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Energy efficient Clustering for improving network life time in WSN using Fuzzy based technique: A Review

Priya Sethi* and Naseeb Singh Dhillon**
**M. Tech. Student, Department of CSE, AIET, Faridkot, (PB), INDIA.*
***Assistant Professor, Department of CSE, AIET, Faridkot, (PB), INDIA.*

(Corresponding author: Priya Sethi)
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ABSTRACT: Energy of sensor nodes is scarce resource in wireless sensor network. It is vital to reduce energy consumption to improve lifetime of wireless sensor network. A proficient way to improve lifetime is to partition sensor network into groups called cluster with high energy node acting as leader of the cluster called cluster head. Cluster head is responsible for managing intra-cluster and inter cluster communication. Energy level of cluster head at a given point of time determines life of cluster and thereby whole sensor network. Failure in the cluster head brings cluster communication to halt and may require re-clustering to get sensor network back on track. These activities involve additional energy expenditure and ultimately possess great impact on lifetime of sensor network as a whole. To balance energy consumption among the cluster heads this paper proposes to have cluster of cluster heads within the cluster of sensor nodes. Given a moment, one cluster head act as master of the given cluster and the master-ship is rotated among cluster heads after specified number of rounds of communication. This improves the energy utilization of sensor network, maximizes the network lifetime and makes the wireless sensor network fault tolerant to some extent.

Keywords: Lifetime, clustering, cluster of cluster heads, wireless sensor network, energy consumption, fuzzy technique.

I. INTRODUCTION

Wireless Sensor Network (WSN) has came forth as an important new field in wireless communication. Due to recent advances in Micro-Electronic-Mechanical Systems (MEMS) and wireless communication technologies; small, low cost, and smart sensors are deployed in a physical environment and interconnected by wireless links and thus provide new opportunities for sensing the physical aspects like motion, pressure, temperature, and attacks etc. It is useful for many applications, such as military, industry, agriculture, traffic control, environment or habitat monitoring and other important domain. WSNs are application-specific, so the design requirements of WSNs change according to the application. WSN is a self organizing ad-hoc network which composed of large number of sensor network. Self organizing allows a network automatically join new node without the need for manual interference.

These networks composed of large number of small and low cost devices, these devices are called nodes and one or more base stations called the sink. These nodes are referred information to base station.

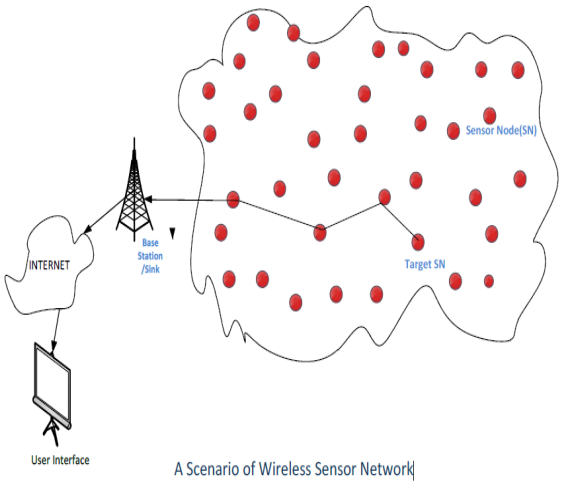

Fig. 1. Architecture of WSN.

These sensor nodes are deployed in different environments like commercial, civil, climate and intelligence data gathering without human intervention.

A sensor network is a deployment of massive numbers of small, inexpensive, self powered devices that can sense, compute, and communicate with other devices for the purpose of gathering local information to make global decisions about a physical environment.

A. Characteristics of Wireless Sensor Networks

Wireless sensor networks have the following characteristics:

-All sensor nodes use the direct transmission or multi-hop transmission to communicate with the base station.

-Sensor nodes sense conditions at different locations at a fixed rate and always have data to send to the base station.

-The sensor nodes are organized into a group is called cluster. Cluster head performs data aggregation and BS receives compressed data.

-The lifetime of wireless sensor network is the total amount of time before the first sensor node runs out of power.

Despite the infinite scopes of wireless sensor networks, they are limited by the node battery lifetime. Once they are deployed, the network can keep operating while the battery power is adequate. This is critical point to be considered as it is almost impossible to replace the node battery once deployed over an inaccessible area. Prolonging network lifetime is a critical issue. Sensors often have long period between transmissions.

B. Architecture of Sensor Node

Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a micro-controller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. The cost of sensor nodes are varies, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. The size and cost constraints on sensor nodes result in other constraints on resources like energy, memory, computational speed and communication bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network.

Microprocessor: It is suited for sensor nodes due to their flexibility to connect to other devices. It performs tasks after that process information and then controls the functionality of other components.

Transceivers: The transceiver provides the functionality of both transmitter and receiver. Radio Frequency communication is best suited for sensor networks. Sensor network use the frequency between the range of 433Mega hertz and 2.4 giga hertz.

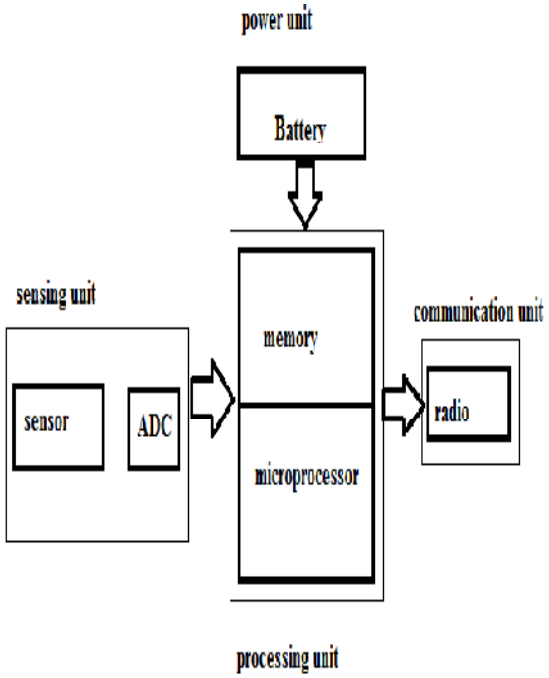

Fig. 2. Units of Sensor Network.

External memory: Two kinds of memory are used on the basis of type of storage: user memory for Storing application related or personal data and programming memory for program the device. Program memory also contains identification data of the device if present.

Power Source: Sensors can sense, store and gather information. For all this they consume power. Power is stored either in batteries or capacitors. Batteries, both rechargeable and non-rechargeable, are the main source of power supply for sensor nodes.

Sensors: Sensors are the hardware devices that produce a measurable response to a change in a physical condition like temperature or pressure. Sensors are the small tiny partials which sense, store and gather information. Sensor node consists of three components: sensing, processing and communicating. Sensor is a device that responds to a change in its surrounding in a measurable manner. There are two types of sensors active and passive. Passive sensors gather data without actually disturbing the environment. They are self powered; that is, energy is needed only to amplify their analog signal. Active sensor gathers data by probing into the environment, for example, a sonar or radar sensor.

ADC: ADC is an analog to digital convertor that allows exploiting the information-theoretic redundancy of the input signal for increasing the efficiency of operation and reducing the power consumption of the converter.

In energy constrained sensor network of large size, it is inefficient for sensors to transmit the data directly to the sink so cluster based approach will be used. Clustering of nodes shows that network is more stable and efficient and it is based upon least distance and higher energy by knowing location. Clustering reduces traffic network and increase performance. In this the sensors node decides to join a cluster in peer to peer mode to represent energy level. In this each cluster has a cluster head which is selected among cluster members. Cluster head do the role of aggregator which aggregate data received from cluster member locally and then transmit the result to base station. Through other cluster heads CH forward data to sensor nodes.

II. LITERATURE REVIEW

Huabiao Qin, "Balanced Energy Consumption and Cluster-Based Routing Protocol" purpose a balanced energy consumption and cluster-based routing protocol (BECCRP) as an improvement on LEACH protocol in order to monitor large-scale environment longer and stably. Gateways will construct a multi-hops path to transmit packet, Cluster heads are just responsible for gathering and aggregating data from cluster members. By setting gateway, the task of data transmission is separated from cluster heads. Therefore, they success in sharing the communication energy consumption at each node equally, enhancing the system efficiency, extending the lifetime of the network.

Prashant Krishan, "A Study on Dynamic and Static Clustering Based Routing Schemes for Wireless Sensor Networks" presents a comprehensive survey of Dynamic and static Clustering based routing techniques in wireless sensor networks. They have the common objective of trying to extend the lifetime of the sensor network while not compromising data delivery.

Chutima, P. and Sujitra, M, "Optimal WSN Design for Efficient Energy Utilization" states energy efficiency in WSN by installing the new fewer nodes as Relay Nodes (RN). These relay nodes may be equipped with more sophisticated energy sources such as solar cells with larger batteries. The SNs will transmit the sensing information to the suitable RN. The proposed model aims at determining routes for transmitting this information so that the resulting network can guarantee the required network lifetime and ensure the radio communication between SNs so that network can guarantee packet delivery from SNs to base station.

Vidya K S and Arun Anoop M, "Lifetime Enhanced Cluster Based Routing in Wireless Sensor Networks" propose a cluster based routing method with a power saving mechanism for enhancing the lifetime. The overlapping coverage area of the randomly deployed nodes forms the basis of the power saving scheme. The routing node selection is based on residual energy which makes the routing procedure energy efficient. The nodes consume a small amount of power during sleep period and hence the lifetime of entire network is enhanced.

Hairong Zhao, Wuneng Zhou, Yan Gao, "Energy Efficient and Cluster Based Routing Protocol for WSN" propose an improved-LEACH protocol in order to save node energy, which is divided into two aspects: Cluster head election and Data transmission. The improved algorithm still uses the concept of "round". A round is divided into clusters establish phase and stable data transmission phase. Stable data transmission phase must be longer than the cluster establish phase in order to make full use of energy. Thus improved-LEACH protocol can reduce energy consumption and prolong the network lifetime.

III. PROBLEM FORMULATION

Main problem in WSN is to handling with Clusters. There are many methods to overcome this problem. To reduce energy consumption re-clustering in clusters is required. The cluster heads are selected in the static clustering using the constraint that the cluster head remains the same until the first head dies. After its death, new cluster head will be chosen which will aggregate the previous head's data. Sometimes cluster heads need to communicate with other heads to transfer the data to the sink. There is a need to update the routing tables; due to this battery consumption will be more. There may be a collision between incoming packets from different cluster heads. The transmission collision will lead to waste more energy which arise the problem of packet delay in the network and decreases the network life time

IV. OBJECTIVES

This thesis exploits following engineering efforts to make a highly efficient Wireless sensor network:

-To study different Static and dynamic cluster in WSN

-Implement the Fuzzy based technique to Clustering for network life time and Residual energy.

-To compare the results with the previous technique with following parameter: Network Life time, Residual energy, PDF.

V. SIMULATION REQUIRED

For simulation NS-2 tool is required. NS-2 is a tool that provide rich environment for simulation of wireless sensor network at different layers.

Ns-2 is a discrete event simulator targeted at networking research. It provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. It consists of two simulation tools. The network simulator (NS) contains all commonly used IP protocols. The network animator (NAM) is use to visualize the simulations. Ns-2 fully simulates a layered network from the physical radio transmission channel to high-level applications. The NS-2 simulator has several features that make it suitable for our simulations.

-Supports networking Research and education
-Protocol design, traffic studies, etc.
-Protocol Comparison

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