6.1. Conclusion and Contributions
The energy efficient and fault tolerant data aggregation based routing algorithms were analyzed in this research and the Modified-LEACH and EERFTDA algorithms are proposed. In Modified-LEACH, the cluster heads are elected based on the residual energy and a few next heads are elected for each cluster. The re-clustering of the network is done after the residual energy of the cluster head and next heads goes below the threshold value. The energy consumption of Modified-LEACH was found to be 20% less than LEACH protocol and 30% less than AODV protocol.

The Modified-LEACH algorithm requires re-clustering after failure of the secondary cluster head. In contrast, event-based clustering algorithm requires clusters only if there is an event. Hence event based EERFTDA algorithm was proposed and analyzed. The sink node disseminates the event of interest to the network. So, the nodes that detect the same event at a time instance forms as a cluster and elect a cluster head among them. The cluster head performs fault-tolerant data aggregation by eliminating the outlier and redundant data. The relay nodes are elected based on residual energy, to overcome the bottleneck problem. The performance of EERFTDA is compared with DRINA algorithm for the QoS parameters such as delay, packet delivery ratio, energy consumption and accuracy. The energy consumption of EERFTDA is 20% less than DRINA and it maximizes the lifetime of the network.

The data aggregation phase of EERFTDA is implemented in hardware using NI WSN nodes and gateway and analyzed both in indoor and outdoor
environments. The threshold values were varied and the accuracy and precision were measured. In order to reduce the outlier generation in outdoor environment, the router nodes were placed. This increased the coverage distance thus reducing the generation of faulty data due to communication failure.

The overall energy consumption of EERFTDA is 30% less than Modified-LEACH, 20% less the DRINA, 35% less than LEACH and 40% less than AODV protocol. The lifetime of the network was found maximum for EERFTDA. From the analysis and hardware implementation of the proposed algorithm, event-based clustering proves to be promising algorithm for increasing the lifetime of the network. Locality Sensitive Hashing based outlier detection algorithm was implemented in hardware and found that, this algorithm is suitable for real-time implementation. Hence event based clustering with outlier detection provides better accuracy and is suitable for data driven wireless sensor networks.

6.2. Future Work
The research contributions made to this thesis have opened several challenging research directions, which can be further investigated. The proposed algorithms dealt only with energy efficiency and fault tolerance for homogenous and static network. The outlier detection technique based on locality sensitive hashing was validated only for homogenous type of data. In future, the routing protocol for heterogeneous network with mobile nodes and sink will be a promising approach to enhance energy efficiency. The other issues of wireless sensor networks such as localization, targetization, security, etc, are also emerging areas of research. A security mechanism that requires low power or self-harvesting nodes can be developed for secure routing. Additionally, the design of efficient routing protocol for real-time applications, enhancing the Quality of Service (QoS) can be considered.