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Energy efficient with prolonging lifetime in homogeneous wireless sensor networks

Shaimaa Hadi[1], Hayder Rahm Dakheel[1], Atyaf Jarullah Yaseen[2]
[1]Department of Computer Science, College of Computer Science and Information Technology, University of Sumer, Rifai, Iraq
[2]College of Computer Science and Mathematics, University of Thi-Qar, Nasiriyah, Iraq

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ABSTRACT

In this artical, we suggest a new clustering model called the fuzzy low energy adaptive clustering hierarchy protocol (FLEACH). It has the ability to go around obstacles and fix the issue of uneven energy consumption in homogenous wireless sensor networks (WSNs). In order to determine the best routing path for the homogeneous WSNs, we also suggest the ant colony routing method (ACORM), which is an energy-efficient routing technique. ACORM aims to investigate issues relating to balancing energy consumption and maximizing network life. To illustrate FLEACH-ACORM's effectiveness in managing energy consumption and optimizing homogeneous network life, we compare our system with two approaches: power-efficient sensor information systems (PEGASIS) and LEACH. Results of the simulation indicate that the network lifetime achieved by FLEACH-ACORM could be increased by almost 28.5% and 19.8% more than that obtained by LEACH and PEGASIS clustering protocols, respectively.

Corresponding Author:

Shaimaa Hadi
Department of Computer Science, College of Computer Science and Information Technology
University of Sumer
Qalat Suker, Thi-Qar, 64003, Iraq
Email: shsumer@yahoo.com

1. INTRODUCTION

Modern developments in microelectromechanical methods, wireless communications, and digital electronics led to introduction of wireless sensor networks (WSN). Consisting of a great amount of various sensors able to store, identify and distribute detailed data. Only one clientwith a sensor can have restricted computing and communication capabilities only; however, when properly designed, WSN nodes that co-operatively perform signal processing tasks to acquire information about remote areas that are potentially hazardous in an unmanaged and reliable manner. Wireless sensor networking uses include battlefield tracking, biological detection, environmental monitoring, industrial diagnostics, smart spaces [1]-[3]. Usually, a web of the monitoring system (WSN) is made up for transmitting system suite (Bull shit). Since WSN is powered by batteries, the replacement of batteries any breath, so to speak for some time, so power usage is also one of the big problems require additional treatment. Therefore, efficient energy consumption mechanisms are required processes, collection, calculation [4]-[6]. WSNs defines essentially two kinds of environments: homogeneous and heterogeneous. Several protocols were developed for homogeneous environments but in heterogeneous environments, the considered. network prolongation strategies were designed to concentrate on racially homogenous sensor nodes, and all network are similar nature. A ongoing progress in processor miniaturization and power saving telecommunications in conjunction with massive detectors has allowed a wide range of nodes to be developed [7], [8]. WSN has features which distinguish it from other network types. One, for example, network stability is related to the nodes' energy supply, and those networks' critical. WSN applications can usually be classified public groups: tracking and monitoring [9]-[11]. In WSN the network is divided into several clusters where the cluster header acts as a point of aggregation to aggregate all collected data into. It decreases the size of information sent from the bloc to the base station, which needs fewer power, and clustering strategies have also proposed addressing the problem of unequal energy usage in WSN networks [12]-[15]. The multiple-to-one traffic pattern is prevalent in conventional sensor networks which means that a will transmit facts tothe tub. The senstive nodes close tothe tub, therefore, bear a quite heavy traffic load energy. Service life of these critical nodes decreases the lifetime of the sensor network considerably. However, there is another issue with disproportionate energy consumption (UEC) headers. The nodes are close to the top node of the cluster are called critical nodes. Any transition from a cluster node to a cluster header those new jump essential tracks. A main nodes, therefore, bear the brunt of data transmission from all nodes within the cluster. Since the cluster's a, their resources will run out more quickly than other nodes. If vital nodes exhaust their resources and become unavailable the other nodes are unable to send the packets to the party leader, and the whole mass is inaccessible even if the residual very small as low energy adaptive clustering hierarchy (LEACH) [16]. Guided towards choosing a optimalisation numberic ofthe cleaster head. We're in this article suggest using a low energy adaptive clustering hierarchy cluster method to group homogeneous sensor nodes according to the theory. A key approach know what their what to. Low energy adaptive clustering hierarchy protocol (fuzzy-cluster) subsequently suggested to solve the homogeneous hand, weare suggest approach ant colony (ACO) homogeneous WSN networks, both within and within the cluster. Fuzzy low energy adaptive clustering hierarchy (FLEACH-ACO) for homogeneous WSN for solving the, and optimizing networks life.

A remainder the paper is structured as following. Following works are discussed in section 2. Sections 3 and 4 present the proposed system parameters FLEACH-ACORM. Section 5 describes the evaluation of performance. Finally, in the segment, concluding and addressing 6.

2. RELATED WORKS

The Zytoune and Aboutajdine [17] Unified was implemented for select energy was above a certain threshold, such as other node routers in each transport load and distribution of energy load between each sensor to maximize the network's overall lifespan. Lu and Wong [18] Suggested protocol for energy-efficient multitrack routing (EEMRP). This has the ability to scan multiple paths of disassembled nodes and uses a method of load-balancing to map traffic through each path. In the link cost function remaining the jumps taken into consideration. Computer intelligence (CI) models were extensively used in the face of various challenges: energy-efficient routing to extend network life. According to the concept of computational intelligence, several routing protocol methods are proposed for WSN networks. Park *et al.* [19] Presented a new high-weight genetic algorithm (GA) routing protocol. Sensor nodes are thus familiar with data traffic levels to track network crowding. The authors introduced new algorithms for packet routing in WSN networks using fuzzy logic (FL) of the redirect optimize a service life of the sensor networks [20]-[22]. Rana and Zaveri [23] the find the optimum, the minimum energy level for the sensor node is fixed such that the sensor node is not involved in the routing if the remaining energy level exceeds that minimum fixed energy level. An was used for propose new methods in order minimal grid [24], [25]. Wang *et al.* [26] A biogeography-based optimization algorithm (BBO) has been applied to resolve the complex deployment issue in WSNs including fixed and mobile binary-detection sensor nodes.

3. RESEARCH METHODS

Each round, the formation of cluster heads requires some time and effort. For optimal data transmission energy use, the stable communication phase must last longer than the cluster head setup duration. It takes too long during the communication phase, which makes it difficult for other nodes to communicate with the BS. Because CH burns more energy, it does so quickly. Figure 1 outlines the stages of the research study. Firstly involves the creation of a network structure that minimizes the depletion of energy using FLEACH-ACORM.

3.1. Implementation of LEACH protocol

By selecting cluster head nodes at random in a loop, the LEACH routing protocol equalizes network energy consumption but introduces the flaw of unstable network functioning. Therefore, it is required to decrease the energy consumption of data transmission in the routing protocol and increase the network life cycle in order to tackle this issue. There is still a solution needed for the issue of cluster heads counting with a broad range and using a lot of power when sending data in the LEACH. Figure 2 shows a typical clustered WSN implementation shown in diagram, nodes are in field sense in layer 1 (normal nodes), generate it the related transferr it to BS in multiple jump approach after performing certain operations such as collecting/fusion. Ultimately the user receives data online from the BS.

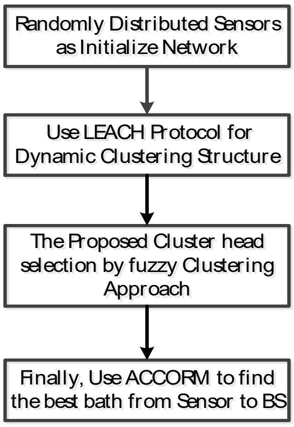

Figure 1. General framework for proposed transmission algorithm

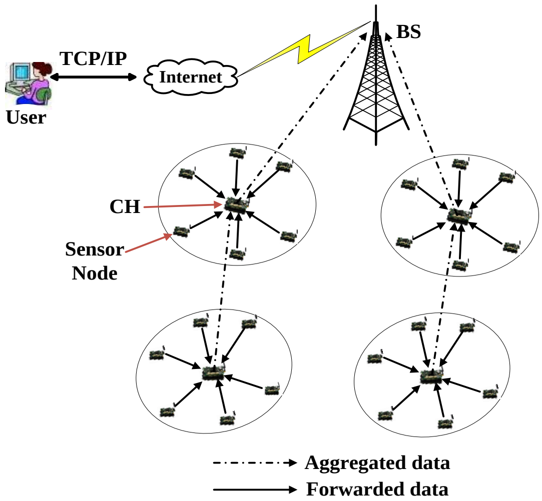

Figure 2. Network clastering

3.1.1. Network model

To discover a sensor network, we made up of N sensor nodes dispersed across a broad expanse to track the surroundings continually. We make some presumptions for WSN about sensor nodes and the fundamental network model:

- The sensor nodes are randomly placed.
- All of the sensor nodes and the base station are fixed after deployment.
- The distance between a node and its receiving nodes can be used to adjust a node's transmit power.
- determined based frequency of the received signal. Then the sensor does not have to be kept to know its exact location.
- All sensors have the same amount of energy when first deployed.
- The node should field.
- All node must be identical.

3.1.2. Modeling energy consumption

For realism, a first-class in LEACH [16]. Both (d^2power loss) and (d^4 power loss) Models are employed, building on the transmitter-receiver distance. Energy consumption per-packet transfer at distance d, with k bits. E for a transmit. A quantities are EF and EM according to the distance D obtained from the (1) and (2) hereinafter.

$$E_n\,T(k) = \begin{cases} k \times \left(E_{elec} + E_{fs} \times d^2\right), if\ d \leq d_0 \\ k \times \left(E_{elec} + E_{fs} \times d^4\right), if\ d > d_0 \end{cases} \tag{1}$$

$$d_0 = \sqrt{\frac{E_{fs}}{E_{mp}}} \tag{2}$$

In (10) calculates consumed with k bits.

$$E_n\,R(k) = k \times E_{elec} \tag{3}$$

Figure 3 and Table 1 give specifics on the characteristics.

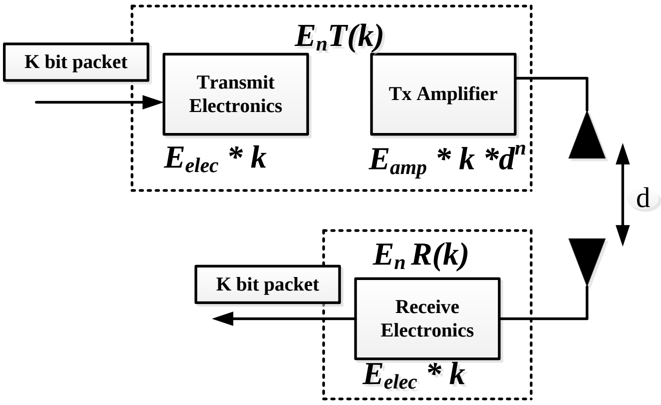

Figure 3. First-order model radio

Table 1. The initial radio model's parameters

Parameter	Value
E_{elec}	$50\ nJ$
E_{fs}	$10\ pJ/bit/m^2$
E_{mp}	$0.0013 pJ/bit/m^4$

3.2. Fuzzy clustering method implementation

We concentrate on this section on illustrating the primary objective of the fuzzy approach to the LEACH protocol. The fuzzy-cluster method is used to optimize node value for a cluster header. That is dependent on the RE energy remaining and the distance between the nodes to base station D (node-BS), as described in Figure 4.

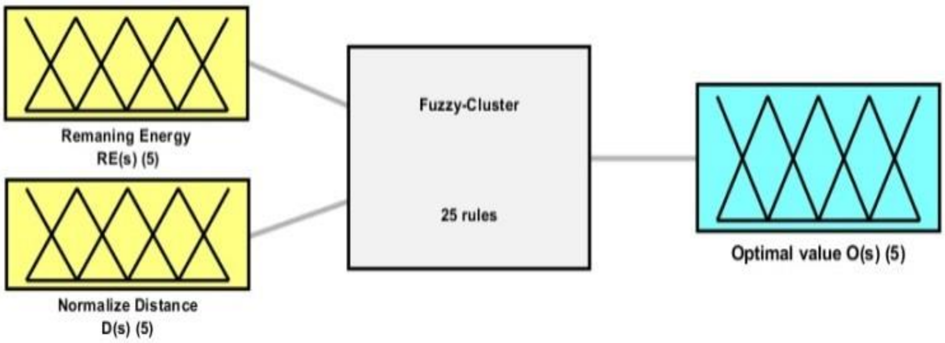

Figure 4. Fuzzy structure with two inputs and one output of optimal value O(s) of CH

The inputs (RE), distance (node to BS), (Optimal value O(s), as in Figure 5, fuzzy membership has five membership functions. [0…10], [0…1], and [0…1] respectively. The knowledge engineer manages the inner product for the fuzzy approach, which consists of a decision table and various techniques for the rules being inferred. Table 2 displays the IF-THEN rules used within the suggested technique, with at least $5^2 = 25$ for the fuzzy law basis. For example, distance to the BS is Optimal. A suspect inference engine treats all these rules in a parallel way by (4).

$$O(s) = (\sum_{k=1}^{n} U_k * C_k)/\sum_{k=1}^{n} U_k \quad (4)$$

Where U_k is the output of rule base, and C_k the output membership function's focal point.

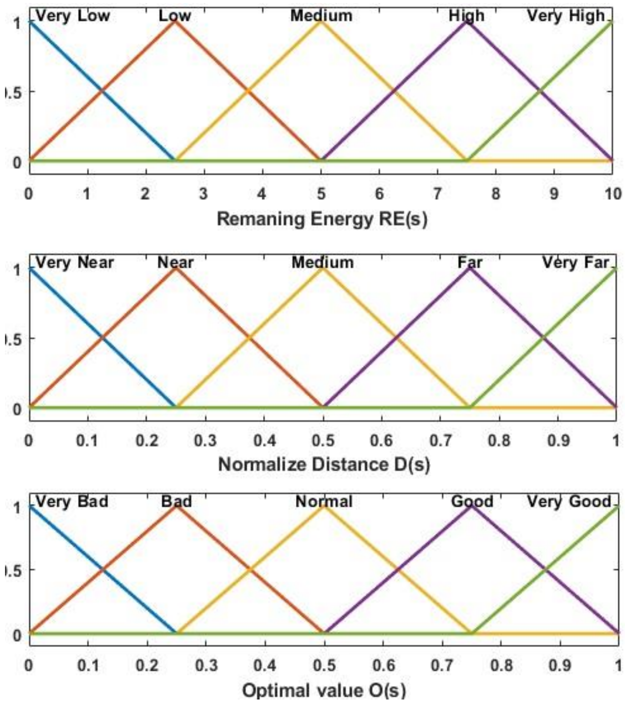

Figure 5. Membership graph for two (RE), (Node-BS) (Optimal O(s))

Table 2. IF-THEN rules

RE (S) / *D(S)*	V. Low	Low	Meduim	High	V. High
V. Near	Normal	Good	Good	V. Good	V. Good
Near	Bad	Normal	Good	V. Good	V. Good
Normal	V. Bad	Bad	Normal	Good	Good
Far	V. Bad	V. Bad	Bad	Normal	Normal
V. Far	V. Bad	V. Bad	Bad	Bad	Bad

3.2. Ant colony optimization implementation (ACORM)

Unbalanced energy utilization in WSNs with multi-hop routing and a many-to-one traffic pattern is a problem. A routing algorithm typically selects the best route for data transfer from source to destination. The node on this channel may quickly run out of battery power if such a method is also employed for connections over time to achieve fast data transmission latency. In order to find the optimum path for homogeneous WSNs, we therefore apply the ACO algorithm in this work. ACORM looks for the best routing route through the CH. In both of the forwarding paths, it chooses the top node from potential nodes (neighbors) (i) by preferring sensor nodes with the maximum remaining energy and locations that are close to each other (with the fewest possible hops) and (ii) by favoring the CH with the highest remaining energy and the closest location to the sink. As far as ACORM is concerned, a tree structure (S,F), where F is the fitness function and S is the collection of potential forwarding path nodes. This provides each potential node s with a fitness value f(s). Based on node S's remaining energy and the distance between it and the sink, the fitness value f(s) is calculated. The best candidate node in the forwarding path to the sink will be chosen based on its level of remaining energy and proximity to the sink. Given by (3), is the fitness function f(s) that we utilized.

$$f(s) = \propto * RE(s) + \frac{1}{\beta * MH(s)} \tag{3}$$

where MH(s) is the distance from node s (minimum number of hops) to the destination and RE(s) is the amount of energy that is still in node s, and $\propto, \beta$ are constant values ($\propto = 0.1$ and $\beta = 0.16$Each employed ant in ACO is nominated to one of the candidate nodes in ACORM because each node it represents in the subsequent path is chosen as the next hops (neighbors) of the source. All active ants calculate the fitness functions of their nodes and communicate this data to their neighbors. Figure 6 displays the flow chart for the suggested approach FLEACH-ACORM.

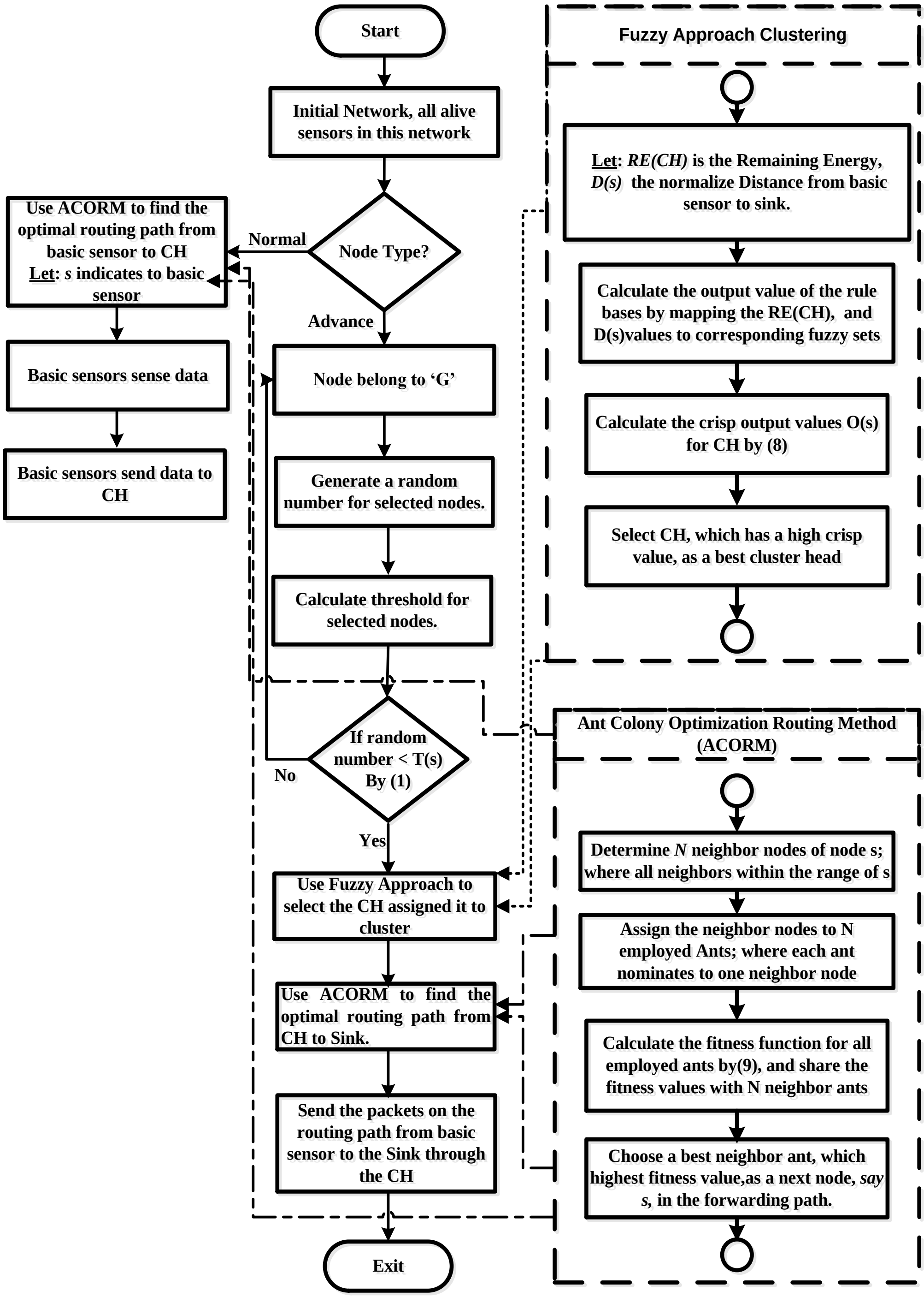

Figure 6. Diagram of FLEACH-ACO protocol routing method

4. SIMULATION PERFORMANCE EVALUATION

4.1. Simulation setup

The stepe are conducted in MATLAB. This scenario assumes that randomly 100 senstve knot are deplooed in the scenario space (= 3, P=0.2,m=0.3). When /m is the values is constant of the node heterogeneity as advancedeg, too P is an optimalation choice of a cluster. This scenario is spread over the topographic area of 100 m/100 m. For this scenario, the maximum sensed transmission is 30 m. It tests the performance of the proposed method in this scenario. Just one data sink. Everything is equal. Carried out for 2000 rounds. For dissipating energy from radio-hardware as shown in Figure 3. The system parameters are detailed in Table 3.

Table 3. Simulation parameters

Parameter		Value
Topographical Area (meters)		$(100\text{m} \times 100\text{m})$
Sink location (meters)		$(50\text{m} \times 50\text{m})$
Scenario	$\propto$	3
	P	0.2
	m	0.3
Number of nodes		100
Limit of transmission distance (meters)		30m
Initial energy of node		0.5J
Packet data size		4×10^3bits
No. of transmission packets (rounds)		2×10^3

5. RESULT OF SIMULATION

Figure 7 demonstrates round the three separate methods (LEACH, PEGASIS, and proposed method) for the area scenario. It can be shown that, in the situation, the proposed approach outperforms FL every-ACO protocol. Once reached by the suggested approach increased by approximately 28.5% and 19.8%, respectively, relative to that obtained by LEACH and power-efficient sensor information systems (PEGASIS) protocols. It can also be used in protocols Figure 7 and PEGASIS. Table 4 lists the specific time period in the region scenario correspooonding to the once dead kont measured by ues the three differentce aprepoosed.

By Figure 7 and Table 4, the proposed approach clearly outperforms FLEACH-ACO Protocol on energy consumption management and the optimization of network life. Figure 8 indicates the average residual is the protocols (PEGASIS and LEACH), as the number of rounds in the area scenario increases. This means the solution suggested achieves stronger energy equilibrium in a WSN.

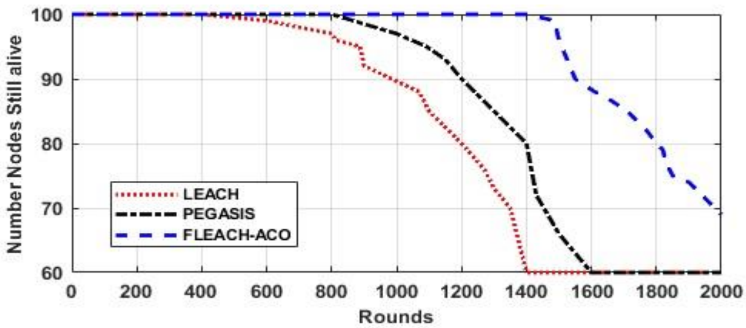

Figure 7. Number of alive nodes (LEACH, PEGASIS and suggested)

Table 4. Number of turns with the one node dead

Approaches	LEACH	PEGASIS	Proposed
The First Lifetime Node dead (Rounds)	441	813	1443

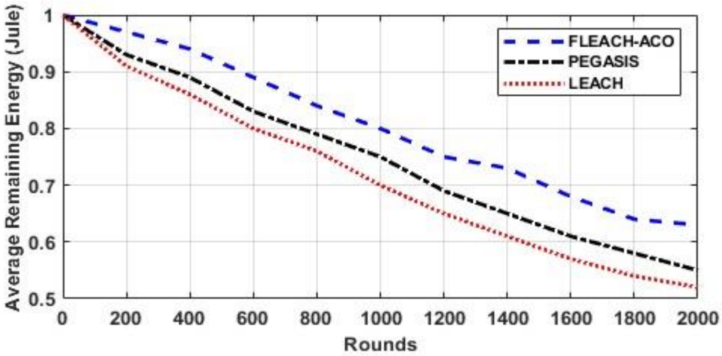

Figure 8. Average remaining energy as a function of transmission round based on different approaches (LEACH, PEGASIS, and proposed)

Also the delay in data packet transmission is a key parameter for some applications. Figure 9 indicates contrast of three different methods. The proposed solution has the smallest delay when compared to LEACH and PEGASIS, it can be demonstrated (particularly safe and meaningful) information transfer. across multiple disjunct minimize lifespan.

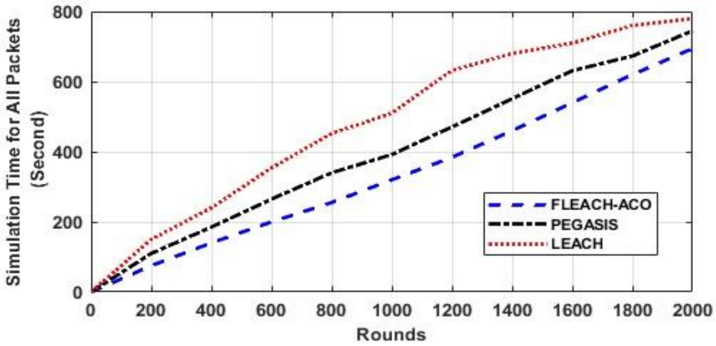

Figure 9. Data transfer a result the specific approach transfer round (PEGASIS and LEACH)

6. CONCLUSION

The network load balance needed to LEACH in WSNs is improved energy efficiency, In this research, we have suggested a novel FLEACH-ACO-based clustering scheme. Based on the amount of energy left, the distance from other nodes to the cluster head, and the distance from the cluster head to the base station, each node calculates its fitness value to become a candidate for the cluster head. The effectiveness of the suggested strategy is assessed using the same standards and contrasted with LEACH, PEGASIS. Simulation results show that the novel strategy is effective at lengthening the lifespan of wireless sensor networks with nodes spread out randomly.

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BIOGRAPHIES OF AUTHORS

Shaimaa Hadi was born in Thi-Qar city, Iraq, in 1984. She received the B.Cs degree from Thi-Qar University, in Computer Science, in 2006. She holds a M.Sc. degree in computer engineering from the University of Thi-Qar, Iraq, in 2018. She is currently working lecturer in the Department of Computer Science, College of Computer Science and Information Technology, Sumer University, Iraq. Her research interest is in Image Processing and Information Security, artificial intelligence, deep learning, cloud computing and Computer Security, Wireless sensor networks. She can be contacted at email: shsumer@yahoo.com, shma1910@gmail.com.

Hayder Rahm Dakheel hayder, received the M.Sc. degree in computer engineering from the University of atilim, Turkey in 2015, the B.Sc. degree from the university of middle technical, Iraq in 2004, His main research interest is in Image Processing and Information Security, cloud computing and Computer Security, He is currently working in the Postgraduate Department at Sumer University. He can be contacted at email: haiderrahm@uos.edu.iq.

Atyaf Jarullah Yaseen was born in Thi-Qar city, Iraq, in 1982. She received the B.Cs degree from Thi-Qar University, in Computer Science, in 2005. She holds a M.Sc. degree in computer engineering from the University of Thi-Qar, Iraq, in 2017,She is currently working lecturer in the Department of Computer Science, College of Computer Science and Information Technology, Thi-Qar University, Iraq. Her research interest is in expert system, artificial intelligence, Wireless sensor networks and machine learning. She can be contacted at email: atyafjarallah82@utq.edu.iq and atyafjarallah82@gmail.com.