ABSTRACT

Wireless Sensor Network (WSN) is one of the well known emerging technologies of the 21st century. WSN raise the interactions between humans and environment to a new level. In recent years, WSN has attracted a lot of attention from researchers in both academic and industrial communities. WSN consist of tiny, energy efficient sensor nodes communicating via wireless channels, performing distributed sensing and collaborative tasks for a various monitoring applications include monitoring of temperature, humidity, vibrations, seismic events, pollution detection, etc.

The need and emergence of WSN in versatile applications have driven the research community over the years and made WSN phenomenon a reality. These networks are characterized by a limited amount of energy supply at the sensor nodes and hence the energy optimization in sensor nodes becomes a vital design challenge for WSN. Clustering technique effectively reduces the energy consumption of sensor nodes and has been widely adopted for data gathering and routing in WSNs. A variety of clustering protocols have been proposed to address the energy efficiency problems in different network scenarios.

This research work investigates on improving the energy efficiency in Wireless Sensor Networks through the Energy Efficient Cluster based

Multilevel Hierarchical Routing with Compressed Sensing based data aggregation. Firstly a novel Energy Efficient Clustering (E2C) technique for single hop Wireless Sensor Networks is proposed, which suits better for periodical data gathering applications. In E2C technique, the network is partitioned into a group of cluster regions with one Cluster Head (CH) for each cluster region. E2C uses a new method of election for cluster heads and cluster formation. The value of CH competition range produces a good distribution of cluster heads. The design principle of E2C is that the role of CH should be rotated among all nodes and the cluster sizes should be carefully determined at different parts of the network to minimize energy consumption and also to extend the network lifetime and energy efficiency.

E2C approach has been simulated by using the Network Simulator 2 (NS2) under different scenarios and its performance is compared with existing clustering algorithms. It is shown that the proposed E2C algorithm allows long term continuous data collection in large networks, offering greater network longevity than existing solutions.

In order to conserve more energy, multi hop communication among the cluster heads is adopted during the inter cluster communications in the data transmission phase instead of single hop communication. It is commonly agreed that multi hop transmission is usually more energy efficient than single hop transmission when the average distance between source to destination is large. In this work, E2C approach has been analyzed with Cluster ID based

Hierarchical Routing, Multi Tier Hierarchical Routing, and Multilevel Hierarchical Routing. In Cluster ID based Hierarchical Routing approach, an unique ID is assigned to each cluster and the cluster ID is used as next hop for data transmission.

Multi Tier Hierarchical Routing defines a multi-hop hierarchical routing, where CHs form clusters and CHs are selected from CHs. At higher level, CHs directly communicate with BS which reduces the routing complications and prolong the lifetime of a network. In Multilevel Hierarchical Routing, when the BS disseminate through the network, a level is assigned to each CH. When a route breaks down due to node failure or other causes, Multilevel Hierarchical Routing employs a best way to find alternate route between CH to BS.

Analysis results of three hierarchical routing methods shows that the Multilevel Hierarchical Routing is much more effective in terms of energy efficiency in Wireless Sensor Networks compared with other methods.

Compressed Sensing (CS) technique is employed to improve the energy efficiency of cluster based hierarchical network. CS is an innovative approach to achieve lower sampling rate for sparse signals. In order to reduce the number of data transmissions and save energy, CS theory is applied to gather and reconstruct the sparse signals in energy constrained large scale WSN. After clusters formed, nodes transmit data to cluster head without using

CS. CHs use CS to transmit the data to sink. The application of CS to data collection in Cluster Based Multilevel Hierarchical wireless sensor networks has been investigated. The performance of the CS based approach is compared in terms of number of transmissions and energy consumption. CS based approach outperforms the conventional transmission approach and requires fewer transmissions to achieve a desired reconstruction quality.

A Service Oriented Framework is developed for real time monitoring of agricultural parameters like temperature, humidity and soil moisture, etc. using WSNs. Reasonable simulation tools exist for evaluating large scale sensor networks, however, they fail to capture practical aspects of wireless communication. Real life framework brings out actual challenges and important aspects related to large scale deployment of sensor networks. The framework proposed facilitates an agriculture monitoring system, with certain on site data acquisition capability, to publish that capability as a service on the Internet.