ABSTRACT

Wireless Sensor Network (WSNs) is a fast emerging research area in the real-world environment because of its large application views with low cost and high flexibility in deployment. When deployed in the inaccessible area, WSNs may be in a position to operate for long periods of time. Ships constitute an important part of modern systems widely used in armed conflicts and commercial purposes such as fishing and transporting passengers and cargos.

Modern ships are equipped with automatic monitoring systems which control and ensure the safety and accuracy of the whole ship operation. It introduces several new requirements, such as link failure recovery, energy efficiency, and network reliability. To address various requirements, designing of Self Reconfigurable WSNs would adapt in a changing environment which results in a solution to the above-said problem. This research aims to develop software for sensor nodes that can reconfigure WSNs at runtime, allowing sensor network to perform within its requirements under changing conditions.

Four novel methods have been developed for the design of Self Reconfigurable mechanism for Critical Application. They are: Reliable and Efficient Self Reconfiguration WSN design to mitigate link failures (RESR); Robust Link Failure Recovery Mechanism using Self Reconfiguration in WSNs (RLFRSR); Signal Strength Based Self Reconfiguration to Ensure Reliability in WSNs (S2R2); and an Adaptive Self Reconfiguration Mechanism for Improving Reliability (ASMIR) in WSN.

Initially, Reliable and Efficient Self Reconfiguration WSN design to Mitigate Link Failure has been proposed. This scheme has been designed mainly for automatic reformation which route to conserve network performance in WSNs. RESR generates a self-reconfiguration plan which can be used for both local recovery and route recovery. RESR increases throughput and reduces both
transmission delay and energy consumption in WSN. This method produces 38.94\% efficiency when compared to the Reliable Reactive Routing Enhancement protocol.

In continuation of the initial work, Robust Link Failure Recovery Mechanism using Self-Reconfiguration in WSNs has been proposed. This mechanism enables sensor nodes to autonomously recover from the frequent link failure by network self-reconfiguration system. RLFRSR produces an optimal path to reduce network delay. This protocol shows 35.98\% efficiency when compared to the Autonomous network Self Reconfiguration System.

As the extension of the previous work, Signal Strength Based Self Reconfiguration to Ensure Reliability in WSNs is proposed that maintain path stability and reliability. Sensor network depending on signal strength of neighboring nodes ensure reliability using self-reconfiguration that adjust radio signal in S2R2. This method produces about 40.02\% efficiency over Test bed for Wireless Indoor experiments with Sensor Networks.

Finally, Adaptive Self Reconfiguration Mechanism for Improving Reliability in WSN is developed that reduces link failure. ASMir mechanism uses an energy sharing algorithm for improving the energy efficiency of the network. This technique provides 46.04\% improvement compared to Extended Fully Distributed Cluster-Based routing protocol.

A comparative analysis of four protocols: RESR, RLFRSR, S2R2, ASMir are simulated and analyzed. Network stimulation tool uses various scenarios (50 nodes and 80 nodes) for comparison against baseline protocols. There is a lot of scope for research with the increasing usage of WSNs and in future real-world scenarios are also suggested for implementation.