CHAPTER 7
CONCLUSION AND FUTURE DIRECTION

In Wireless Sensor Networks, sensor nodes are battery powered and in many cases it may not be possible to change or recharge the batteries. The key challenge in a WSN routing protocol deals with the energy efficiency of the nodes in order to prolong the network lifetime. A hierarchical clustered routing is a reliable robust and scalable solution for energy minimization in WSN. The main idea behind the clustered routing is to divide the network into different groups and each performs different tasks. So that the amount of data transmission can be reduced and energy dissipation for communication also minimized.

7.1 CONCLUSION

This research work focuses energy efficient routing for WSN. So that three reliable energy efficient clustered routing protocols have been proposed in this thesis. The proposed routing protocols are evaluated in terms of delivery ratio, delay, average energy consumption and network lifetime.

In the existing routing protocols like LEACH and DHAC a cluster formation scheme is introduced for energy efficiency which results in the smallest expected number of clusters. However it does not guarantee good cluster head distribution and assumes uniform energy consumption for CHs. In order to make it as a guaranteed good cluster head distribution, uniform energy consumption, less delay, overhead, good delivery ratio and extended network lifetime three routing protocols are implemented.
The first step in the literature survey is to clarify the routing protocols in WSN as network structure based, Hierarchical and Operation based. From the literature it is learnt that in WSN energy consumption is an major issue for network lifetime. Also WSN faces many challenges in routing because delivery ratio, maximum energy consumption of a node, overhead, reliability and delay. So designing protocols which should support high delivery ratio with minimum overhead is a required one.

In Chapter 4, RCRP has been proposed for energy efficient communication. The network is grouped as clusters and CHs are selected based on sensor nodes energy and delivery ratio. CHs are allowed to transmit the data directly to the Base Station so more energy is required in CHs only. In existing protocols, reclustering is often required. But in RCRP, it is avoided by uniformly distributed the nodes to the CHs and energy consumption is greatly reduced in CHs.

In chapter 5, EERRSCR has been described. In this proposed work three factors namely nodes reliability, energy and density have been used to select the cluster head. It is increasing the efficiency of the CH. Cluster heads are the backbone for hierarchical routing protocol and it is enhancing the performance. Also advanced forward aware factor method has been included to avoid backward transmission. The network life time of nodes are 750s, 990s, 1400s and 1800s for number of nodes 50,100,150 and 200 respectively. While comparing this with LEACH the proposed protocol is giving 2x times improvisation in terms of network lifetime. This protocol outperforms RCRP also.

In Chapter 6, FRRSCR has been proposed so that in addition to the previous work fuzzy rule based system is incorporated to enhance the performance. Since
wireless sensor networks need simple and fast methods to make decisions, fuzzy logic appears as an appropriate approach due to its ability to calculate results fastly and precisely. In order to improve the efficiency and accuracy of the CH selection and to speed it up the fuzzy logic is proposed. In this chapter also advanced forward aware factor technique is included so that while transmitting the data if there is any nearby cluster heads are present towards the BS in its level or its upper level than that of its CH then node can forward the data through the upper level CH to the Base station. So it is reducing the transmission delay. In order to reduce the energy consumption in CHs, nodes are permitted to transmit the data to the upper layer CHs also if it closer to BS. In this protocol maximum energy consumption of a node is greatly reduced than others so network lifetime is extended considerably.

It is concluded that by seeing the performance of three proposed routing protocols namely RCRP, EERRSCR and FRRSCR gives better result in terms of higher delivery ratio, less delay, less energy consumption, minimal maximum energy consumption of a node, less CH energy consumption, low overhead and extended network life time.

7.2 FUTURE DIRECTION

The proposed routing protocols can be made more effective in future by including metrics related to QoS and time constraints. Also security measures can be incorporated to strengthen the protection over data from eavesdroppers. In future the performance of energy efficiency can be evaluated. Different weights can be incorporated into the clustering process. Also mobility issues can be investigated for more complicated scenarios. In this research work delay, delivery ratio, overhead,
maximum energy consumption of a node, CH energy consumption, average energy consumption and network life time are considered as the parameters to evaluate the performance of the protocols. Several other parameters such as traffic patterns, node density and initial placement pattern of nodes may affect the routing performance and hence this work can be extended to investigate them further. Also the proposed clustered routing protocol will be enhanced to be tested under mobility of both BS and sensor nodes.