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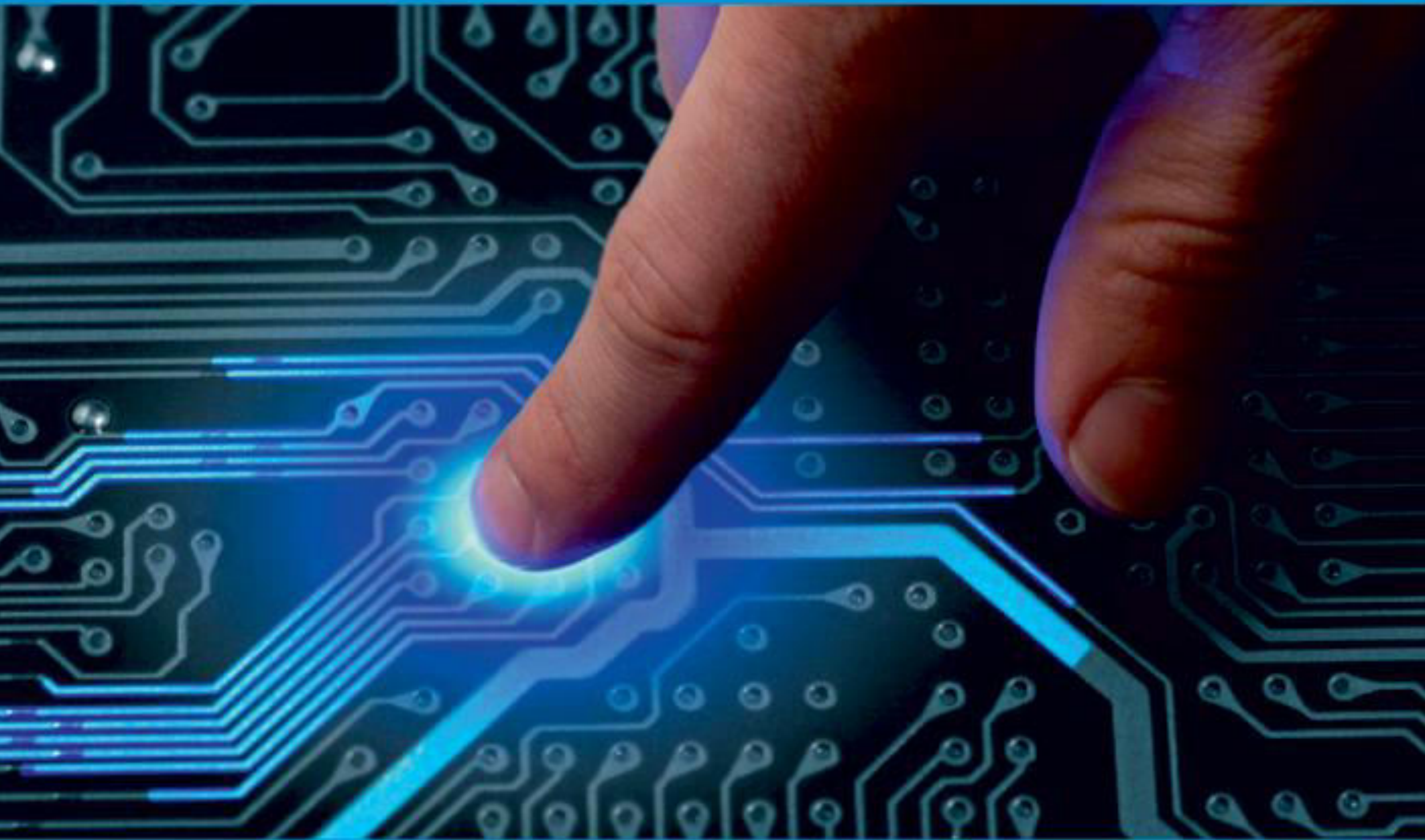

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Energy-Efficient Cluster Head Selection and Increasing Node Lifespan in Wireless Sensor Networks

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ABSTRACT: This project aims to enhance the energy efficiency of the Wireless Sensor Networks (WSNs) through the development and implementation of the “Energy-Efficient Cluster Head Selection in Wireless Sensor Networks and increasing Node Lifespan” protocol. By this protocol selecting a cluster head in a Wireless Sensor Network (WSN) based on dynamic parameters such as time since last cluster head and highest battery power of the node. The system initializes a set of nodes with random values for these parameters and then calculates a score for each node using a weighted combination of these factors. The node with the highest score is chosen as the cluster head. Introduces a customizable clustering algorithm, addressing energy consumption imbalances among sensor nodes. The protocol's adaptability to dynamic network conditions contributes to prolonged network lifetime. Performance evaluations and comparisons with existing protocols and validate theeffectiveness of the new protocol.

KEYWORDS: Energy-Efficient Algorithm; WSN; Cluster Head Selection Process; Node Network Life Time.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have emerged as a cornerstone technology in various applications such as environmental monitoring, healthcare, and smart cities. These networks consist of numerous sensor nodes, typically battery-powered and equipped with limited computational and communication capabilities. As a result, optimizing energy consumption within WSNs is paramount to extend their operational lifespan and ensure sustainable functionality. One critical aspect of energy optimization in WSNs is the selection of cluster heads. Cluster heads serve as pivotal nodes responsible for data aggregation, routing, and overall network organization. Efficiently choosing cluster heads is essential to minimize energy expenditure and prolong network longevity. To address this challenge, this project proposes a novel algorithm designed to streamline the selection process of cluster heads in WSNs. The proposed algorithm employs a sophisticated weighted scoring mechanism to evaluate sensor nodes based on predefined criteria. These criteria encompass various factors crucial for effective cluster head selection, including the time since the last cluster head designation and the remaining battery power of each node. By assigning scores to individual nodes based on these criteria, the algorithm aims to identify suitable candidates for cluster head designation, thereby optimizing energy consumption and enhancing network sustainability. However, the effectiveness of the algorithm is not solely dependent on static criteria; instead, it embraces dynamic considerations to adapt to changing network conditions. Dynamic factors such as network topology, traffic patterns, and environmental influences are integrated into the scoring mechanism to ensure robust decision-making in real-time scenarios. By incorporating real-time data, the algorithm can make informed decisions regarding cluster head selection, thereby maximizing energy efficiency and network performance. In summary, the proposed algorithm for efficient cluster head selection in WSNs represents a significant advancement in optimizing energyconsumption and prolonging network lifespan. Through its innovative approach, dynamic adaptability, and focus on network robustness, the algorithm holds the potential to drive transformative changes in the field of wireless sensor networks, enabling the realization of sustainable and resilient IoT ecosystems.

II. PROBLEM STATEMENT

In the widespread deployment, Wireless Sensor Networks (WSNs) face significant hurdles regarding energy efficiency, directly impacting their operational effectiveness and lifespan. Existing systems for selecting cluster heads in WSNs often lack adaptability to changing network conditions and struggle to addressenergy consumptions among sensor nodes efficiently. Conventional protocols depend on fixed criteria to choose cluster heads, leading to inefficient energy utilization and a reduced network lifespan. Moreover, theseprotocols may not adequately consider variations in node

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battery levels and the duration since the last cluster head selection, leading to inefficient network operation.

III. OBJECTIVE

The main objective is to prolong the overall lifespan of the wireless sensor network by efficiently managing energy resources. Energy-efficient cluster head selection seeks to optimize energy utilization by selecting cluster heads based on factors such as residual energy levels and communication capabilities.

IV. RELATED WORK

[1] the paper likely provides insights into the design, implementation, and evaluation of a modified energy-efficient protocol tailored specifically for addressing dead nodes and energy consumption optimization in wireless sensor networks.

[2] ViTAMin as a novel approach to minimizing energy consumption in WSN routing by establishing a virtual backbone tree structure. It may offer insights into the design, implementation,and evaluation of the algorithm, as well as its potential impact on the field of wireless sensor networks.

[3] The survey analyzes key aspects such as cluster formation, cluster head selection, data aggregation, and routing mechanisms within the LEACH protocol framework.

[4] The algorithm aims to balance energy usage among sensor nodes by selecting optimal relay nodes and paths while considering factors like remaining energy levelsand communication distances.

[5] This approach prolongs network lifetime by balancing energy usage across the network. The paper discusses the design principles and operation of LEACH, highlighting its advantages in terms of energy efficiency and scalability.

[6] The survey covers key aspects such as network topology, energy efficiency, scalability, and fault tolerance, offering insights into the design considerations and performance metrics of different routing protocols. Additionally, the paper discusses emerging trends and challenges in WSN routing research, such as mobility, security, and quality of service (QoS) support.

[7] This research contributes to the development of energy-efficient routing strategies for wireless sensor networks, addressing the critical challenge of energy conservation in resource-constrained environments.

[8] The paper provides a detailed description of the algorithm's design principles and evaluates its performance through simulation studies.

The results demonstrate that the proposed algorithm outperforms traditional cluster head selection methods in terms of energy efficiency and network longevity.

[9] The proposed algorithm improves upon existing methods by considering multiple factors such as residual energy, node proximity to the base station, and communication overhead.

[10] The proposed enhancements focus on optimizing various aspects of the LEACH protocol to improve its energy efficiency and performance. This includes refining the cluster head selection mechanism, enhancing data aggregation techniques, and introducing adaptive adjustments basedon real-time energy monitoring.

[11] The protocol aims to optimize network performance by organizing sensor nodes into clusters and efficiently managing communication and data transmission within these clusters

[12] Paper introduces EA-CRP, a pioneering energy-aware clustering and routing protocol crafted explicitly for wireless sensor networks (WSNs). EA-CRP aims to enhance energy efficiency and extend network longevity by dynamically adapting to fluctuating network conditions and varying energy levels of sensor nodes.

[13] Thealgorithm aims to improve the efficiency of cluster-head selection in WSNs by considering various factors such as node residual energy, distance to the base station, and communication overhead. By incorporating these parameters, the algorithm intelligently selects cluster heads to optimize energy consumption and prolong network lifetime.

[14] The algorithm incorporates fuzzy logic to dynamically adjust cluster formation based on factors such as node proximity, energy levels, and network density.

[15] The paper addresses the crucial issue of energy optimization in WSNs. The authors propose a modified cluster head selection algorithm aimed at prolonging the network lifetime by efficiently managing cluster head assignments. The algorithm incorporates novel criteria for selecting cluster heads, taking into account factors such as node proximity to the base station, residual energy levels, and communication overhead.

[16] I-LEACH optimizes routing by employing an efficient data transmission strategy that minimizes energy consumption while maintaining communication reliability. The algorithm dynamically adjusts routing paths based on factors such as node proximity, traffic load, and energy levels, thereby maximizing network throughput and minimizing energy wastage. Through comprehensive simulations and performance evaluations, the authors demonstrate the effectiveness of I-LEACH in improving network performance and prolonging network lifetime compared to traditional routing algorithms.

[17] The protocol seeks to optimize energy consumption and prolong network lifetime. Murali conducts a thorough analysis, evaluating the performance of the cooperative WSNs in terms of energy efficiency, network coverage, and reliability.

[18] The paper focuses on enhancing the performanceof the LEACH protocol, which is widely used in WSNs for energy-efficient data aggregation and routing. Pengand Li propose modifications to the original LEACH protocol to address its limitations and optimize its effectiveness in various network scenarios.

[19] By incorporating this time-based criterion, the algorithm seeksto distribute the energy consumption more evenly among sensor nodes and prolong the network lifetime. Through simulation studies and performance evaluations, the authors demonstrate the effectiveness of their time-based cluster-head selection algorithm in enhancing the energy efficiency and stability of WSNs using the LEACH protocol.

[20] The study addresses the growing demand for miniaturization and energy efficiency in sensor node design. The authors detail innovative approaches to reduce the size and power consumption of wireless sensor nodes, including the use of ultra-compact components and energy-efficient circuit designs.

V. EXISTING SYSTEM

LEACH (Low Energy Adaptive Clustering Hierarchy): LEACH is one of the pioneering protocols for WSNs. It employs a randomized rotation of cluster heads to distribute energy consumption across nodes, thus extendingnetwork lifetime.
PEGASIS (Power-Efficient Gathering in Sensor Information Systems):
PEGASIS organizes nodes into a chain structure, where each node communicates only with its neighbors. Data is transmitted along the chain, reducing the energy consumption required for long-distance communication.
TEEN (Threshold-sensitive Energy Efficient Sensor Network Protocol) APTEEN (Adaptive Threshold- sensitive Energy Efficient Sensor Network Protocol): These protocols are variations of each other and focus onevent-based sensing in WSNs. They use thresholds to trigger data transmission, allowing nodes to remain in alow-power sleep mode until a certain event or threshold condition is met.

VI. PROPOSED SYSTEM

Our proposed algorithm serves as the foundation of the system, crucial in evaluating the nodes based on predefined criteria such as the time since the last cluster head and battery power. Utilizing a weighted scoring mechanism, the algorithm assigns scores to each node, with higher scores indicating better suitability for cluster head designation.

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Through this process, our algorithm efficiently selects cluster heads, thereby decreasing the energy consumption of every node. As a result, the lifespan of each node is extended, contributing to the overall longevity and sustainability of the network. By this process we could assign the cluster head in efficient manner so that we can decrease the energy consumption of every node and the life time of the node gets increased.

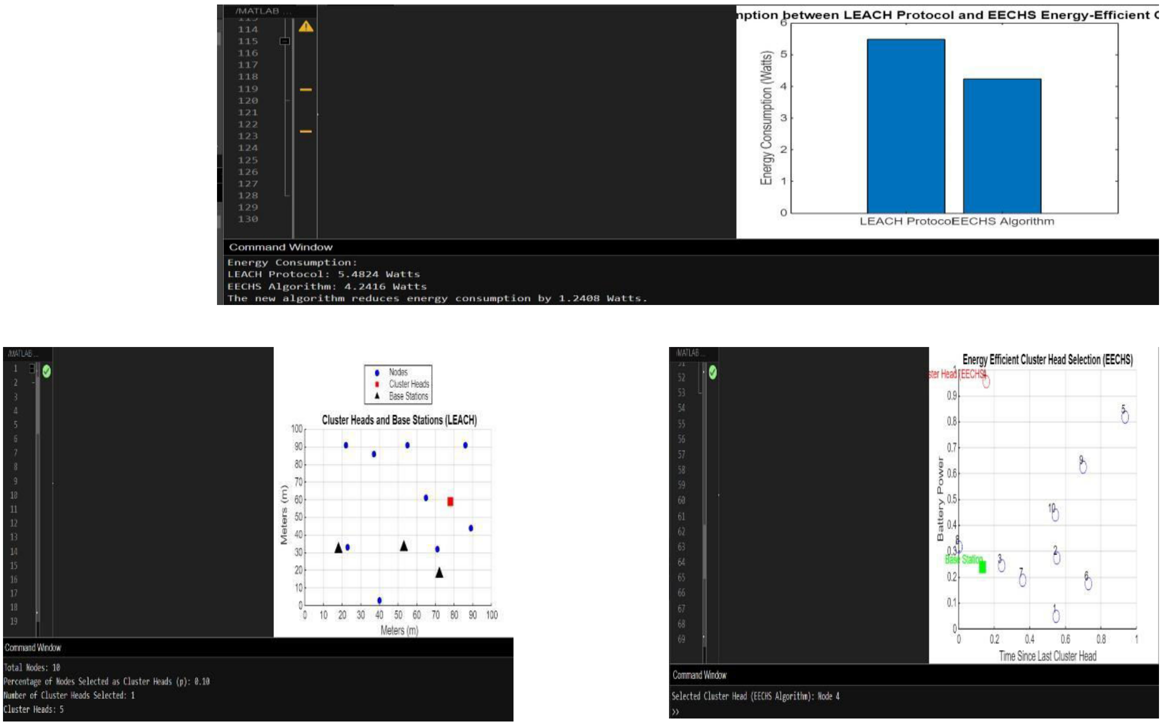
VII. METHODOLOGY

Initialization: Each node in the network is initialized with relevant parameters, including the time since the last cluster head designation and the remaining battery power. Evaluation: Nodes are evaluated based on predefined criteria, such as proximity to other nodes, battery power, and communication history. Weighted Scoring: A weighted scoring mechanism is applied to assign scores to each node, considering the importance of criteria in cluster head selection. Nodes with higher scores are deemed more suitable for cluster head designation. Cluster Head Selection: The algorithm selects cluster heads based on the calculated scores, aiming to optimize energy consumption and network performance.

VIII. RESULTS AND DISCUSSION

energy-efficient cluster head selection using the EECHS algorithm. Initially, it initializes a network of nodes, each assigned random values for attributes such as 'time_since_last_ch' and 'battery_power'. Subsequently, it calculates an EECHS score for each node based on these attributes and selects the node with the highest score as the cluster head. The code also plots a scatter graph representing nodes' attributes, with the selected cluster head highlighted. Additionally, it prints the index of the selected cluster head. Overall, the code facilitates efficient organization of nodes into clusters, crucial for optimizing wireless sensor network performance.

8.1 Cluster Head Selection:
Cluster head selection is a critical task in wireless sensor networks (WSNs) and other distributed systems where nodes are organized into clusters to improve efficiency and scalability. The selection process aims to choose suitable nodes within the network to act as cluster heads, which coordinate communication and data aggregation among cluster members.



Cluster Head Selection for LEACH Protocol

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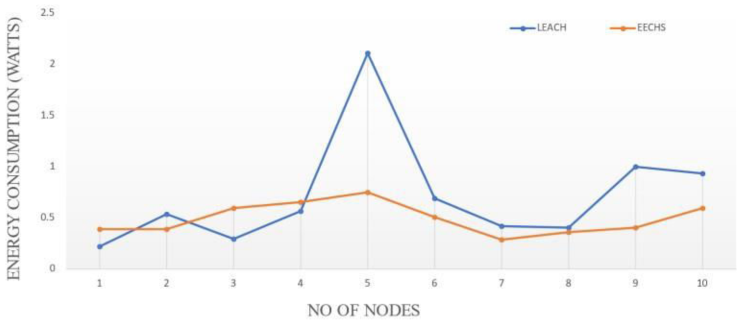
Energy Efficient Cluster Head Selection(EECHS) Protocol

8.2 Energy Consumption:

Energy consumption in wireless sensor networks (WSNs) is crucial due to limited node resources. Keyfactors include transmission, reception, idle, processing, and sensing energy. Optimizing data aggregation, sleep scheduling, and routing reduces energy usage. Duty cycling and hardware optimization further enhance efficiency. Efficient management prolongs network lifetime and ensures reliability.

LEACH	EECHS
0.2208	0.3884
0.5368	0.3898
0.2931	0.5912
0.561	0.6507
2.11	0.7454
0.686	0.5046
0.4176	0.2822
0.4015	0.3561
0.9964	0.3999
0.9341	0.5924



Energy Consumption Of LEACH and EECHS Protocol

Comparison of Energy Consumption for LEACH and EECHS Protocol

8.3 Average packet loss ratio:

The average packet loss ratio in a network measures the proportion of packets lost during transmission.It is calculated by dividing the total number of lost packets by the total number of packets transmitted, averagedover a specific time period. Packet loss can occur due to various factors such as network congestion, collisions,errors, or link failures. Minimizing packet loss is crucial for maintaining data integrity and network performance. Effective error detection, retransmission mechanisms, congestion control, and quality of service(QoS) strategies help mitigate packet loss and ensure reliable data delivery in communication networks.

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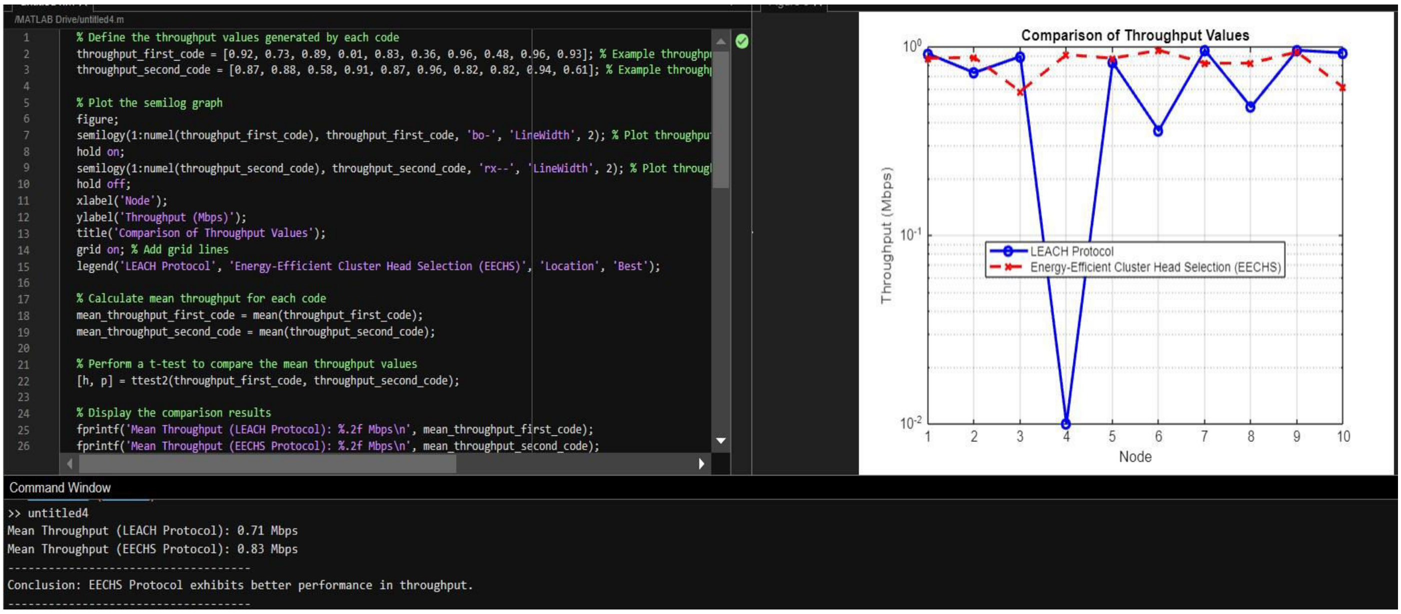
8.4 Throughput:

Throughput in a network refers to the rate at which data is successfully transmitted from source to destination over a communication link or network. It is typically measured in bits per second (bps), kilobits per second (kbps), or megabits per second (Mbps). Throughput is influenced by factors such as bandwidth, latency, packet loss, and network congestion. Higher throughput indicates better network performance and efficiency. Maximizing throughput involves optimizing network resources, minimizing latency, managing congestion, and employing efficient protocols for data transmission. It is a key metric for evaluating the overallperformance and capacity of communication networks.

Comparison of Packet Loss Ratio between LEACH Protocol and EECHS Protocol



Comparison of Throughput for LEACH Protocol and EECHS Protocol

8.5 Delay Time:

Delay time in networking encompasses propagation, transmission, processing, and queueing delays. It represents the time for a packet to traverse from source to destination. Propagation delay is influenced by distance and medium speed, while transmission delay depends on packet size and link data rate. Processing delay occurs as routers examine packet headers, and queueing delay arises from packet queuing. Minimizing delay is crucial for efficient network performance, especially in real-time applications like VoIP or video streaming. Optimizing network infrastructure and protocols helps reduce delay, ensuring timely and reliable data transmission.

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Delay Time for LEACH Protocol

Delay Time for EECHS Protocol

IX. CONCLUSION AND FUTURE WORK

In conclusion, the proposed algorithm offers an effective solution for cluster head selection in WSNs, contributing to energy optimization and network longevity. By considering predefined criteria and employing a weighted scoring mechanism, the algorithm achieves efficient cluster head selection, thereby improving the overall performance and sustainability of WSNs. By improving energy efficiency and prolonging node lifespan, this algorithm lays the foundation for the development of robust and resilient WSNs capable of supporting a wide range of applications in various domains.

Future work for this project could involve refining the clustering algorithm to accommodate diverse network topologies and environmental conditions, such as varying node densities and mobility patterns. Additionally, exploring machine learning techniques to predict optimal cluster head selection based on historical data and real-time network dynamics could further enhance energy efficiency. Integration of energy harvesting mechanisms and advanced power management strategies can be investigated to extend node lifespan.

REFERENCES

1.Pallavi Yarde, Sumit Srivastava, Kumkum Garg, “A modified energy efficient protocol for optimization of dead nodes and energy consumption in wireless sensor networks”, 2017 Eleventh International Conference on Sensing Technology (ICST) DOI: 10.1109/ICST41122.2017 4-6 Dec. 2017

2.Jaekwang Kim, Jee-Hyong Lee, “ViTAMin: A Virtual Backbone Tree Algorithm for Minimal energy consumption in wireless sensor network routing”, 2023 International Conference on Information Networking (ICOIN) DOI: 10.1109/ICOIN56518.2023

3.Braman Alakesh and G. R. Umapathi, "A comparative study on advances in LEACH routing protocol for wireless sensor networks: A survey", International journal of advanced research in Computer and Communication Engineering, vol. 3.2, pp. 5683-90, 2014.

4.J. Kim, K. Yoon, S. Lee, J. Jung, J.-H. Lee, “An m-EVBT algorithm for energy efficient routing in wireless sensor networks,” in the Proc. of Int. Conference on Ubiquitous Information Management and Communication, pp. 636-641,

2009.
5.M.J. Handy, M. Haase, D. Timmermann, "Low energy adaptive clustering hierarchy with deterministic cluster-head selection," in the Proc. of 4th Int. Workshop on Mobile and Wireless Communications Network, pp. 368-372, 2002.
6.Akkaya, Kemal, and Mohamed Younis. "A survey on routing protocols for wireless sensor networks." Ad hoc networks 3.3 (2005): 325-349.
7.M. Younis, M. Youssef, K. Arisha, Energy-aware routing in cluster-based sensor networks, in: Proceedings of the 10th IEEE/ACM International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS2002), Fort Worth, TX, October 2002.
8.Al-Baz Ahmed and El-Sayed. Ayman, "A new algorithm for cluster head selection in LEACH protocol for wireless sensor networks", International journal of communication systems, vol. 31, no. 1, pp. e3407, 2018.
9.Khalid A. Darabkh and Jumana N. Zomot, "An improved cluster head selection algorithm for wireless sensor networks", 2018 14th International Wireless Communications and Mobile Computing Conference (IWCMC), 2018.
10.ohammad Shurman, Noor Awad, Mamoun F. Al-Mistarihi and Khalid A. Darabkh, "LEACH Enhancements for Wireless Sensor Networks Based on Energy Model", Proceedings of the 2014 IEEE International Multi-Conference on Systems Signals Conference on Communication Processing, pp. 1- 4, February 2014
11.Khalid A. Darabkh, Wala'a S. Al-Rawashdeh, Mohammed Hawa, Ramzi Saifan and Ala' F. Khalifeh, "A Novel Clustering Protocol for Wireless Sensor Networks", Proceedings of 2017 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET 2017), March 2017.
12.Khalid A. Darabkh, Noor J. Al-Maaitah, Iyad F. Jafar and Ala' F. Khalifeh, "EA-CRP: A Novel Energy- aware Clustering and Routing Protocol in Wireless Sensor Networks", Computers and Electrical Engineering, 2017, [online] Available: https://doi.org/10.1016/j.compeleceng.2017.11.017
13.L. Zhao, S. Qu and Y Yi, "A modified cluster-head selection algorithm in wireless sensor networks based on LEACH", J Wireless Com Network, vol. 2018, pp. 287, 2018.
14.P. Nayak, A. Devulapalli, A fuzzy logic-based clustering algorithm for WSN to extend the network lifetime. IEEE Sensors J. 16(1), 137–144 (2016)
15.P. Satyanarayana, Gokul Sriram Guptha Maremalla, G. Phanindra, A. CH. R. R. Devi, K. Anantha Rajya Lakshmi, Yadavalli S S Sriramam"Enhancement of Network Lifetime in Wireless Sensor Networks Using Modified Cluster Head Selection Algorithm" 2023 9th International Conference on Advanced Computing and Communication Systems DOI: 10.1109/ICACCS57279.2023.10112754 (ICACCS)
16.Z. Beiranvand, A. Patooghy and M. Fazeli, "I-LEACH: An efficient routing algorithm to improve performance amp; to reduce energy consumption in Wireless Sensor Networks", 2013 5th Conference on Information and Knowledge Technology (IKT), pp. 13-18, 2013.
17.V. Murali, "Analysis of energy efficient LEACH-based cooperative wireless sensor network" in, New Delhi, India:Springer, 2016.
18.Z. Peng and X. Li, "The improvement and simulation of LEACH protocol for WSNs", 2010 IEEE International Conference on Software Engineering and Service Sciences, pp. 500-503, 2010.
19.H. Junping, J. Yuhui and D. Liang, "A Time-based Cluster-Head Selection Algorithm for LEACH", IEEE Symposium on Computers and Communications ISCC 2008, pp. 1172-1176, 2008.
20.J. Lu, H. Okada, T. Itoh, T. Harada and R. Maeda, "Toward the world smallest wireless sensor nodes with ultralow power consumption", IEEE Sensors J., vol. 14, no. 6, pp. 2035-2041, Jun. 2014.

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