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ENHANCED SELECTING OF CLUSTER HEAD IN WIRELESS SENSOR NETWORK USING CAPSULE NETWORK

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Abstract- One of the most important ways to prolong WSN's lifetime is clustering, which includes dividing sensor nodes into groups inside wireless sensor network and make the election of CHs for the clusters. Data would be aggregated from specific nodes of the cluster by CHs to forward it to the base station. Among the biggest problems with wireless sensor networks is to select best cluster heads with energy. In this paper, to improve the routing protocol in WSNs we used the methodology which is the capsule neural network to choose the most appropriate CH with best energy. The simulation results demonstrated that our approach better than LEACH and modified LEACH methods to select cluster heads in WSNs. The results showed big enhancement in the no. of alive SNs per rounds for specific number of rounds 100, 200, 300, 400 and 500 rounds respectively, comparing to LEACH and Modified LEACH protocols in selecting cluster heads in wireless sensor networks. Our approach also gives us a noticeable enhancement in two criteria residual energy and alive sensor nodes comparing with LEACH and modified LEACH algorithms.

Keywords: Capsule Neural Network, Cluster Head Selection, Wireless Sensor Network, Energy Optimization.

1. INTRODUCTION

We found the motivation to enhance routing in WSNs by clustering using capsule neural network through the cluster head selection, energy consumption and network lifetime in the research papers that published in this journal [1], [2], also the researchers used clustering to enhance in WSN [3-6]. The desirable routing protocols which consuming less energy amount. A lot of previous researches of routing protocol algorithms in wireless sensor networks that focused on improving routing protocols in WSNs. They improved it through enhancing energy and network lifetime parameters also another parameter. Another research used cluster head selection technique to enhance the WSNs. In our thesis we will use capsule neural networks which is the proposed model to select cluster head, which in return will enhance the residual energy and network lifetime also we will get better alive nodes per rounds. For that purpose, different routing algorithms are proposed, where results be with low energy consumption when the protocols based on clustering technique. WSNs are compromised with low energy sensors and they are difficult to replaced or recharged for batteries of sensors. The researchers designed a routing protocol which requires during communication less energy so extends the lifetime of network. Increasing the lifetime of the network and reducing the consumed energy by efficient cluster head selection [7].

The energy, bandwidth, memory and capabilities of processing of SNs in WSN are among the aspects that limit them. Superb energy efficiency achieved in WSNs by designing clustering. The management of the whole network done by mechanism of control which is clustering topology. Data packet transmission and reception are the essential sources of energy usage in wireless sensor networks. Consequently, we should effectively manage and control the consumption of energy so as to produce routing protocols for wireless sensor networks that are energy-aware. The problem of energy and the recurrent selection for the optimal path has an impact on WSN lifetime in the majority of routing algorithms. Through data aggregation and periodic choosing of different nodes as the CH, energy usage can be decreased and balanced, several data forwarding algorithms employ clustering techniques. LEACH has been put up as a significant clustering protocol for WSNs. All cluster heads in this protocol send directly send the data that they aggregated to the sink [8]. In [9] the researchers used modified leach (LEACH-M) to choose CH in WSNs to address the problems of choosing CH and excessive energy usage, where the network energy was successfully balanced using LEACH-M method also more efficient use of energy. In [10] the by using TOPSIS method to select cluster head and considering four criteria: the number of neighbors, the residual energy, the range of transmission and the distance to the base station. This method increased network lifetime compared to LEACH and AHP methods.

In [11] the researchers used sampling-based spider monkey optimization to select cluster heads with efficient energy in wireless sensor networks, they solved the problem of location-based cluster head selection which cause increasing in computation, weak accuracy in selection, and selecting same nodes, by proposing SMO (Sampling-based spider monkey optimization). And comparing with other protocols like (SMOTECP, LEACH-C, and PSO-C) in both homogeneous and

heterogeneous setup this method improved stability and the lifetime of network through consuming energy efficiently. In [12] the type II fuzzy logic based with aggregation of data technique used to select cluster head in WSN, by depending of three input parameters (residual energy, node centrality, and distance to BS).

2. PROPOSED MODEL

In this paper, we used capsule neural network model for developing and achieving selection of CH in WSNs to decrease the consumption of energy and increasing the lifetime of the network. Capsule networks made of several capsule layers. As we see in our flow diagram Figure 1 for the model we used after giving the value of the energy for the nodes and then convolve the probability parent capsule output which include the capsule layer. After that we made squash layer as in the original paper [13] of capsule which represent the child layer. After routing by agreement, we made update for the probabilities and after each iteration (round) it back to capsule layer. When the specified rounds finished will get to update the weights of the capsule network.

3. SIMULATION RESULTS

The developed learning of capsule neural network to select cluster heads in wireless sensor networks, the effectiveness of this is validated in the environment of MATLAB by arraying 100 nodes in a region of network with space 1000×1000 for comparing the results of our proposed model with LEACH and modified LEACH protocols with the following initial parameters:

Table 1. The simulation parameters of the network

Simulation parameter	The value of the Parameter
Nodes	100
area	1000×1000
Initial energy	2 J
Maximum number of rounds for comparing with LEACH and Modified LEACH	500
Maximum number of rounds for Capsule neural network scenarios	1000

The process of simulation is achieved to optimize the parameters of network which is residual energy, lifetime of network and no. of alive nodes.

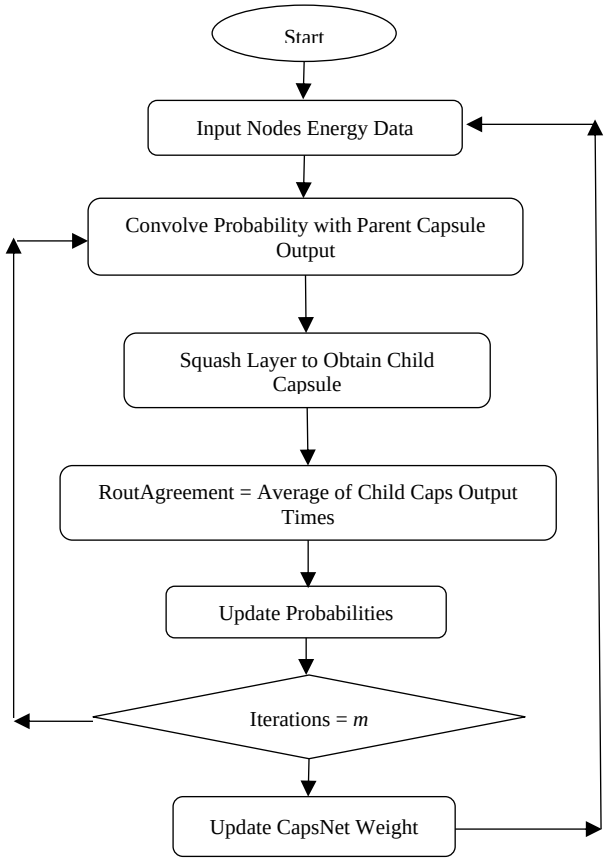

Figure 1. Flow diagram for the proposed model

4. COMPARATIVE STUDY

Comparing our proposed model about selecting cluster heads in WSNs with LEACH and modified LEACH protocols, the results give us improvement in residual energy, number of alive nodes and network lifetime. As we see in the Figure 2 showing the big enhancement in the proposed model after 1000 rounds for the number of alive sensor nodes. All results and figures of our experiments are in MATLAB environment. Our results for the residual energy parameter of the proposed model also gave us a big enhancement about this parameter for 1000 rounds. The results showed in the Figure 3.

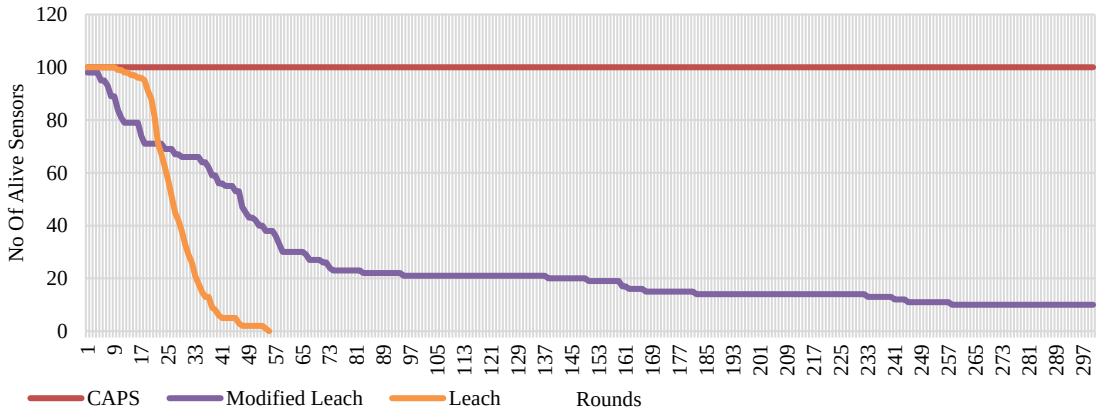

Figure 2. No. of alive sensor nodes per rounds (500 rounds) for CAPS, Modified LEACH and LEACH

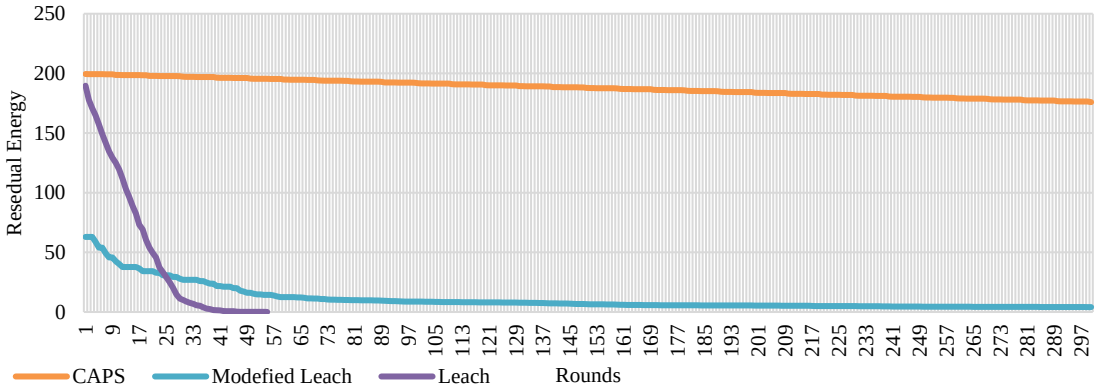

Figure 3. Residual energy (500 rounds) for CAPS, Modified LEACH and LEACH

In return to these results of enhancements in residual energy and alive sensor nodes (network lifetime) was at the expense of (packet delivery ratio, delay and throughput). The following experiment of parameters for 1000×1000 area and 500 rounds in case of 100, 200, 300, 400 and 500 nodes, respectively, regarding our proposed model and LEACH protocol.

4.1. Packet Delivery Ratio

The experiment was for 100, 200, 300, 400 and 500 nodes (500 rounds) for CAPS (proposed model) and LEACH respectively as shown in Figures 4 and 5.

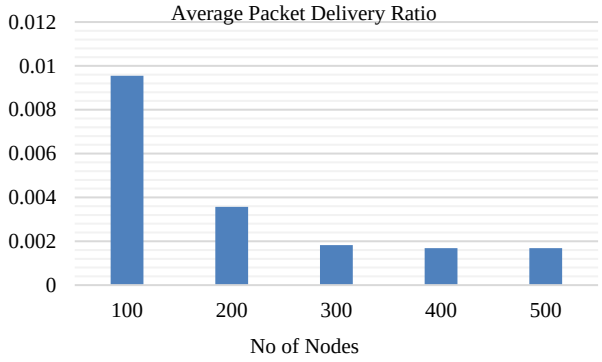

Figure 4. The average of packet delivery ratio in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for CAPS (proposed model)

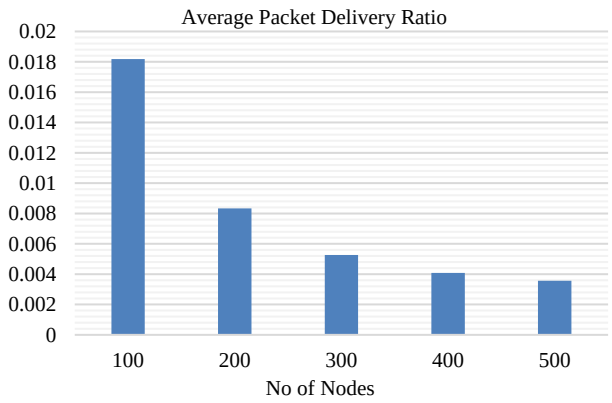

Figure 5. The average of packet delivery ratio in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for LEACH protocol

As we see the results of the packet delivery ratio parameter is better for LEACH protocol than our proposed model (CAPS).

4.2. Delay

The same experiment for 100, 200, 300, 400 and 500 nodes (500 rounds) regarding to delay parameter the results was not well for CAPS as shown in Figures 6 and 7.

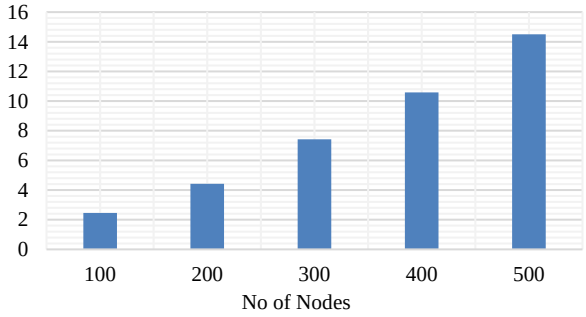

Figure 6. The average of delay parameter in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for CAPS (proposed model)

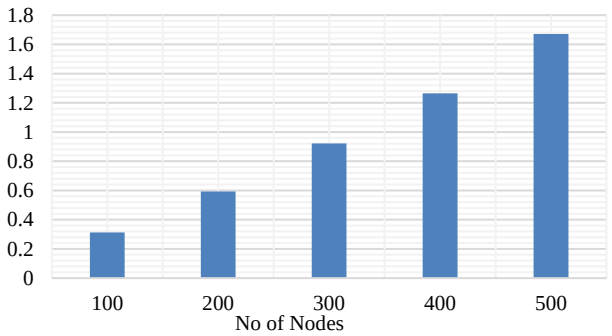

Figure 7. The average of delay parameter in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for LEACH protocol

4.3. Throughput

According to the previous two parameters the throughput results would be for sake of LEACH protocol against our proposed model (CAPS) as shown in Figures 8 and 9.

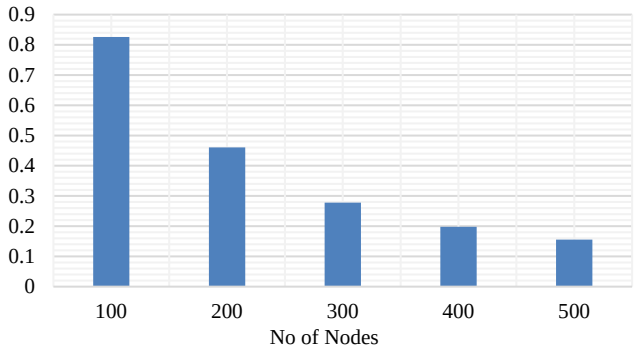

Figure 8. The average of throughput parameter in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for CAPS (proposed model)

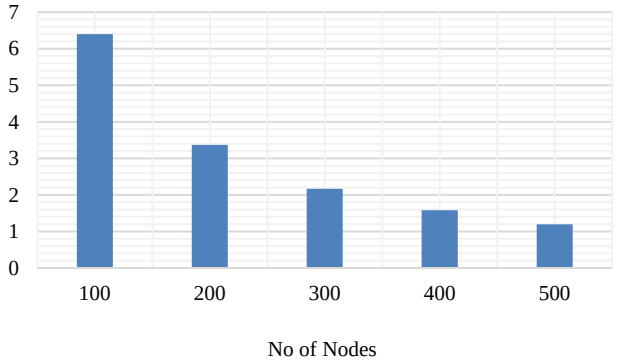

Figure 9. The average of delay parameter in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for LEACH protocol

4.4. No of Dead Nodes Per Rounds

The no. of dead SNs per rounds according to our experiment along to 500 rounds for CAPS and LEACH protocol. Which in turn showing the huge enhancement by using capsule neural network for the number of dead nodes. As shown in Figures 10 and 11.

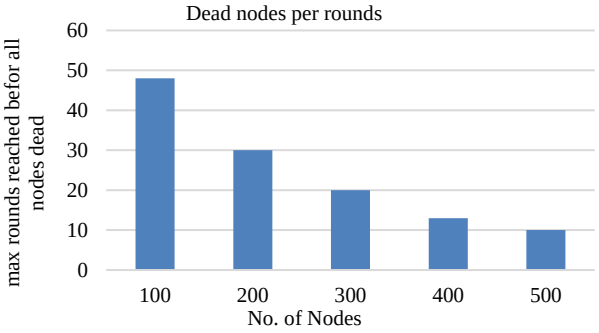

Figure 10. The number of dead nodes per rounds in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) for LEACH protocol, as we see all nodes of the network are dead in all cases after specific number of rounds. As we increase the number of nodes of the network the number of rounds is decreased

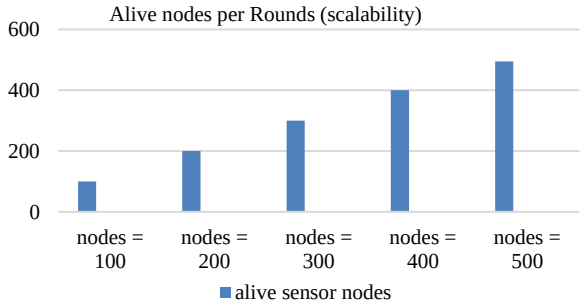

Figure 11. The no. of dead nodes per rounds in case of (100, 200, 300, 400 and 500) nodes in a network of area 1000×1000 (500 rounds) CAPS (proposed model) as we see none of the nodes is dead in all cases comparing with LEACH protocol (in previous Figure 10) where all nodes of the network are dead after specific number of rounds

As we showed in previous the results for no of dead nodes per round. While the results of CAPS (proposed model) for the number of dead SNs per rounds in WSNs for cluster head selection is quite improved.

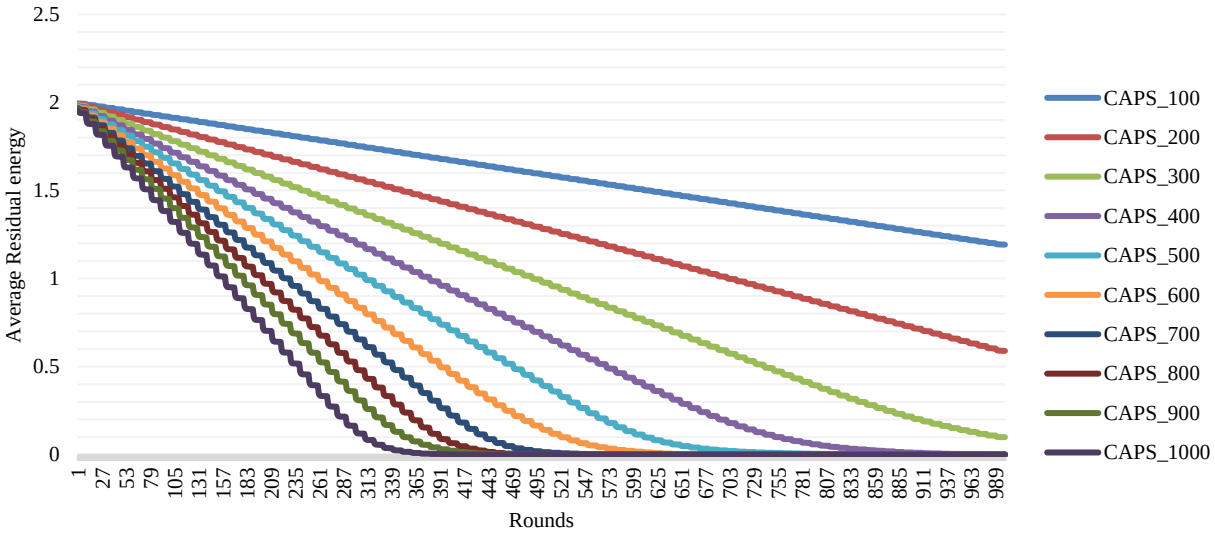

Figure 12. Scenario of our proposed model (CAPS) for 1000 rounds regarding residual energy, which showing as we increase the number of nodes in the network (1000×1000 area), the average of residual energy is decreased

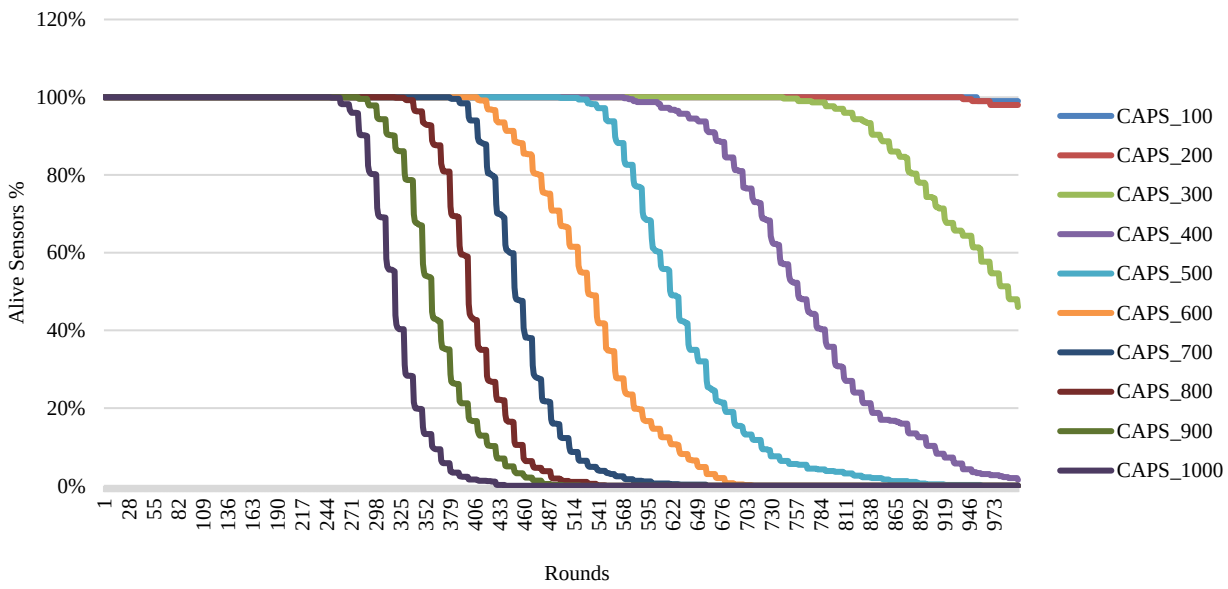

Figure 13. scenario of our proposed model (CAPS) for 1000 rounds regarding alive sensor nodes, which showing that as we increase the number of nodes in the network (1000×1000 area) the percentage of alive sensor nodes is decreased

5. CAPSULE NEURAL NETWORK SCENARIOS

The scenarios we test on our proposed model for the enhanced parameters we get which is the alive sensor nodes and the residual energy, the experiment was for these parameters for 1000 rounds using MATLAB environment. The results shown in Figures 12 and 13, respectively. As we notice the residual energy for nodes after each round for selecting cluster head get decreased for the residual energy and alive sensor nodes parameters.

6. CONCLUSION

In this work, we developed a unique methodology to select CHs in WSNs by capsule neural network (CAPS). Our proposed model produced optimization in residual energy, network lifetime and reduced the no. of dead sensor nodes per rounds. We made experiment compared with LEACH and Modified LEACH protocols in case of 100,200,300,400 and 500 nodes for 500 rounds respectively, the results were a noticeable improvement in residual energy and lifetime of network parameters with reducing the number of dead nodes. The simulation was for 1000 x 1000 area using MATLAB environment. In spite of this improvement of capsule neural network, in return it lacks in delay, packet delivery ration and throughput parameters. Two scenarios were tested for the enhanced parameters which are residual energy and network lifetime of WSN for 1000 rounds, both parameters decreased in value after passing the 500th round.

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