was supported by DARPA in 1995 through the VINT (virtual inter network testbed) project. Based on a refactoring by Steve McCanne network simulator version 2 was initiated. The core of ns2 is composed in OOMD language and OTcl (object Tcl). OTcl language is used to write the simulation script extension Tcl.

IV. PROPOSED WORK

The following figure 2 shows the workflow of the proposed work. The network is divided into even and uneven cluster. The modulation techniques are applied, namely PCM, DPCM and DM.

![Figure 2: work flow of the proposed work](image-url)
4.1 Algorithm
The proposed work consists of the following phases. These are briefly described below:

1. Sensor Deployment
   - Deploy the sensor node in the triangular grid topology
   - Clusters are divided into even and uneven cluster. This is shown in the figure 2 and figure 3 respectively
     a. Even cluster: In this the area/radius of each cluster remains same.
     b. Uneven cluster: In this area/radius of each cluster reduces with constant value as it approaches the Base Station.

2. Setup phase and path determination phase
   - Initially the node at the center of the cluster is chosen as cluster head.
   - Using the midpoint formula, the center of each cluster (which is square) is calculated and node corresponding to that point is assigned as CH1 by the base station.
   - CH1 broadcasts (intimates/signaling) to all the sensor
   - Nodes that it is the cluster head (Energy consumed at this stage is very less).
   - All the sensor nodes in the cluster will have CH1 ID as the address to transmit their sensed data.
   - Data which is sensed by sensor nodes is transmitted to the CH1 via single hop.
   - All the received data from the CH is processed and filtered and transmitted to the base station (BS) via multi-hop using a shortest path algorithm. After the first round, BS is no longer responsible for assigning the new CH.
   - Present CH will again broadcast a message (Broadcast signals are sent only to half of the radius of the total area) informing its energy level and this energy of CH is compared with every other node in the cluster and the node having higher energy is assigned as the new CH else CH1 will remain as CH and the procedure repeats.

3. Data Optimization phase
   Different modulation techniques are used to compress the data, namely PCM, DPCM, and DM technique.
     a. PCM: Simple pulse code modulation where payload is the complete sensed data which is converted to digital.
     b. DPCM: Differential pulse code modulation where difference in previous and present sensed value is transmitted.
     c. DM: Delta modulation it is reduced to one bit. Only that bit will be sent as a message.

V. RESULTS

Table 1: Energy consumption by the sensor node by applying the techniques

| Modulation\Clustering | Even | Uneven |
|-----------------------|------|--------|
| PCM                   | 19.0 | 4.7    |
| DPCM                  | 5.3  | 4.3    |
| DM                    | 3.0  | 2.0    |

From table 1 observe that, uneven clustering gives the best result when compared to the even clustering. Because the uneven cluster has the different size of clusters hence it consumes better battery power of the sensor node. The DM gives the better output when compared with the all modulation technique. Because it transfers only one bit of data.
VI. CONCLUSION

In the presented work various factors which influence energy consumption and network lifetime were considered such as deterministic triangular grid sensor deployment, even and uneven clustering. It has been observed that clustering of nodes improves the overall efficiency of the network, with even cluster size, the energy consumption is reduced and for uneven clustering it is much improved.
Therefore packet size optimization is employed. PCM, DPCM and Delta modulation are used to reduce the size of the data packets.

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