ABSTRACT

The advancement in microelectronics has enabled the development of low cost and low power multifunctional sensors. Composing these sensor nodes into sophisticated computational and communication infrastructures to form wireless sensor networks is a unique challenge to modern technology. A wireless sensor network is composed of a large number of sensor nodes and they are densely deployed in the field to monitor the environment, collect the data and route it to a sink. Wireless sensor network is an emerging field with various applications extending from domestic to military. The main constraint is that the nodes in such a network have a battery of limited stored energy the network lifetime gets reduced. In many of its applications it is difficult or sometimes impossible to recharge or replace the battery. Thus, extending the lifetime of the network plays a pivotal role in wireless sensor networks, especially where human access is not possible for many applications.

The processing and energy limitation of the sensor nodes pose a greater challenge and make it difficult to extend the lifetime of the network. A variety of energy efficient operations have been proposed in the literature to increase the lifetime of the nodes in wireless sensor networks. There are various topology management schemes such as SPAN, STEM, GAF, BEES etc., for improving network parameters such as capacity, energy, coverage and latency. These schemes improve some parameters at the cost of some other important network parameters.
In Wireless Sensor Networks, mostly nodes are deployed in random fashion and it has to be ensured that a backbone network should be connected at any given point of time to maintain connectivity. The selection of these backbone nodes plays a vital role while deciding the topology as by carefully selecting backbone nodes, the forwarding energy consumption can be reduced. The topology control in wireless sensor networks is used to maintain network connectivity, optimize network lifetime and to make it possible to design power efficient routing. In order to increase the energy efficiency, the backbone method is chosen and integrated with STEM. Simulation results show that the proposed hybrid scheme reduces the energy consumption by 57.2% as compared to STEM scheme.

Sustainable Physical Activity in Neighbourhood (SPAN) scheme, preserves network capacity, decreases latency but provides less energy savings. Sparse Topology and Energy Management (STEM) scheme does not preserve capacity resulting in great energy savings and high latency. In the proposed scheme, new coordinator rule is implemented in SPAN, and then integrated with STEM. It is observed that the energy conserved increases by about 3.18% to 4.17% without sacrificing network capacity. Due to the definite path in the proposed scheme the latency is reduced by almost half the latency of STEM scheme.

The battery of limited energy operates wireless sensor nodes, it is very important to increase the lifetime of the wireless sensor network in 3-Dimensional sensor networks since human access in such application is not possible. In such networks, it is important to maintain the connectivity also. In
order to achieve this, various 3-Dimensional virtual cells are analyzed and selected the Truncated Octahedron cell is the best suitable cell based on the volumetric quotient. By using this virtual cell, a hybrid topology management scheme is proposed for improving the lifetime of the wireless sensor networks with guaranteed connectivity.

The sensing range of the sensor node is smaller than the radio range and hence there are a large number of nodes within the coverage area of a node. Hence, network connectivity can be maintained with less number of nodes. By using this fact, energy can be saved by switching off the transceiver, which consumes most of the energy. On the other hand, the sensor node spends most of the time in monitoring state and the transceiver is idle. In the idle state the transceiver consumes almost the same energy as in receiving state. Hence putting the transceiver in the sleep mode when it is idle can save the significant energy. In this thesis, a hybrid topology management scheme for 3-Dimensional sensor networks are designed by making use of the above said facts. The proposed hybrid scheme improves the lifetime of the 3-Dimensional sensor network by a factor of 19 with guaranteed connectivity.