Zone Divisional Network with Double Cluster Head for effective communication in WSN

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Abstract: Wireless sensor networks have brought a revolution in almost every field of sensing. The flexibility in their use makes them favorite for many applications. The limited battery constraints have been a concerning issue. A lot of research has been directed for the maximum and effectively utilization of energy of sensors. The deployment of sensors is also a key feature which affects the network life time. In this paper we divide the network into different zones and concept of double cluster head is introduced in this approach. Simulation are performed in MATLAB and it can be employed further for data transmission in the network.

Keywords: Wireless sensor network (WSN), Cluster head (CH), Assistant Cluster head (ACH)

1. INTRODUCTION

A wireless sensor network (WSN) not only extends our capability to explore but also to monitor and to control the physical world. It holds its significance in catastrophic or emergency scenario where human involvement may be too dangerous and it might be infeasible as well. Recent advancement in wireless communication, micro-electro-mechanical systems i.e. MEMS technology and digital electronics have made it possible for the development of low-power, low-cost and multifunctional sensor nodes that are small in size and can communicate effectively in short distances[1].This paper is organized as follows: section 2 discuss the application of wireless sensor network. Section 3 presents the architecture of WSN node. In section 4 different deployment phase has been given. Section 5 discuss about clustering. Section 6 discuss about zone divisional network. Section 7 and section 8 gives the simulation results and conclusion respectively followed by reference listing.

2. APPLICATIONS OF WSN

Sensor networks includes different varieties of sensors i.e. low sampling rate magnetic, seismic, visual, thermal, acoustic, infrared and radar that can monitor a wide variety of ambient conditions like temperature, humidity, pressure, level of noise etc.[2].Sensor nodes can be employed for event detection, continuous sensing, location sensing, event ID and local control of actuators. Wireless networks opens wide scope for many new application areas and these applications can be categorized into environment mainly forest fire detection[3], flood detection[4] , military, home, health and commercial areas.

3.WIRELESS SENSOR NODE

The selection process of hardware components for a wireless sensor node is decided by requirement of the application in context of size, cost and additional components that are to be used.

3.1 Architecture of Wireless sensor node

The basic architecture of wireless sensor node is shown as below:-

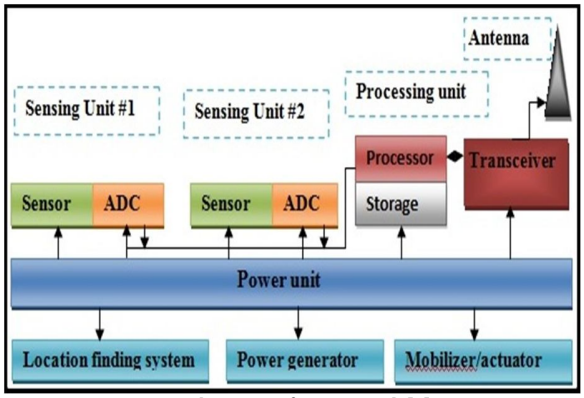

Fig 1 Architecture of Sensor Node[1]

A sensor node consists of four major components [1] as shown in Fig. 1: processing unit, sensing unit, power unit and transceiver unit. Other additional components are location finding system, mobilizer and power generator.

Two subunits of sensing unit are sensors and analog to digital converters (ADCs).

1. ADC converts the analog signals into digital signals and then they are fed into the processing unit.
2. The main function of processing unit is that it allows the sensor node to collaborate with other nodes for performing the assigned task.
3. A transceiver unit does the task of connecting the node to the network.
4. The power is also an important component of WSN. Power units can be supported by a power scavenging unit such as solar cells.

4.DEPLOYMENT PHASE

Node deployment is mainly dependent on application. The two important things that are to be considered are the autonomy and adaptability [5]. Autonomy specifies that sensors can be deployed in an unattended region or physically unreachable area, so they are required to operate with the minimum efforts from the base stations or human administrators. Adaptability specifies the capability of wsn node to adapt according to environmental changes that it monitors, e.g. sensor may decrease their duty cycles in order to reduce the power consumption when there is not much considerable change in sensor readings [6].

5. CLUSTER FORMATION

In order to make data aggregation more efficient in a network, nodes are partitioned into a number of small groups called clusters. In each cluster one sensor node is selected as cluster head which supervises the task of data collection from various nodes and thereby forwarding it further. This clustering scheme increases the life time of network by avoiding unbalancing of energy load throughout the network [7].

Single Hop and Multi Hop cluster communication

In single hop cluster communication, cluster head transmit their data directly to base station. This is very much suitable approach for small networks. But to mitigate hot spot problem, clusters near the Base station are kept larger in size and those who are at distance they are to be smaller in size to preserve their energy to transmit directly to distant Base station.

Multi hop scheme is implemented for larger network for transmitting the data to Base station. In this inter cluster communication take place, and cluster head of each cluster forwards the data to neighboring cluster and thereby to Base Station.

In this the size of clusters nearer to Base Station are smaller in size and farther ones have large size so as former can preserve their energy for forwarding the data and hence in this way they mitigate hot spot problem.

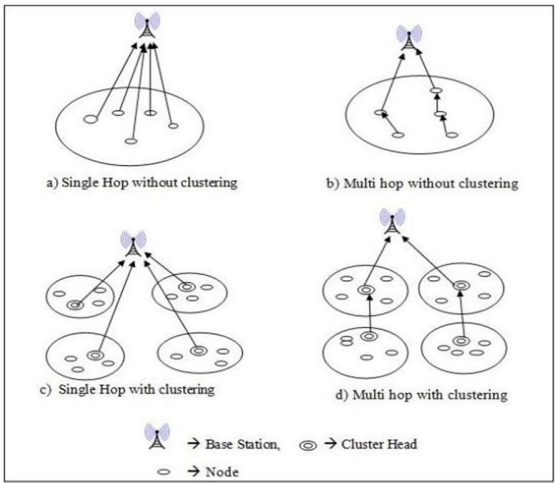

Fig.2. Single-Hop and Multi-Hop Communication [8]

UCR (unequal cluster based routing protocol) is the first protocol to mitigate hot spot problem [9]. Various clustering techniques have been shown in the Figure 1.4

6. ZONE DIVISIONAL NETWORK

In this whole network is divided into different zones [10]. Zone number is assigned according to the distance from the Base station. In every zone there can be any number of clusters depending upon the number of nodes being employed. The size of zone 1, i.e nearer to Base station will be smaller than then the zone 2 and so on. It is done to conserve the energy for data forwarding. The Zone number is allotted by the equation (1).

$$Z(i) = [(di\_bs - di\_min)/r)] + 1 \quad (1)$$

Here Z(i) is the zone number, di_bs is the distance of node from the BS, di_min is the minimum distance of node from BS.

Double Cluster Head in a cluster

In this zone divisional network formation we employ double cluster head approach in the single cluster. MCH(Main cluster head) and ACH(Assistant Cluster head) are selected in the cluster according to residual energy of nodes in the cluster. Residual energy of nodes in the cluster is calculated by equation (2).

$$T = E_{oi} / \left(\sum_{j=1}^{i-1} (E_{oj}) / n-1 \right) \quad (2)$$

Where Eoi is the initial energy of nodes and Eoj being the average energy of all nodes in a cluster.

MCH will have highest residual energy and ACH will have residual energy low than MCH only. Data aggregation is performed by ACH only. So load on MCH is reduced effectively.

Inter-cluster communication

Once the ACH and MCH are selected, then data forwarding is done by MCH to the MCH of next cluster in the zone, depending upon the nearest to the Base station. Average energy of whole cluster is considered while forwarding the data.

Simulation and results

7. SIMULATION AND RESULTS

The simulation is performed in MATLAB 2011b. It is done for two different topologies.

Zone Divisional Topology

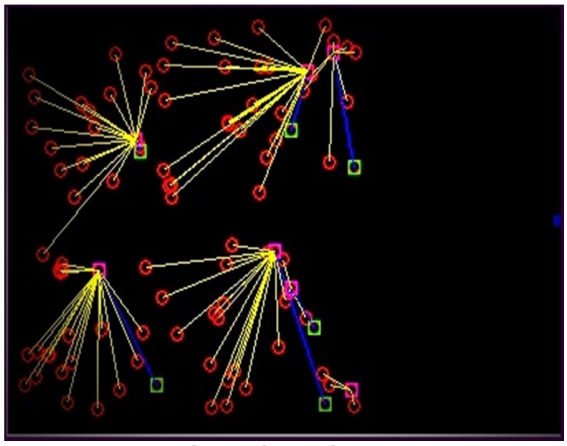

Fig.3 zone divisional network

Here the network is divided into 3 different zones. 1st zone contains two clusters and similar the case with second and third clusters as shown in Fig.3

ACH forwards the data to MCH and then MCH forwards it to next cluster. This topology can be used for making the communication effective and for increasing the network lifetime.

Grid topology

Simulations are also performed for the random deployment of nodes in grid topology. Which is shown in Fig.4.If compared, zone divisional topology is really an efficient one as it utilizes maximum of intra cluster communication. Grid topology as shown might lead to Hot spot problem. There is no efficient consideration of cluster size while transmission of data to the Base station which will lead to reduction in the network life time.

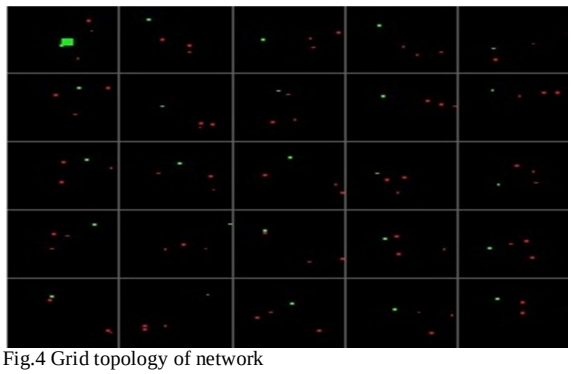

Fig.4 Grid topology of network

8. CONCLUSION AND FUTURE SCOPE

As in this paper we have presented zone divisional approach for homogenous environment. The Zone divisional topology makes the network more energy efficient as it uses the efficient clustering where as in grid topology, there is hot spot problem which is removed in Zone divisional topology by using unequal clustering in the network. The future work will be focused on implementing the data transmission in this network topology.

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