An Efficient Routing Protocol for Dynamic Sensor Networks

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Abstract— Due to current advancement in micro electro mechanical technologies, digital electronics and wireless communications, the wireless sensor networks have attracted many researchers for its scope, further development and enhancing the existing system. Wireless sensor networks are formed by small sensor nodes communicating over wireless links without using a fixed network infrastructure. Static network employs only motionless nodes in which there is no change in position of nodes and its apposite dynamic network is a network in which nodes changes their position means the nodes are movable. Dynamic networks have large range of applications as comparison with the static network because of its mobility feature of nodes. Also, dynamic network is capable to vary the load on its nodes to handle energy consumption. In this paper, we have proposed a new routing algorithm that makes use of hybrid energy efficiency protocol and revise it for static networks as well as for dynamic networks by adding the thought of base neighbor node. Here, we mainly focus on the lifetime of static and dynamic network. We apply the proposed algorithm on static network as well as on dynamic network and compare the results.

Key words: Dynamic Sensor Networks, Routing Protocol

I. INTRODUCTION

The development of sensor network was started during the Cold War by the United States. A network of acoustic sensors was positioned at planned positions on the underneath of the ocean to sense and follow Soviet submarines. This structure of acoustic sensors was named as SOSUS (Sound Surveillance System). In this system human operators played a significant part [1]. Around 1980's the Defense Advanced Research Projects Agency started the modern investigations on sensor networks with the DSN (Distributed Sensor Networks). These incorporated sound sensors communication (in a resource distribution network a high level technique that associate procedures operating on a common application), algorithms (containing self-position algorithms for sensors), processing techniques and shared software's (dynamically adjustable shared systems and language drawing) [2].

Due to the growth in wireless technology, the Wireless Sensor Networks (WSNs) have attracted many researchers for its scope, further development and enhancing the existing system. Sensors are also commonly known as "motes". One of the primary benefits of WSNs is their independence from the wiring costs and constraints. WSNs are composed of a set of highly planned deployed sensors, which are highly sensitive to the environment and capable of communication with each other through wireless channels [1].

The basic structural design of the wireless sensor network is shown in figure- 1, in this architecture sensor node arranged in the sensing-field (actually sensing field is a big geographical area) and they converse with each other to gather information. This gathered information is then sent to the base station (sink node), essentially base-station work as a gateway. Now, information is transmitted to the internet with the help of gateway and ultimately to the user since user is directly attached to the internet [3] [4].

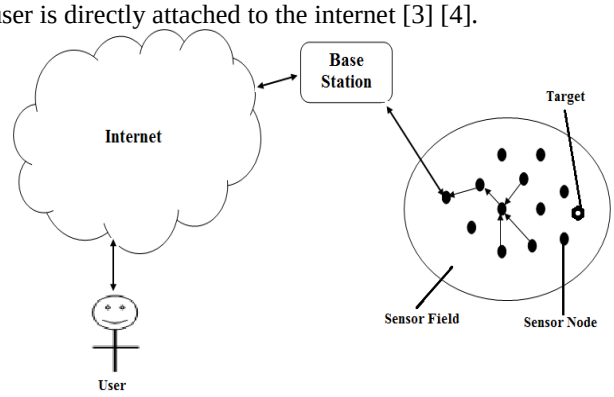

Fig. 1: Architecture of Sensor Network

In this paper we have proposed an routing algorithm and routing is an essential part of communication between network nodes, So, now we discuss some routing issues [5] in wireless sensor networks, which are as follows-

1) Infrastructure Less: Since in wireless sensor networks the sensor nodes are randomly deployed, it is infrastructure less. So care should be taken while designing the routing protocols for wireless sensor networks.
2) Energy Constraints: Sensor nodes mainly based on the battery for power. Since batteries cannot be replaced more care should be taken while using the available energy.
3) Network Lifetime: Sensor node`s lifetime is mainly dependent on their batteries. When a node desires to send the data, it has to decide on the stumpy energy node. While selecting the stumpy energy node there may be a prospect of network partition. Hence a node with balanced energy must be selected to maximize the network lifetime.
4) Cost: Since the number of sensor nodes deployed in the sensing area may be in order of thousands, the cost of a single node has to be kept low.
5) Scalability: The sensor network should adapt to the changes in increasing size. Because some nodes may go to another location and some nodes may join newly to the network.
6) Quality of Service: Sensor network should possess minimum delay, less control overhead, high throughput and efficient resource allocation.
7) Coverage: Coverage depends on the range, location and density of the sensing node. Hence the coverage area of the sensor network should be high enough.
8) Exposure: Sensors should be highly able to observe a target in the sensing area. Network should possess maximum exposure path (best case coverage).
9) Security: In military applications the sensing information is very confidential. Data loss or damage to

the data can occur due to the malicious node in the network. Hence Security should be provided in terms of confidentiality and integrity.

II. LITERATURE SURVEY

Generally, routing protocols in wireless sensor networks are categorized into three categories. They are flat, location based and hierarchical routing protocols [6]. In this paper, we only give attention to hierarchical routing protocols and from these hierarchical protocols mainly on two- efficient gathering in sensor information systems (PEGASIS) and on hybrid energy efficiency protocol, because our research work mainly utilized the concept of these algorithms.

A. S. Lindsey and C. Raghavendra [7]

S. Lindsey and C. Raghavendra have suggested an efficient algorithm as power efficient gathering in sensor information systems (PEGASIS) for wireless sensor network. Unlike LEACH protocol the sensor nodes in the network form a chain based arrangement. In LEACH the nodes are arranged in clustered manner. And in PEGASIS there is no cluster head selection phase. Hence it avoids overhead fairly. The sensed data is sent to single hop neighbor node. Each node sends data to its neighbor and thus forms a chain arrangement. A token is passed to the nodes. After receiving the token the node delivers the data to neighbor.

B. Djallel Eddine Boubiche and Azeddine Bilami [8]

Djallel Eddine Boubiche and Azeddine Bilami have illustrated a new chain clustering based algorithm HEEP (Hybrid Energy Efficiency Protocol). Hybrid Energy Efficiency Protocol (HEEP) makes use of PEGASIS principle inside the clusters. In HEEP, a chain of nodes is formed within the same cluster dissipation. Each cluster-head sends the collected data collected in the cluster to the BS through cluster-heads neighbors. Data is collected by the cluster-head using multi-hop techniques, which helps in reducing consumption of power. Collecting the data from each node in a chain lessens the amount of data transmission between nodes and their cluster-heads, to prevent the node from draining energy. Hence, in given technique of chains clustering the data communicating distances and the number of nodes communicating with cluster-head is reduced.
That results in better energy saving and prolonged cluster-head lifetime. HEEP uses the concept of the randomizing the role of the cluster-head between the nodes used in LEACH, which regulates energy drainage and makes sure that the nodes chosen as cluster-heads persist for a long time. HEEP operates in two phases. In the first phase formation of chained clusters and election of cluster-heads takes place. In the transmission phase the aggregated data is transmitted. As transmission distances are minimized, the total rounds of transmission are improved.

III. PROPOSED ALGORITHM

We have proposed a new routing algorithm that makes use of hybrid energy efficiency protocol and revise it for static networks as well as for dynamic networks by adding the thought of base neighbor node. We utilize hierarchical routing protocol in which network is considered as group of clusters, so here creation of cluster is done as in hybrid energy efficiency protocol and for the routing purposes we use base neighbor node in between cluster head and base station. Non cluster head nodes sends its data to the cluster head and cluster head node collects all the data from their nodes and send this data to base neighbor node. Now, base neighbor node sends collected data to base station. So, by making use of base neighbor node we decrease the load of cluster head node and preserve the energy as well as lifetime of cluster head node. Eventually, this idea long the life of cluster head node and also of sensor network. We also have utilized the concept of dynamic sensor network.

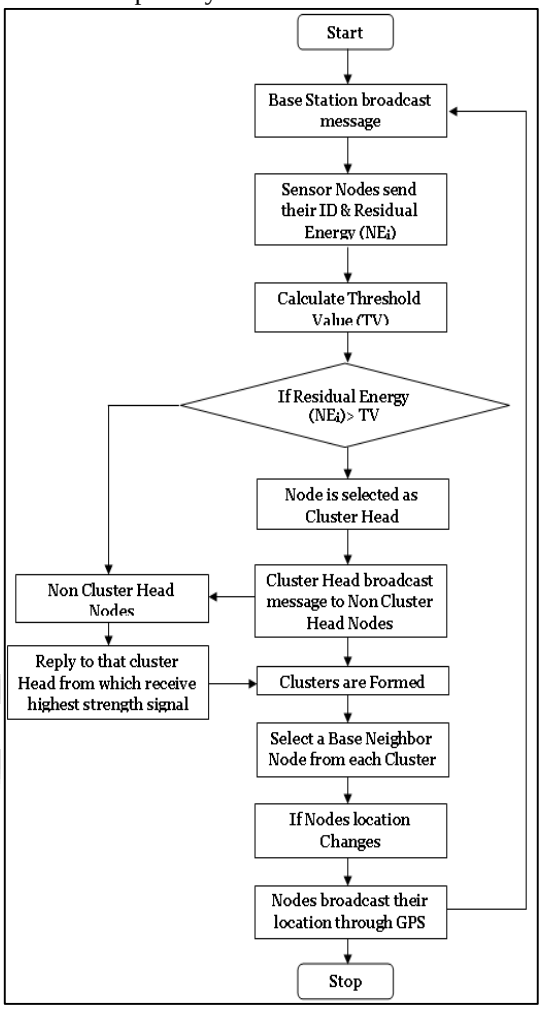

Fig. 2: Flow Chart for Initilazation and Formation of Cluster and Base Neighbor Node Stage

Now, the proposed algorithm is applied on both static networks as well as on dynamic network. The main difference between static and dynamic network is that in static network nodes are stationary and in dynamic network nodes are mobiles. So, in dynamic network as the node changes their position then they sends their location information with the help of GPS and also in this movement node lost their energy. The planned routing algorithm works in 3 stages- initialization stage, formation of cluster and base neighbor node stage and data collection and transmission stage. The flowchart for these stages is shown below in figure- 2 and figure- 3.

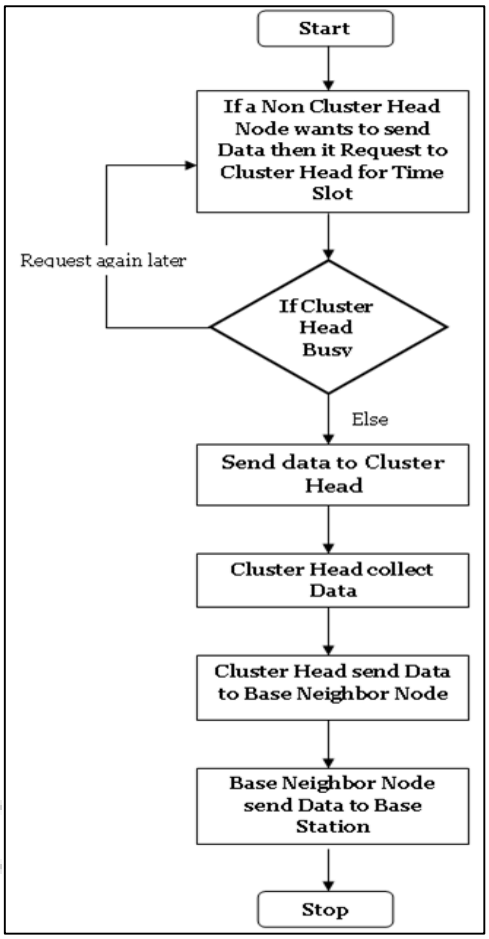

Fig. 3: Flowchart for Data Collection and Transmission Stages

IV. EXPERIMENTAL RESULTS AND ANALYSIS

In this section we have shown the experimental results, for this purpose we have utilized two networks of 100 and 200 sensor nodes respectively. Results are generated in the form of graph for both static as well as dynamic network on the basis of our performance parameter lifetime of network. Now, we summerize the complete experimetal process in the following steps:

1) Initially, we create a network of sensor nodes by entering the number of nodes. Here, we have created two networks one of 100 nodes and another one of 200 nodes. The network that created initially is known as static network because in this network there is no movement in sensor nodes. Nodes having two properties- node id and their residual energy. Now, the threshold value is calculated by avereging the energy of all the nodes in the network. Now, the nodes are selected from the network nodes which are having energy more than the threshold value and this nodes are label as cluster head nodes.
2) Now, as we provide the movement in the initially created network (static network) by applying the proposed routing algorithm, we obtain dynamic network. As the nodes are moved then they lost their energy in this movement, and also in data transmission. So, the enrgy as well as lifetime of the static network is more then the dynamic network due to node movement.
3) The lifetime graph of the static network and dynamic network of 100 nodes as described in previous step as shown in figure- 4 and figure- 5. Also the same graph for the static network and dynamic network of 200 nodes is shown in figure- 6 and figure- 7. With the help of these graphs we show that at the start of network the lifetime of the static network is more as compared to dynamic network but as the time goes the life time of dynamic network is equivalent to the static network.

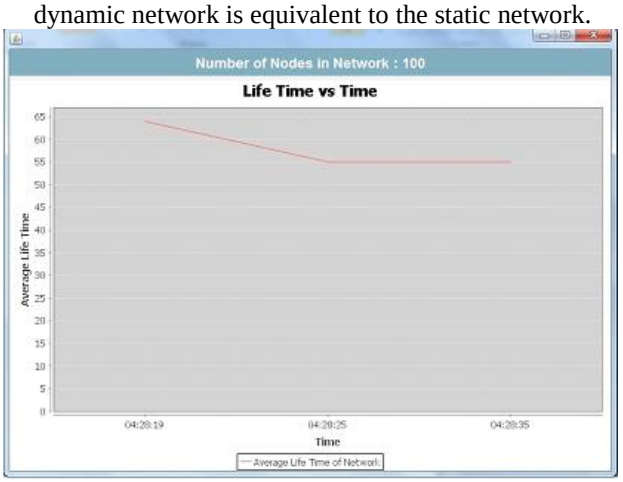

Fig. 4: Life Time Graph for Static Network With 100 Nodes

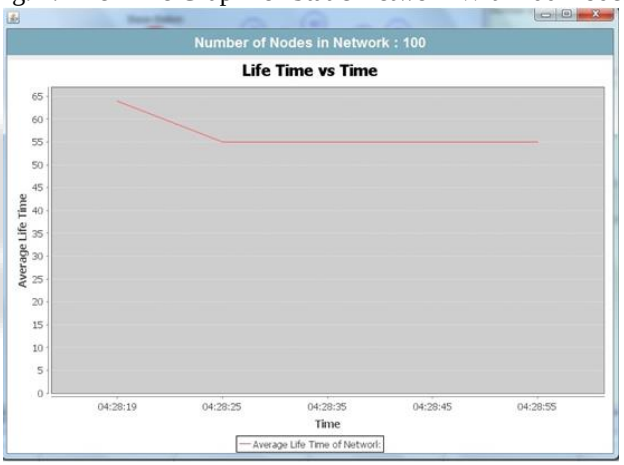

Fig. 5: Life Time for Dynamic Network with 100 Nodes

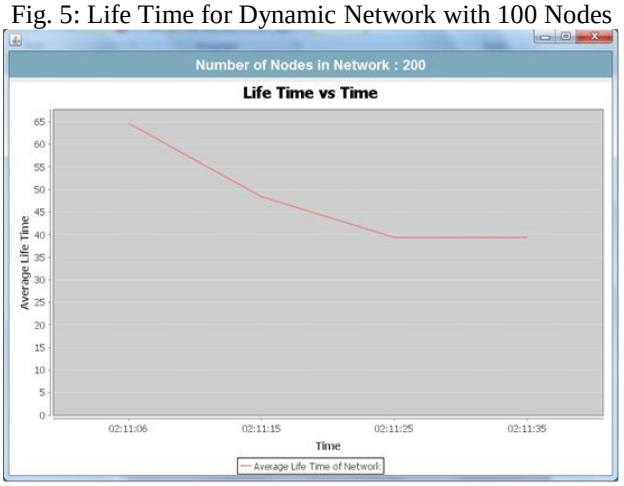

Fig. 6: Life Time for Static Network with 200 Nodes

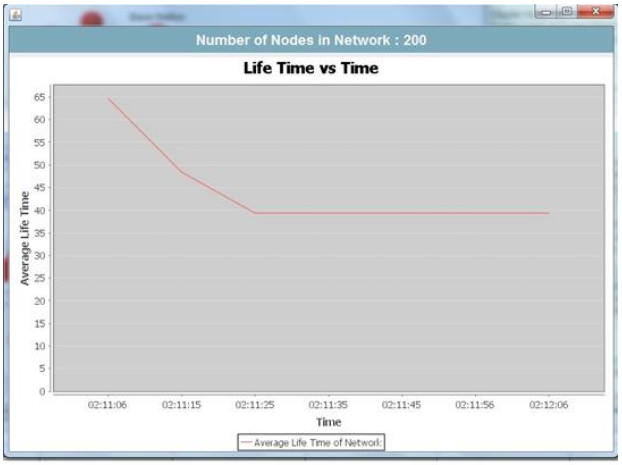

Fig. 7: Life Time Graph for Dynamic Network with 200 Nodes

From the resultant graphs we conclude the following facts:

1) As the numbers of nodes in the network are increases the lifetime of the network is decreases in both static as well as for dynamic networks, because if number of nodes in the network is increases they consume more energy in node movement and transmission of data as cluster members as well as cluster head nodes.
2) If nodes are moved in the network then they lost their energy and after all shorten their lifetime. As we know that in dynamic network nodes are dynamic means they change their position and so hence the energy as well as lifetime of dynamic network is less than static network. But, after applying the proposed routing algorithm we have seen that the proposed algorithm works well for static as well as for dynamic network. Figure- 3 and figure- 4 shows that the lifetime graph of static network and dynamic network of 100 nodes respectively and figure- 6 and figure- 7 shows the graph for 200 nodes. It is clear that at the start of network the lifetime of the static network is more as compared to dynamic network but as the time goes the life time of dynamic network is equivalent to the static network.

V. Conclusion

Dynamic networks have large range of applications as comparison with the static network because of its mobility feature of nodes. Also, dynamic network is capable to vary the load on its nodes to handle energy consumption, in spite of the fact that nodes lost their energy in node movement. After applying the proposed routing algorithm we have seen that- as the numbers of nodes in the network are increases the lifetime of the network is decreases in both static as well as for dynamic networks and at the start of network the lifetime of the static network is more as compared to dynamic network but as the time goes the lifetime of dynamic network is equivalent to the static network. In this paper we have only compared the lifetime of static network and dynamic network on the basis of proposed algorithm in future we will also evaluate the performance of proposed algorithm with another hierarchical routing algorithms.

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