Fuzzy Based Energy Efficient Protocol

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Abstract- A wireless sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. The position of sensor nodes need not be engineered or pre-determined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities. In this research paper, the use of fuzzy logic techniques to improve the energy efficiency and network lifetime of the network is envisaged. The TSEP protocol is taken as the base protocol for the study. Various performance parameters will be evaluated and the comparisons with the proposed technique using fuzzy logic based TSEP protocol with the existing protocols will be made to evaluate the performance of the proposed technique.

Keywords- Wireless Sensor Networks, Fuzzy logic, Energy Efficient Protocol, MATLAB, TSEP Protocol

I. INTRODUCTION

Wireless sensor networks (WSNs) are increasingly used in many applications, such as volcano and fire monitoring, urban sensing, and perimeter surveillance. A Wireless sensor networks have many sensor devices that send their data to the sink or base station for further processing. This is called direct delivery. But this leads to heavy traffic in the network and as the nodes are limited with energy, this decreases the lifetime of the network. In a large WSN, in-network data aggregation (i.e., combining partial results at intermediate nodes during message routing) significantly reduces the amount of communication overhead and energy consumption.Efficient designing of wireless sensor networks has become a hot area of research in recent years, due to the vast potential of sensor networks to enable applications that connect the physical world to the virtual world. By networking large numbers of tiny sensor nodes, it is possible to obtain data about physical phenomena that was difficult or impossible to obtain in more conventional ways.The nodes are randomly deployed either inside the field where a particular phenomenon is to be monitored or very close to it. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities because the large number of nodes in a WSN renders direct manipulation by a user for network organization. A user could not go through thousands of nodes directing the network configuration and clustering. Data aggregation technique can successfully minimize the data traffic and energy consumption only when it is carried out in a secure manner.

The sensor network comprises sensor field, where the sensor devices or nodes are scattered in this field. Here, each of these nodes will have the capability to gather information and then route information back to sink and end users. With the help of multi-hop infrastructure and less architecture the information is routed back to the final user through sink as shown in Figure 1.

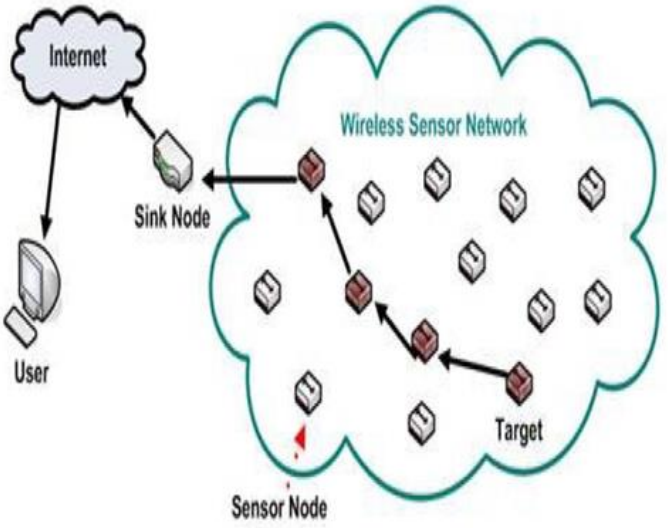

Fig.1: Wireless Sensor Networks

The Sensor networks may consist of many different types of the sensors such as magnetic, seismic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions that include the following [1]:

- Vehicular movement,
- Humidity,
- Temperature
- Lightning condition,
- Pressure,
- Noise Levels
- Soil makeup
- The presence or absence of certain kinds of objects,
- Mechanical stress levels on attached objects.

II. LITERATURE SURVEY

Wireless sensor network is typically composed of a large number of sensor nodes, which may be densely deployed either inside the phenomenon or very close to it, depending on the field of their usage. The position of sensor nodes need not be engineered or pre-determined. This envisages random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also indicates that sensor network protocols and algorithms need to possess self-organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Instead of sending the raw data to the nodes responsible for the fusion, sensor nodes use their processing abilities to locally carry out simple computations and transmit only the required and

partially processed data. Realization of these and other sensor network applications require wireless ad hoc networking techniques.

The differences between sensor networks and ad hoc networks are outlined below:

- The number of sensor nodes in a sensor network is higher than the nodes in an ad hoc network.
- Sensor nodes are densely deployed as compared to ad-hoc nodes.
- Sensor nodes are more prone to failures.
- The topology of a sensor network changes very frequently.
- Sensor nodes mainly use broadcast or multi-hop communication paradigm whereas most ad hoc networks are based on point-to-point communications.
- Sensor nodes have limitations of power, computational capacities, and memory.
- Sensor nodes may not have global identification (ID) because of the large amount of overhead and large number of sensors.

Various cluster based protocols have been proposed by numerous researchers such as LEACH (Low-Energy Adaptive Clustering Hierarchy), TEEN (Threshold Sensitive Energy Efficient Sensor Network), SEP(Stable Election Protocol) etc.

In multi-hop or multi path communication protocol, multiple paths are established between the source and the destination, through which the data can reach the destination i.e. sink or base station [2]. Now how these links are used are based on the individual routing strategy of the network For instance, some routing algorithms use the best path to send the data, keeping the other alternate paths as a backup and use it if the primary path fails, some use all the paths concurrently to send data and so on. In the past few years multi-path routing approach is extensively used for different network management purposes, such as providing a fault tolerant routing, improving transmission reliability, congestion control and Quality of Service(QoS) supported in the wired and wireless networks, but the unique features of the wireless sensor networks and the characteristics of the short range radio communications introduce new challenges that should be addressed in designing the multi-path routing protocols. The main objective of cluster based routing is to efficiently maintain the energy usage of sensor nodes by involving them in multi-hop communication within a particular cluster.

III. PROPOSED WORK

Clustering is an efficient approach that has been implemented in many communication protocols for WSN. In a clustering based network nodes are grouped into several clusters. Each cluster consists of one cluster-head and a number of member nodes. Member nodes or normal nodes send their data to CH in addition to sending it to the desired recipient. Cluster head may perform data processing like data fusing before forwarding the data to sink. A number of clustering protocols have been developed and are being researched every year, with the increase of usage of sensor networks. In this research paper, we will discuss the general radio propagation model and energy calculations related to it. We will also discuss in detail the TSEP protocol its flowchart and then give an insight of the proposed method.

Data aggregation is collecting data from member nodes, and transmitting the final data in a single packet to sink node. Data aggregation is widely used in clustering approach, because data from member nodes are collected by cluster heads and sent to the sink in a single packet, in order to reduce network traffic. When a sensor node receives two packets from two different source nodes, it can process incoming data packets and calculate the average readings, in order to send the final value as a single data packet.Data propagation techniques are also very effective in controlling energy consumption.

IV. SIMULATION & RESULT ANALYSIS

The implementation of the proposed algorithm has been done in MATLAB software using its various toolboxes Fuzzy Logic Toolbox, MATLAB graphics functions and basic programming structure of the software.

The various network parameters proposed in this research paper are shown in below table:

Parameters	**Values**
Energy consumed in the electronics circuit to transmit in or receive the signal, E_{elec}	50 nJ/bit
Energy consumed by the amplifier to transmit at a short distance, E_{fs}	10 pJ/bit/m_2
Energy consumed by the amplifier to transmit at a longer distance, Emp	0.0013 pJ/bit/m_4
Data Aggregation Energy, EDA	5 nJ/bit/signal
Message Size	4000 bits
Initial Energy, E0	0.5 J

Table 1:Simulation Parameters

As observed from the figure above, the nodes start to die as the number of rounds increases, shown by the red dots in Figure 2.

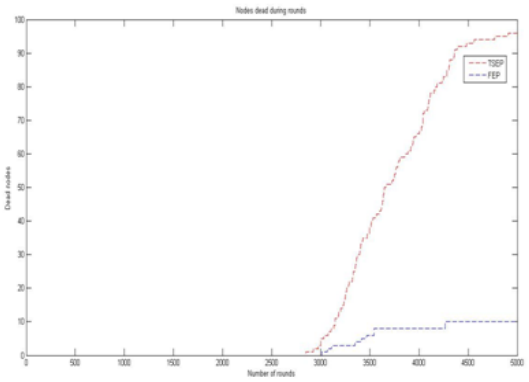

Fig.2: Number of Dead Nodes

Figure 3 shows a comparison of avrage energy of nodes over the simulation period. As shown in the graph the red plot shows the TSEP protocol while the blue plot marks the Fuzzy based TSEP protocol.

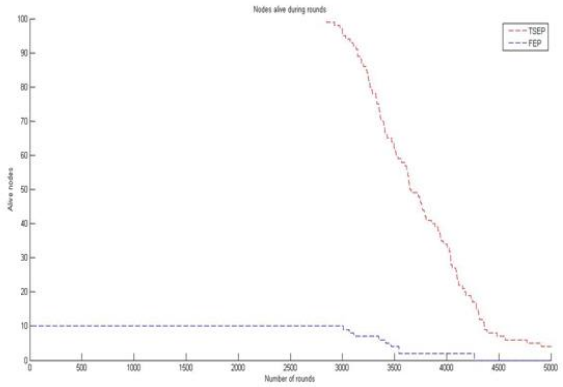

Fig.3: The number of alive nodes

The number of packets transferred by the nodes is given by figure 4 in the Fuzzy based enhanced TSEP protocol.

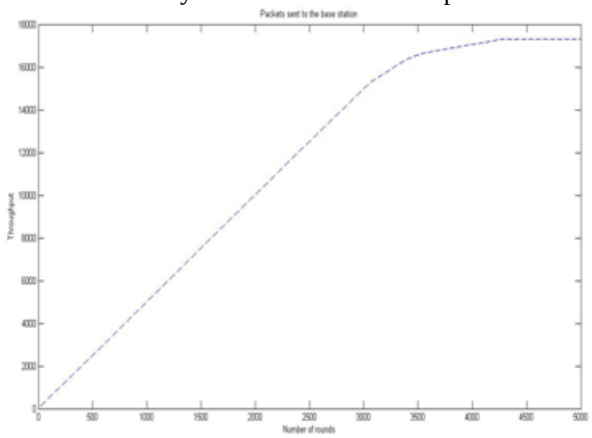

Fig.4: Throughput of FEP

V. CONCLUSION

Increasing the energy efficiency is a major concern in the area of Wireless Sensor Networks. It has direct implication on the network lifetime i.e. the amount of time the network would remain active. As has been put throughout this research work, the Wireless Sensor Networks are equipped with fixed non rechargeable batteries, thus it is utmost important to choose those methods which will reduce the power consumption of the nodes. The clustering based techniques have been developed with this concern and have been found to be successful in achieving a considerable improvement in network lifetime as is evident from the literature survey of various clustering based routing techniques. The heterogeneous networks particularly SEP and TSEP has been discussed in detail in this research paper.

VI. REFERENCES

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