

Comparison of Energy Efficient Routing Protocols in Wireless Networks

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Abstract

Wireless sensor network has extraordinary parameters along with its several appliances that have attracted awareness amongvarious investigators. For attaining reduction in energy dissipation as well as affording highly precise coverage in network region, the network was divided into several regions and clusters were formed inside every area. The quantity of residual energy and the distance from the centre of each node were estimated by the base station (containing the location and residual energy of each node for all living nodes in each region) for the purpose of choosing the cluster head (CH) in each round. Due to the lack of energy restrictions, the base station calculates the CH and is also in charge of telling the network about it, which lowers the load consumption and workload of network nodes. This protocol’s information transfer stages resemble those of the LEACH protocol. To better evaluate the results, the proposed method was implemented with LEACH protocols using MATLAB software based on packet delivery ratio and energy efficient. The results showed that better performance in network lifetime, death time of initial node and last node.

Keywords: LEACH Protocol, Wireless Networks, Energy Efficiency, Routing protocols.

Introduction

A number of sensor nodes that can sense, analyze, and transmit small-scale data make up the Wireless Sensor Network (WSN). WSNs have been employed in numerous technologies, including environmental monitoring, systems controlling, tracking, and military/security applications. This is due to the development of electronic technology, the self-organization of the WSNs, as well as

the small size and high performance of nodes. The WSN, which has a unique design, has received much research [1].

The main objectives of this work are mentioned as follows

Implementing clustering scenario and analyze the effects of increase in large number of nodes in the cluster based on energy of Cluster Head (CH).

The sensor nodes are free to move from one cluster to another.

Moreover, this work further aims to implement an energy efficient dynamic algorithm that reflects the CH after a specific period of time hence, saving energy.

Finally comparison has done with efficiency of proposed algorithm by analyzing the graphs of energy levels of the CH during the lifetime of the network.

Lifetime duration of network has been increased with this proposed approach.

Related Work

The most fundamental need of the data from the sensors is power since those nodes would simply not be able to start working there without. Additionally, the sensor nodes used in WSNs are often smaller in size and can be put in remote areas. As a result, re-energizing the sensor nodes using the conventional approach of charging or changing the batteries is not a realistic solutionSoua [2]. In case of Internet of Things, Singla et al. [3] introduced an approach that provides CH with flow of work based on WSN which comprising sensing capacity for energy harvesting. Nassima et al. [4] one of the primary methods for reducing energy usage in wireless sensor networks is clustering. According on several factors, including the clustering methodology, objectives, cluster count and size, etc., clustering protocols proposed in the literature can be categorized. Diop et al. [5] introduced energy efficient method which helps to resolve the security issues while communication in wireless network system. Pour et al. [6] determined that CH selection algorithm in which cluster heads had chosen based on remaining energy, location of nodes as well as node centrality.

Materials and Methods

Consequently, a wireless sensor network (WSN) structure relies on an ecosystem surveillance situation was taken into consideration. The sensor nodes in the field were thought to be movable, but the base station was supposed to be immobile. Additionally, it was envisaged that the wireless sensor nodes would have distinct connections for generating power and communicating the sensory information.

Clustering approach in WSN

A WSN is divided into groups or subparts through the process of clustering. Creating clusters within a WSN is primarily done to boost its scalability, robustness, high efficiency, and power consumption. A cluster also improves efficiency by managing and reusing communication capacity. The goals of cluster systems differ from those of other systems in a number of ways, including load balancing, fault tolerance, increased connection, and maximum lifetime. As a result, clustering is a useful strategy for better resource management and longer network life. The metrics such as PDR and energy consumption and efficacy are described below which are evaluated using eqn. (1) and (2).

Packet Delivery Ratio: The packet delivery ratio can be calculated by dividing the total number of data packets that have reached their destinations by the total number of packets that have been delivered from sources. In other words, the packet delivery ratio is the proportion of packets delivered from the source to those received at the destination.

$$PDR = \frac{\text{Number of packets received}}{\text{Total number of packets sent}} = \frac{DR}{DR + DL} \quad (1)$$

Energy consumption: Since the majority of WSN nodes run on batteries, their lifespan is heavily influenced by how much energy they use. Since individual nodes are inexpensive, replacing the entire node is more cost-effective than trying to find the individual node and replace or recharge its battery supply.

$$\text{Energy consumption} = E_{\text{transmit}} * K * d^a + E_{\text{receive}} * K * N + E_{\text{ReceiveClusterHead}} * K \quad (2)$$

Energy Efficiency: To reduce the use of power resources and extend the network lifetime path while moving data, energy-efficient routing methods are needed.

Architectural Diagram

LEACH is a self-organizing clustering algorithm that distributes the energy burden across the sensor nodes by choosing the CH in a random manner. LEACH’s operation may be broken down into two steps: setup and steady state. Every round of this protocol starts with setup, which involves creating the cluster, and ends with steady state, which involves sending data to the sink. In order to reduce overhead, steady state stages are typically larger than setup stages. Every single sensor node first chooses whether or not to become a CH during the cluster setup phase. Node makes this determination by selecting a random value that must fall between 0 and 1. If the number of electors is less than the threshold, the node will be CH. The efficient and effective cluster head formation deployed in WSN introduced by Priyadarsi et al. [7]. Cluster formation based on distance using LEACH protocol is shown in figure 1 designed by Kole et al [8].

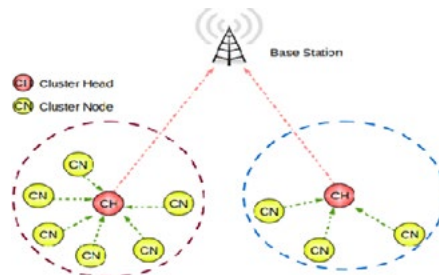


Figure 1. Cluster Head formation in WSN

Farahzadi et al. [9] formed the enhanced cluster in network for reducing the energy utilization. Also, cluster formation has done using LEACH protocol as well as distance based resource allocation in distance to distance communication for enhancing spectrum and efficiency of energy by Singh [10].

Leach algorithm

Leach algorithm is designed for minimizing the energy consumption by distributing the nodes arbitrarily with two stages namely i) Setup ii) Steady state stage are described in figure 2.

Input: Number of nodes

Output: Efficient Energy and packet Delivery Ratio.

BEGIN

Step 1: Exchange information of nodes with id, location and energy.

Step 2: Choosing Cluster Head.

Step 3: If yes, the cluster head are broadcasted with packets.

Step 4: Once the packets are broadcasted, wait for connect-CH message, send that specific schedule

to active members in nodes and then enter into steady phase.

Step 5: If proper cluster head not chosen, the nodes are waiting for CH for further communication.

Step 6: Send connect-CH message by linking the nodes for better communication.

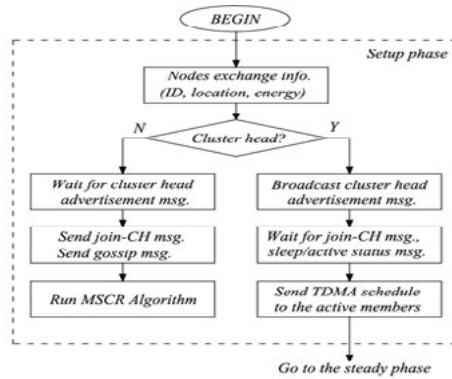


Figure 2. Various phases in LEACH protocol

Step 7: Run clustering based LEACH protocol for enhancing efficient energy.

The flowchart for leach based protocol is shown in Figure 3.

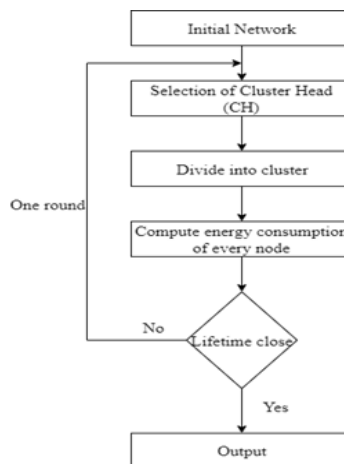


Figure 3. Flowchart for LEACH protocol

First, the authors initialize the network by spreading up of 30 number of sensor nodes to detect the energy efficiency and lifetime of network. Then, among several nodes, the cluster head need to chosen for sending the packets from source node to destination node. Moreover, the clusters are isolated from chosen cluster head for computing the energy consumption of each and every node. Also, the lifetime of network are evaluated considered to be output, and if the lifetime is not better, then we have to select the cluster head one more time and repeat the process till getting better lifetime of the network.

Also, the principle of this LEACH protocol is to enhance the lifetime of WSN by reducing the energy utilization required to build the cluster head, maintaining CH too.

Experimental Analysis

From our simulation results, it is observed that increase number of nodes from 1 to nodes to 30 nodes also the quantity of attackers from 10 to 200, the expenditure of energy using LEACH based clustering method is somewhat less owing to communication overhead. Figure 4 and 5 represents the graph for the metric PDR in which the existing work reaches the ratio with 20 nodes but the proposed method attains the delivery ratio among 30 nodes with number of packets transmitted versus number of packets received.

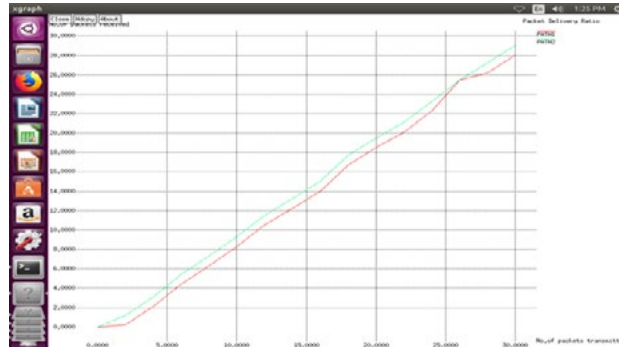


Figure 4. Packet Delivery Ratio metric

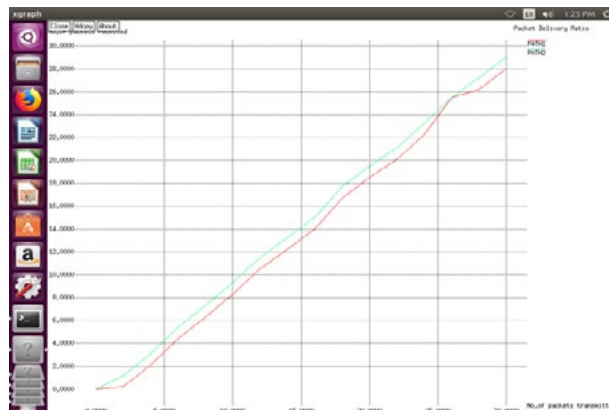


Figure 5. PDR representation among Number of packets transmitted versus received

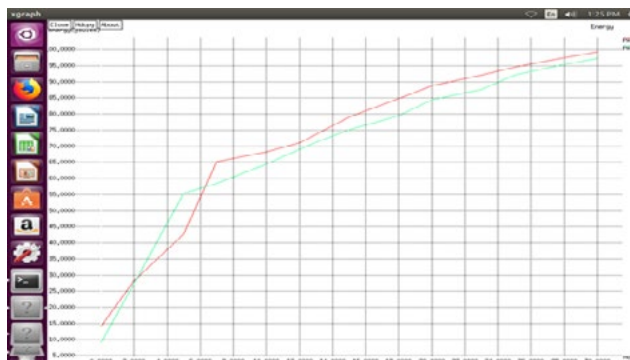


Figure 6. Energy consumption in WSN

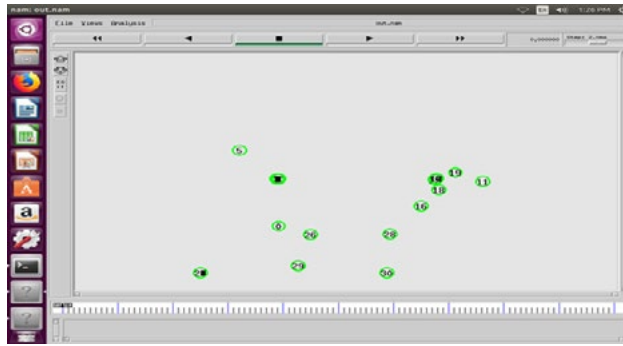


Figure 7 Wireless Network with spreading of 30 nodes

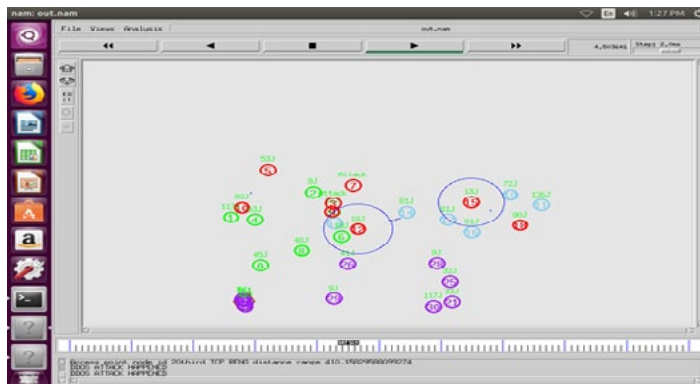


Figure 8. Sending of packets from source node to destination node

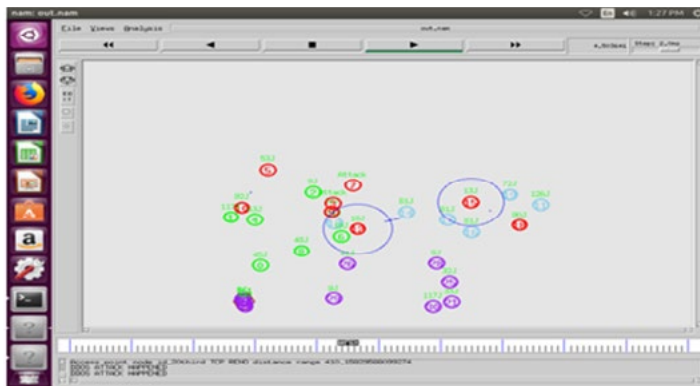


Figure 9. Representation of attack while transmission

Conclusions

This study aims to address one of the main energy limits faced by wireless sensor nodes in WSN applications and took into account a real-world scenario of movable nodes. Researchers have put out a number of clustering protocols to improve WSN energy efficiency and lengthen the lifetime of the network. The suggested method increases WSN lifetime and lowers energy usage by utilizing the LEACH protocol paradigm. In terms of increasing the amount of leftover energy, the number of functional nodes, and the network lifetime of the WSN, the simulation results confirmed the effectiveness of the suggested technique. The metrics such as packet delivery ratio and energy

efficiency are evaluated to enhance the lifetime of network along with efficient energy in sensor networks. The suggested method can also be applied to moving WSN scenarios that do not have naturally moving components. In such systems, just the energy lost during the mobile node's mobility must be taken into account. Depending on the requirements of the particular application, the scheme can also be used to various mobility models.

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