ABSTRACT

The well-developed field of Wireless Sensor Networks (WSNs) is ideal for efficiently gathering and processing the data required for today's environment. The network's ability to process and send accurate data is impacted by a number of disruptive elements, including redundant data, interference, battery life, and distance between nodes. Packet size optimization is one of the most important areas in wireless communications research. In order to obtain error-free data and operate an Energy-Efficient (EE) network, it is crucial to size the packet lengths for transmission via the network.

WSN's primary goal is to detect the real time environmental status and transmit the relevant data to its Base Station (BS) so that it can take appropriate action, based on the kind of application for which it is placed. Different protocols are used by these Sensor Nodes to communicate with one another. The issue with the traditional approach is that each node sends its sensed data straight to the base station during data collection, which causes it to rapidly run out of power.

To the best of the knowledge, entirely battery-less WSN, which depends exclusively on gathered energy, has not been taken into account in the literature. Performance in these networks is the primary goal, to be maximized with infinite energy and interrupted availability. In order to prevent transmission failures brought on by energy depletion, packet sizes should be dynamically tuned with respect to the power offered by each node. From this angle, it is important to take into account the energy balance at each node for every packet transfer. This study proposes a solution for the packet size optimization problem that takes each nodal energy balance constraint into account. Furthermore, while previous research has not taken this into consideration, our analysis assumes that different types of sensor nodes may have different packet sizes.

For packet length scaling in a WSN and Internet of Things (IoT)-based network, a nature-inspired method is developed. This optimization strategy is created using the way a spider catches prey as inspiration. The precise models for EE WSN, Packet Error Rate (PER), EC, and communication channel are determined. Three scenarios in a limited wireless sensor network, namely 1-hop, 2-hop, and multi-hop, are used to test the suggested methodology.

On the other hand, energy scavenging from nearby energy sources becomes more feasible as the number of nodes increases, and it has become increasingly popular as a way to prevent battery problems. In order to extend the lifetime of packet size optimization methods, battery-powered networks with limited total energy and constant power availability have been presented until now. Also, networks without batteries that rely on energy harvesting provide limitless total energy with intermittent availability. This is a result of the environment's shifting conditions or the length of time needed for harvesting and capacitor storage. Battery-less networks and the optimization of packet size in WSN and IoT-based networks have not yet been tackled. Previous methods have already left their mark on all aspects related to data packet length.

To design the packet length quickly and efficiently for an EE network, a new bio-inspired method is developed for building and optimizing a battery-powered network channel structure that takes packet length considerations into account.

In WSN and IoT-based networks, packet length optimization is achieved using the Sling-Shot Spider Optimization (S2SO) method. The special way those spiders grab prey served as the basis for the development of this algorithm. Therefore, in each cycle, the packet size is spontaneously tailored for data transfer. The technique called S2SO is suggested to handle packet size optimization for various sensor nodes in heterogeneous networks and solve the controlled problem S2SO viability is confirmed by applying it to a MATLAB-simulated WSN network model and contrasting it with traditional optimization strategies.

Additionally, there is a direct correlation between the PER and the distance between nodes. Relay nodes are these extra intermediary nodes that are added to particular topologies. Prior to each data transmission cycle, optimization should be carried out dynamically due to the varying energy availability at each node. In order to handle packet size optimization in heterogeneous networks with different sensor nodes, this study answers this constrained optimization problem. The assumed trajectories are typically multidimensional, i.e., tree-like, bi/multi-furcating, connected, or unconnected graphs; or uni-dimensional, i.e., cyclic or linear. Based on the learnt or presumptive depiction, the best course is chosen. This study assessed S2 performance in combination with other maps since it gives the user options for different dimensionality reduction strategies. If the real-world trajectory is multidimensional, then every predicted branch should include cells from every experimental time point since signalling is a continuous process. On the other hand, it is discovered that certain temporal data are consistently observed exclusively in one of the proposed branches. This work may help avoid certain algorithms as a consequence, which have a multidimensional trajectory inference from the following study.

In situations where network packet sizes are small, overhead can account for most of the energy used. However, when it grows too big with more packets, it needs to be resent, which raises the PER and leads to inefficient energy use. The greater PER is the main factor contributing to increase EC whenever the packet size grows. Instead of using the strategy in any dimension, rather employ the new approach, specifically the S2SO strategy, to further lower the PER.

In the next work, IoT nodes consuming EE depends on optimizing packet sizes. The fundamental idea behind WSN is to reduce the amount of energy used for wireless packet delivery. For this, a mathematical model called SCCO (Shifting Cultivation and Cropping based optimization) is created that accounts for communicating channel, consuming energy with better efficiency. It depends on the fields that are cultivated for a relatively short time, and allowed to recover. Then, the new crops are planted after the cultivation. This process is said to be SCCO. This work concentrates on the packet length optimization and EC in WSN and IoT-based networks. The SN communication distance is minimized in order to increase the network lifespan and optimal fitness values.