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## CHAPTER 6

### CONCLUSION AND FUTURE WORK

The primary objectives of this research are to balance network lifespan and energy efficiency while creating a secure, energy-efficient clustered-based routing technique for WSNs. The work is divided into three stages: clustering, routing, and security. The main conclusions from each research stage are discussed, along with suggestions for future studies.

#### 6.1 SUMMARY

The aim of the comparative analysis of various optimization approaches is to identify a suitable method for locating the optimum routing path for a secured algorithm in a clustered hierarchical WSN.

The hybrid methodology that combines an ACE-based strategy with GA is employed to perform clustering. GA is used for selecting proper CH and Cluster formation. In the proposed method feedback is received after each iteration. The feedback information contains the information regarding the residual energy, distance, neighboring nodes count, alive nodes count, and number of times the current node is elected as a CH. Initially, the total number of nodes is considered as 100 with 2000 data packets. It is concluded from the results that the proposed work outperforms the LEACH protocol in terms of residual energy, alive node count, and throughput. The residual energy of the proposed method is almost 10% greater than the existing method. Almost more than 30% of the nodes are alive in the proposed compared with the other existing methods and the throughput is almost more than 10% when compared to the existing method.

With the ODNB algorithm, the shortest path is found to transfer data from the source to the destination. To identify malicious nodes that interrupt the network and cause long-distance transmission, the shortest path is established here based on node behaviour and demand. The TMS and RTA are used to compare the results of

the proposed research. The results indicate that the suggested approach outperforms the other two existing methods. The PDR is nearly 92.2% higher than with the current techniques. There is approximately 21% less delay and almost 21% fewer packet drops compared to other approaches. Moreover, the energy efficiency is over 25% higher than the other two techniques compared.

To prevent data loss during transmission, a secured data route is required. In this work, secure data transmission is achieved by the usage of Multi Criteria based Secured Routing Protocol (MSRP). Here, the CH is chosen and the appropriate shortest path is found utilizing multiple criteria to establish security. The AODV, TSRF, and ESMR are used to compare the results. It is concluded from the results that the proposed work performs better than other existing methods. From the results, it is evident that the network lifetime is more than 34% better than the existing methods the throughput is almost 36% greater and the delay is almost 29% less than the other existing methods. Residual energy is almost 30% more than the other existing methods when the number of malicious nodes is 50.

## **6.2 Future Work**

Developing algorithms for secured cluster-based routing can lead to significant advancements in efficiency. Analyzing the kind of network and number of nodes can help to increase efficiency and network lifetime. Any real-time application could make use of the developed secure clustered based routing protocol. The same protocol may be used for a heterogeneous network.