Abstract of the Ph.D. Work

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Wireless Sensor Networks (WSN) introduction has brought the comfort of uninterrupted wireless networks into many lives. The data transmission nodes consist of heterogeneous sensor nodes (SNs) fitted with a battery deployed randomly to monitor surroundings. Clustering algorithms with effective routing protocols are used to handle the random deployment of nodes. As a result, redundant data packets are aggregated and enable sound data transfer from sensor nodes to BS (Base Station) through CHs (Cluster Heads). Different routing protocols of energy optimization have been introduced in previous years but have not examined protocol behavior in different environments. An adaptive, sub-clustering, and multi-hop routing protocol is proposed with experimental-based analysis, considering energy and distance as the main parameters. It creates a smooth and straightforward route from the cluster nodes, cluster heads, sub-cluster heads to the base station. Experimental studies show a substantial increase in network lifetime efficiency by comparing the proposed method with the existing protocols. Furthermore, the proposed protocol behavior shows deterministic properties, so it is called Deterministic-LEACH (D-LEACH). When navigating the route during transmission of data in the multi-hop path, we refer to this protocol as MDR – "Multi-hop Deterministic Energy Efficient Routing Protocol."

The use of WSN is extensive as in different applications, such as smart grid, water municipals, health care, monitoring a patient's health condition, etc. The major challenge of WSN is energy efficiency. Energy Efficient-based WSN has always been a research focal point to improve its performance. Aiming at optimal energy utilization to improve life expectancy with guaranteed QoS, an optimal cluster-head (CH) selection and optimal routing algorithm in WSN proposed. The work has carried out the selection of the CH based on various factors like node's residual energy, proximity, distance to the BS, cost, node degree, and node centrality or coverage, used in the proposed Wavelet Mutation-based BAT Algorithm (WMBA). After that, an optimal path selection using Quosi Opposition-based Grasshopper Algorithm (QOGA) made between CH and BS based on different factors, such as distance, node degree, and residual energy under the Modified K-Means Clustering

Algorithm (MKMC) clustering process. The experiment shows that the proposed methodology achieves better life expectancy for the WSN by achieving an energy consumption of 975J for the entire round of 2000 and a PDR of 93.56%, and remains energy-efficient compared to the existing state-of-art method.

Based on inter-cluster communication, an energy-efficient clustering protocol proposed named LEACH-E. The proposed protocol is an enhanced version of the base protocol LEACH. LEACH-E based on the sensor node's location and residual energy, which consume much energy during data transmission. Since all data sent to the cluster head, high-level communication take place and consumes more energy. In this method, try to identify the cluster's maximum residual energy node, previously not the CH. That node collects data from the SN and transfers it to the BS. In this way, the cluster head node's power consumption is reduced and improves the network's lifetime. It also improves the hierarchical routing techniques, which makes protocol more energy efficient when compare with LEACH.

Wireless Sensor Networks (WSNs) are designed to care for and accessible real-time monitoring of the environment depending on the region involved. The main experiments in WSN include energy optimization, routing, identification of obstacles, security, etc. Energy efficiency is a crucial issue for all types of WSNs. The sensor device is attached with a battery and therefore turns out after a specific interval. Improving data extravagance in an energy-optimized way is more important to upgrade maximum sensor devices' lives in the overall network. The clustering technique has already been shown to improve or enhance the life span of WSNs. "Low Energy Adaptive Clustering Hierarchy" (LEACH) protocol is analyzed to minimize power consumption and compare with the K-means algorithm. That shows an analytical method for evaluating energy consumption based on a graphical representation. Analysis and simulation results indicate that the k-Means algorithm can save enormous energy compared to the LEACH protocol with a similar amount of data rate, bit error rate, and other parameters for a specific network area. It is related to the k-Means algorithm to obtain the performance of different datasets in healthcare applications.

Enlighten on security enhancement using encryption techniques in Wireless Sensor Networks. WSN, also called an infrastructure-less network, containing numerous sensor nodes to sense data from different environmental conditions and send these data to a base station through relay nodes in some intervals. Transfer of data is secure by cryptographic technology, which classifies into two techniques asymmetric key cryptographic and symmetric key cryptographic. A Modified Cuckoo Search Resources Allocation (MCS-RA) approach saves the power and prolongs network and cryptographic use to security from different attacks.