Chapter 9

Conclusion & Future Scope

This chapter describes the conclusions about the results and summarisation of research work carried out. Also some future scope suggested here to extend the project for further real time implementations.

Simulation is an important methodology to develop, investigate and evaluate the network systems. The simulation study was carried out using software simulation tools such as: MATLAB/SIMULINK, True Time, and OPNET. The parametric optimization is considered to evaluate the performance of WSN based on performance metrics.

OPNET simulation tool was used to evaluate the performance of the Wireless and Wired Network in terms of different number of users, traffics. For high traffic and users wired network outperforms than Wireless network due to the transmission limit, SNR (signal to noise) and bandwidth of the received signal. So to improve the overall performance of the system it is better to use hybrid network which is the combination of both wired and wireless network.

To communicate nodes with each other in ad-hoc manner there are various constraints affects to the performance of the WSN in order to extend the communication range and maintain network scalability. The main WSN limitations are battery capacity (power consumption), bandwidth underutilization and computing power. Hence, packet routing techniques must be applied to provide long-range and large-scale communication in WSNs.

As signal transmission power utilized by nodes of WSN increases, the performance of WSN improves in terms of the communication range. So the nodes can communicate with less propagation delay and can recover the information from all the visiting points. All the nodes of WSN are battery operated nodes and it is not suitable to increase the power to improve the performance of network. The suitable algorithm can be used to determine the optimized value of the transmission power for each node so that less power can be utilized by nodes to exchange the information. Also soft computing techniques can be applied to determine the optimized value of the transmission power.

Sustaining a route from a source to a destination may consume more bandwidth and power than is required to support the data traffic flow. In order to optimize the communication, it is important to know the characteristics of the WSN topological structure. Parametric evaluation for Topological structure like Tree, Mesh and Star of WSN has been carried out and its performance was analyzed.

IEEE 802.15.4 Standard for WSN is used in beacon enabled mode to transfer the data under Superframe structure to improve the performance of it. For the Contention Free Period GTS Mechanism is analyzed for WSN. GTS (local) throughput and Global throughput for the WSN beacon enabled mode are evaluated for GTS Mechanism using IEEE 802.15.4 OPNET simulation model in terms of Superframe Order (SO) and Beacon Order (BO). Selection of Superframe Order must be done carefully to ensure that the GTS in a superframe can accommodate at least one packet size and higher SO values i.e., greater than 7 are not supported by WSN application. The maximum utilization of the allocated GTS is achieved for superframe orders SO= [2, 3, 4, and 5]. If 100% duty cycle is not considered (SO<BO) then inactive period increases and throughput decreases which is influenced by processing, transmitting, propagation, and queuing delays. The throughput can be increased by decreasing wasted bandwidth which occurs because of a fraction of the slot can be used during transmission of data and remaining bandwidth is wasted in every GTS slot in every superframe. This can be resolved by splitting the slots which make superframe structure with 32 slots. This method can be applicable only for small data transmission which can accommodate with this new slot duration. If data is large which cannot accommodate with this modified slot duration then modified method may not give optimum solution.

To reduce the wasted Bandwidth and to increase the GTS throughput, packet size has been decided by Soft Computing Techniques ANN and ANFIS. Both are trained to determine the packet size adaptively depending upon the input parameters Data Rate and Inter Arrival Time and give the optimum Packet size to get optimum GTS Throughput based on network situation and the parameters.

Hardware implementation of Soft Computing Technique ANN is implemented on FPGA using Spartan 6 XC6SLX45 in VHDL code. The relative difference of Hardware (FPGA) and Software (MATLAB) implementation is negligible. The error can be further minimized by considering the more number of bits to represent weights and biases of ANN and accuracy also can be increased with the cost of memory.

The performance of WSN is implemented on Hardware using MICAz motes. Throughput of WSN of Hardware implementation and Simulation Implementation is evaluated gives almost similar behavior.

Future work will explore some of the research directions pointed out in the thesis so far

ℵ The optimization of routing communication and signal reach parameters can be done using soft computing technique.

ℵ Here we have considered star topology; other topology can be optimized using different algorithms. The future work involves testing our work under different simulation models using a wider range of protocol parameters and more complex network topologies.

ℵ There is also a room for improvements using IEEE 802.15.4 slotted CSMA/CA for time-critical events, priority-based delay mitigation and special GTS allocation mechanisms for time sensitive networks.

ℵ Genetic Algorithm can be used to tune the weights and biases of ANN and ANFIS.