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Enhancing Lifetime of Wireless Sensor Networks: A Review

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***Abstract*—**Low Energy Adaptive Clustering Hierarchy (LEACH) is a network of wireless sensors made up of tiny sensor nodes that are capable of sensing, processing, and transmitting information and feedback. These sensor nodes are distributed at random in a sensing environment or sensor field to sense real-world phenomena like heat, moisture, humidity, sound, vibration, etc., and then aggregate and send to the base station (BS). The significance of energy energy-effective routing algorithm has risen, since the energy constrain is the major factor affecting sensor nodes. To control and manage the energy consumption of sensor nodes, a significant number of techniques have been proposed by various scholars. This review paper presents published works that have been proposed for increasing the lifespan of wireless networks at the very beginning of this paper, a brief overview of Wireless networks, its architecture working and the problems associated with it are discussed. After the detailed overview of the approaches that have been presented for overcoming various limitations of current wireless systems. Lastly, in the conclusion of this paper the reviewed results were compared with earlier techniques, the results thus far show a notable improvement in the node mortality rate and network lifetime.

Keywords/Index Terms— Base Station, Cluster-head, Sensor Node WSNs, LEACH. Wireless sensor network, Network Lifespan

1. Introduction

The WSN is a collection of sensor nodes that are linked to each other wirelessly; these interlinked nodes gather information or data about the field surrounded by wireless communication. Each sensor nodes have low residual energy and are split in an ad-hoc decentralized manner. As the wireless sensor network is an infrastructure-less connection and this connection is also expanded in many wireless sensor networks in ad-hoc method, this structure of the wireless sensor network is used to sense the real-world conditions of the intelligent interconnection systems (El Houssaini et al, 2014). For sensing the network, the wireless sensor networks are capable of both environmental conditions and physical quantity, the wireless sensor network possesses the capability to process the data locally, work supportively, and communicate intelligently. To appreciate the working principle of the WSN, see Figure 1. WSN has three main elements, sensing unit, computation unit, and transmission unit. The workings of these three units are as follows:

1.1 Sensing unit: - In the sensing unit an analog signal is produced by sensing the physical phenomena like heat, temperature, and humidity to the ADC to convert the analog into digital data, and then transferred to the computation unit for further processing.

1.2 Computation unit: - The computational unit's task is to calculate and make decisions of the data from the sensing unit, it manages the data, communicates, and performs self-organization on the given instructions. The computation unit is made up of a microprocessor chip, memory for the saving of the program codes, an embedded timer, and active temporary memory for saving the sensed information.

1.3 Transmission unit: - This unit is assigned for the rest of the duties like sending and reception of data within sensor nodes, and to the base station; these functions are performed by the transmitter/receiver circuitry.

The wireless sensor network uses the base station as a midway interface between the network and the operator. The operator can get the needed feedback from the network, the user needs to fire a demand on the system and gather the outcomes that were found by the base station. Essentially, the WSN is made up of a collection of more than hundreds of sensor nodes (Maraiya et al, 2011). By the use of wireless signals, the sensor nodes communicate between themselves. There are four basic mechanisms used by wireless sensor networks, these are: - energy, sensing and processing devices, and transmitter/receiver. The wireless sensor networks nodes which are self-inherit the limitations of the resources. The limitations of the sensor nodes are: - processing speed, memory storage capacity, communication frequency band, or bandwidth. The wireless sensor network is liable for a suitable self-ordered infrastructure having inter-communication bandwidth (Matin & Islam, 2012).

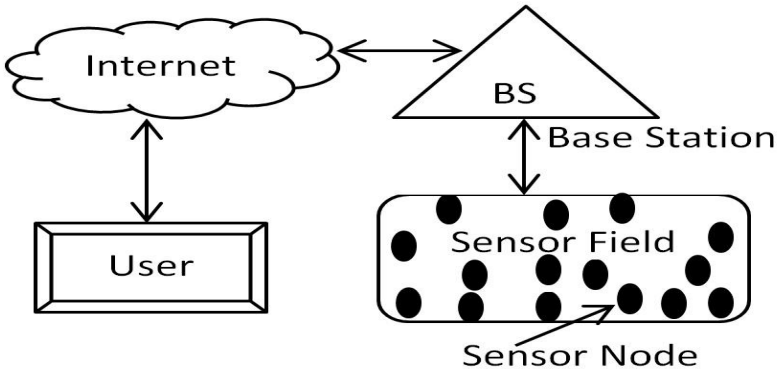

Figure 1: General structure of WSN

The sensor nodes that exist on they start sensing the data available. The requests that are directed from the base station to the wireless networks are answered by WSN to outperform the detecting samples or any precise instruction. The WSN is a combination or collection of separate sensor nodes within the network, For any small sensor set-up the concept of single-hop communication works as the sensor nodes are located near the sink and do not have any requirements to connect indirectly with each other, however on the other hand in many of the WSN applications where the coverage area of large and the sensor nodes are located distant away from each other and sink. There is a need for multi-hop communication for information sharing and communication (Maraiya et al, 2011). The transmission methods are known by many names: single-hop transmission as direct transmission and multi-hop as indirect transmission respectively. At very recognized and widespread selection zones, the applications of the sensor networks are applicable. These areas include but are limited to military applications, medical, community safety, observation, environmental checks, and commercial applications. All these sectors surround and track the advancement of microcontroller technology, wireless communication, and the improvement of computers. As the request of the WSN increased data traffic increased numerous complications in the WSNs. The main aim of the problem was the node-by-node transmission by the base station to the sensor nodes and the limited remaining power for the cluster head. As a consequence of this challenge, the network is affected by the energy limitations and hot spots which thus resulted in the jamming and network allocations.

As the sensor nodes are battery power-driven, it comes to be the main challenge for the working period due to its limited lifespan. Two issues that become a challenge are the difficulty is battery replacement and recharging (Felicia et al, 2018). The first reason was the price, which is increasing for the upkeep of the

nodes for a huge quantity which is usually deployed over a large area. Another reason was that the unreachable node which is deployed in areas like volcanoes, and polluted areas, is embedded in construction materials and deployed in unfriendly for the army applications. The coverage and the interconnectivity problem increase by certain nodes are weakening, leading to separating from the network or leaving a part of the sensor field. To overcome these challenges many algorithms were presented. The presented protocols assist in increasing the lifespan of a sensor node. Among many of the developed algorithms, one is routing protocol which assists in increasing the lifespan of the wireless network. To accomplish the ultimate power efficiency and increase the overall network lifespan the routing protocols were demonstrated to be much extra effective and efficient. The core target of scholars is designing such a power-effective routing algorithm in WSNs, through which the lifespan of WSNs would increase. Various types of procedures like flat, location-based clustering, and hierarchical routing-based protocols were presented for the WSN, Of all the presented WSN algorithms, the clustering-based algorithm outperformed in many cases.

In clustering-based algorithms, the cluster head is responsible for the rejection of information or data and also can reduce the final information or data volume (Muhammad et al, 2021). Then BS acquires the data that is sent by the cluster head. The network is shared into numerous clusters, in a cluster-based routing algorithm, and every individual cluster reduces the energy intake which was used for extended-distance communications. The capability of the nodes can be stabilized with the assistance of clustering by lessening the whole consumption of the power; the main motive of the workload was the larger gap between the sensor nodes and cluster heads. Hence, clustering is an energy-efficient answer for increasing network durability and improving energy technique efficiency. Furthermore, the number of messages that are requested for transmission to the base station decreases. Several old-style cluster head selection methods use the structures that comprise the energy balancing and network lifespan, these old-style methods used the idea of Power Efficient Gathering in Sensor Information Systems (PEGASIS), Hybrid Energy efficient Distributed Clustering (HEED), Distributed energy-efficient clustering (DEEC) protocol, Low Energy Adaptive Clustering Hierarchy (LEACH), Threshold sensitive energy efficient sensor network (TEEN) PROTOCOL, which gathers the information from its member variant, and then it combined the information and then transfer to the information collection hub or the base station.

Essentially, LEACH can be well-defined as the typical illustrations of hierarchical protocols. The energy is reduced considerably with the aid of the LEACH protocol to stabilize the limitations of power consumption. Apart from that, nodes with high residual energy become cluster heads once or more than once in some situations, as they have fairness constraints on power usage. The method of the TEEN procedure is put on when each cluster changes its period during the task. The LEACH subjects for the

PEGASIS. The PEGASIS is mostly fixated on increasing a series of chains among all the sensor nodes. This method comes into action due to the aim of energy nodes; via this, the energy nodes can gather a form and transmit it to the nearby node. The mixture of the nodes gets combined by moving from one sensor node to another, as the creation of the mixture is finished the cluster head transfers it to the sink. For all the wireless sensor networks in terms of power, the cluster-based algorithm can increase the efficiency. The additional expense is necessary by the clusters for the choice of cluster head and construction of clusters. To increase the lifespan of the wireless network, the closeness of the sensor nodes and the Power is essential. The following contributions have been made:

The following contributions were reached in this survey:

1. Improve information transmitting capacity packet losses due to network traffic.
2. Limiting monitoring area and transmitting distance by clustering.
3. Stabilises energy running down in the cluster head selection process.
4. Decrease energy usage in transmitting data to long distances.
5. Prolonging WSNs Lifespan.

2. Literature Review

Previously, enormous amounts of methods have been presented by many researchers for improving the life duration of wireless sensor networks; many proposed types of research are deliberated and reviewed in this segment of the paper.

Pathak (2020), presented work methods built on the artificial bee colony algorithm namely (PBC-CP) proficient bee colony-clustering algorithm. In their paper, the selection of cluster heads the paper used many factors such as; nodes residual energy, length from base station to sensor nodes, and degree of nodes. To send the information from the CH to BH, the power-effective route was selected which aids in reducing the consumption of power in a sensor network. The findings showcased the efficiency and effectiveness of the presented method over existing methods concerning network lifetime.

William (2022) indicated that a wireless sensor network is used in observing the variations in the dynamic surroundings that happen over time intervals. The wireless sensor networks use the means powerfully, for allowing the numerous applications and energy-efficient information broadcast was desirable. The paper that was proposed in this research is named Strong Clustering Algorithm and Data Aggregation (SCADA). To achieve scalability with nominal cost in SCADA-ML and Quality of service (QoS) optimization the research presented a novel routing protocol using machine learning. While putting the method of machine learning to dissimilar sizes of WSNs, the two key factors focused on data aggregation and cluster head selection. The artificial neural network (ANN) is another term for neural network machine learning method which aids in maximizing the entire cluster-head yield and cluster creation. Here are some features for the sensor nodes such as the length from the base station, remaining energy, and assigned bandwidth. All these features are used to

provide commands to the ANN architecture for selecting which CH is best. In the following phase, the other given term explained the use of machine learning for minimizing the usage of cluster power for every cluster by putting on the effective data collection on the CH nodes. This was The purpose of machine learning to identify how to minimize the cluster power by the effective data collection for every cluster on CH nodes and the grouping of data aggregation in controlled testing; the machine-learning-based results were outperformed by the SCADA-ML technique.

Chun & Liping (2023) implemented a method that permits sensor nodes and base stations (BS) to travel concurrently, then splits the sensing field into virtual grids, and then arranges a movable base station in every grid cell. The BS picks the suitable following hop for every cluster head in the field to construct the best routing forest and then gathers information from all root nodes of every routing tree at an undeviating speed along the pathway with full coverage. The results compared with the latest cutting-edge routing algorithms, the presented protocol solves better in terms of network delay then improves information throughput whereas maximizing the network lifespan makes it more appropriate for applications in time-sensitive situations.

Afia et al (2023) developed a new solution to enhance cluster-based Lifespan and increase routing constancy in a bidirectional method then increase the average network throughput. The first stage is to fragment the network and divide it into clusters. The second stage is the formation of clusters, and then the cluster head is nominated using the fuzzy method centered on inputs that permit over the system and then select cluster head. Lastly, the offered routing protocol chooses the utmost suitable routing route based on the cluster head's immediate neighbors then also the endpoint's position. The outcomes show an effective selection technique of cluster head using the fuzzy system which results in a 10% improvement in the network lifespan. Madye & Salah (2023) suggested a protocol in which frequently observe the communication network, it is expected that some amount of sensor nodes will be randomly distributed throughout the sensor field, and the algorithm is a clustering based on multipath routing that targets to stabilize cluster power consumption by making clusters with the appropriate size and with enough residual energy, furthermore prolonging the lifetime of the network, which sections the network into many layers of groups or clusters, The suggested protocol reduces power dissipation and increases network lifespan, and network stability when compared with SEP-E, SEPFL, and SEP protocols.

Shahriar & Kiaksar (2022) proposed a new threshold-centered categorize procedure appropriate to compact and ultra-compact networks were offered. As an alternative to categorizing entire information in the bulk dataset and then choosing a selected amount of them, the suggested procedure sorts a precise amount of features which greater or slighter than the given threshold point or else situated among double threshold quantities. The initial is based on the

expectation and the variance of the information, then the hypothetical study to discover precise and imprecise threshold values in turn for well-known like negative exponential, Gaussian, and Rayleigh, and unidentified possibility distribution was offered. At that moment, the procedure to categorize a previously defined amount of information is gathered. Lastly, the efficiency of the suggested procedure was presented in a time or period of complexity manner, then also running time. To do this, they used hypothetical and arithmetical studies to display the supremacy of suggested procedures in recognized and unrecognized allocations using widely recognized universal and gradual universal forms like K-S mean, Merge, and Quick-based sorting procedures.

Bila et al (2023) Proposed a new structure of WSN routing to make sure information communication among nodes centered on power cautioning, the technique used to discover the top choice in making cluster heads by taking note of the power level of all sensor nodes been offered using Firefly Algorithm. This method ensures information communication among the sensor nodes in the network and minimizes power consumption. It does the grouping of the sensor nodes to the network clusters and then every cluster allocates some role to a sensor node. This role turns a sensor node into a cluster head. Cluster heads have to collect information from nodes inside the cluster, and then transmit the information from cluster head to sink. Furthermore, the communication lines of all sensor nodes in wireless sensor networks depend on even sharing, where data is equally distributed throughout the network centered on the maximum radio range.

Zahoor et al (2023) suggested research with known datasets is centered on wireless sensor networks and then gathered employing the LEACH protocol. Furthermore, equally LEACH and HMGEAR are both carefully utilized as standard procedures that are used to perform wireless sensor network routing and are not costly computationally. Thus, the recommended ideal precisely categorizes every node that portrays the same performance. The routing is executed equally before and after malicious nodes are detected using LEACH. When a malicious sensor node is discovered and detached, routing is concluded for both the HMGEAR and LEACH algorithms. Additionally, the processing overhead of this method is minimized with the help of Proof-of-authority (PoA) agreement tools.

Rehab (2020) proposed a Study and Assessment on Algorithmic Purposes of Leach Protocol in WSNs. The research works with the study and assessment of the two different types of LEACH protocol and then makes some comparisons based on their usage, function, network lifespan, application, and network performance. The suggested study has deployed LEACH with a hierarchical clustering protocol, the multi-hop LEACH, which uses big areas and is reinforced by using this algorithm in military applications.

Shuyu & Chengdu (2018) presented a paper because of the restricted power of wireless sensor networks and the huge number of information transmissions; it is significant to improve LEACH

protocol for effective network information transmission in wireless sensor networks. This research usages an ant colony and particle swarm algorithm to improve the LEACH protocol which is most usually used in wireless sensor networks, to decrease the power consumption in WSN information transmission and improve the information transmission routing. Hence, particle swamp optimization is used to improve the LEACH protocol to get the utmost global optima, the information broadcast phase of LEACH, a single-hop route easily causes a CH to drain the power in the early stages of the network, and therefore the network life span is reduced. To solve this challenge, the inter-cluster transmission route is presented with the aid of the ant colony, transforming the single-hop to a multi-hop route. Bearing in mind that the ant colony algorithm is likely to plunge into a local optimal solution, the particle swarm algorithm is used to restrict with the efficient pheromone used to free the local optimal solution therefore fast-tracking its attainment of the global optimal transmission route under the LEACH algorithm. The simulation outcomes display that the efficiency of artificial intelligence of LEACH protocol routing is improved and its disparity between information broadcast and network power consumption is solved.

Abdallah & Geoges (2023) proposed the LLL-EACH protocol which is an all-inclusive framework that incorporates identity assignment, self-network organization, packet routing, and time slot reservation. Therefore an algorithm overhead is short because of assigning local identity instead of wide-scale identities, by assigning a distinctive identity to sensor nodes inside the cluster and assigning the same identity to sensor nodes in different clusters. The algorithm also assigns identities and time slots when needed to increase network resources. Furthermore, to improve the protocol, they present the LLL-EACH-Version 2 (LLL-EACH-V2) protocol that modulates the preamble bits to insert into the identities in the overhead rather than imputing additional bits. They also offer the processing complexity of the LLL-EACH-V2 protocol. The comparison was made with the DIVE protocol; the LLL-EACH protocol decreases the length of identities and mean power per packet by 50% and 13%, in turn. Additionally, the LLL-EACH-V2 protocol decreases the mean power per packet by 27% and improves the network output by 16% concerning the LLL-EACH protocol, making it an effective and scalable answer.

Haibo et al (2019) presented a paper to put advancing methods to enhance the routing protocol. Initially, the optimum total number of cluster heads is discovered according to the total power intake for every round to decrease the possibility of unnecessary CH dissemination. At that point, the CH is used as a base to build the Voronoi Diagram and then the sensor nodes inside the Voronoi diagram turn into the cluster, and then the power dissipation in transmission in the intra-cluster would become less. Lastly, to enhance the multi-hop routing algorithm, a new algorithm is added called an ant colony with a cluster head close to the base station to collect data and send it to and from a distant cluster head.

Mishra & Shashi, (2020) in their approach to sustain the network lifespan, load balance and maintenance are regularly essential. In certain features like chemical process control and tragedy avoidance, it is challenging and expensive to change and recharge the battery of sensor nodes. This arising challenge becomes necessary to develop an alternative energy-efficient result for the power of nodes and throughout the system performance to minimize the residual power consumption. Alongside the cost saving and residual energy consumption, the network's steadiness and performance remained vital to maintain by the energy-conscious methods. The power loss source was studied for the discovery of new results to save the power usage in the network, in this approach. Alongside elaborated optimization and preservation methods for available power of WSN are offered.

Sharma et al (2019) presented techniques used in various sectors like smart farming, smart cities, smart houses, and online industrial surveillance applications that are used for the application of the real-life Internet of Things. Typically, there is inadequate power capability is obtainable in the old-style WSNs; furthermore, the batteries are non-rechargeable. On many features, the lifespan of the WSN was built on the duty cycle, battery charge level, and application type. The proposed research for the WSN sensor nodes battery charging using solar energy harvesting method, by applying this method, the limited energy solar design solution was presented. Likewise, various difficulties like interruption of power; solar energy forecast, thermal matters, and additional solar ecological issues were raised in the solar energy ingathering. The reason for this proposed paper is to work on increasing the WSN network's lifespan by using the method of solar harvesting. After the result was simulated by the researchers they found out that the lifespan of the sensor network is improved from 5.75 days to 115.75 at 23% duty cycles, up to the limitless network lifetime. Alongside this development, the network throughputs from 100 kbs to 160 kbs increase in SEH-WSNs.

Orumwense & Khaled (2022) proposed a procedure that offers significance to the sensor nodes for charging and similarly aids in the enhancement of the accessible charging structure; overall this complete situation helps to maximize the lifetime of the WSN. Firstly, to check the sensor nodes in the network and likewise to visit the sensor node in the network, and monitoring algorithm was presented through the recharging the sensor nodes can be achieved. Afterward, to find the easiest travel distance used by the WCV a greedy charge algorithm was adopted and at the ending point, the energy of the sensor nodes algorithm wassuggested when the base station return the WCV is needed. To find the performance of the researcher’s scheme, the simulated tests were similarly conducted. The simulated tests demonstrate that the presented work made effective enhancements as related to the other literature reviewed using numerous matrices.

Bangotra & Kumar (2022) suggested an effective routing protocol where they related two opportunistic routing protocols with two NIO algorithms. The two opportunistic algorithms were an intelligent opportunistic routing protocol

(IOP) then a trust-based secure intelligent opportunistic routing protocol (TBSIOP) that were related to NIO algorithms for enhancing the power efficiency and extending network lifetime. The performance is evaluated using a MATLAB simulator and the findings were related in terms of power efficiency, point-to-point latency, average hazard level, and packet delivery ratio from the present PSO and ACO-based routing protocols. All the opinions under consideration were documented in the maximum 50% malicious sensor nodes for the test case of 25, 50, and 100 respectively. The TBSIOP performances were affected considerably by maximizing the size of the network, as a 100% packet transferred ratio was there. As the results show the TBSIOP, throughout the routing process, can evade the malicious sensor nodes. As related to another algorithm, the lifespan of the TBSIOP protocol was enhanced through this procedure. As the application task is involved, this is demonstrated to be useful for smart healthcare delivery. By giving energy-efficient services, the transmission during the data allocation can also be enhanced; this can benefit in keeping nodes alive in the network for an extended period by giving energy-efficient services.

Babu & Vasim (2022) proposed the concept of the LEACH algorithm. The enhanced (LEACH) low-energy adaptive clustering hierarchy algorithm achieved the clustering approach and formed the Advanced Efficient Low-Energy Adaptive Clustering Hierarchy (AE-LEACH) algorithm. In this paper, the authors displayed that in the clustering process, the cluster heads were chosen by the firm descriptors randomly like remaining energy then a maintained distance from BH. This approach, suggests that the cluster head predicts the target destination and selectively activates the continuous track of the next round sensor node by using the practice filter algorithm. This whole activation approach makes a route from clusters to BH by taking the CH as their backbone. To access the energy of the clustering algorithm efficiently the Gini index approach was used. Respectively, this whole experiment stated an efficient work performance on the concepts of system lifetime energy consumption, and residua power. The Gini index for remaining power attains a meaningful lower Gini index of 78.38%, 86.11%, and 85.92% as related to K-means clustering, HEED clustering, and LEACH clustering algorithm respectively. Apart from that the network lifespan and power dissipation were directly comparable to time accuracy.

Wang (2018) reviewed the HEED algorithms implementation for a heterogeneous network. The heterogeneity of the different levels was capable of being well-defined by the type of nodes level-1, level-2, and level-3 based on the HEED implementation denoted by levels hetHEED-1, hetHEED-2, and hetHEED-3 respectively. In this method, the research stated that the hetHEED level aids in enhancing the network ten times the lifespan of nodes was also improved significantly and the rate of power consumption wasdecreased. Using the heterogeneity level for nodes the lifespan was increased and also this aids in sending more packets to the sink. The

manifold network lifespan was maximized as the network power increased. However, it is realized as a benefit that the Fuzzy logic aided in the increase of the network lifespan with 114.85% of original HEED with no significant network power increase. Therefore, in the last stage of the heterogeneous network, the hetHEED-3 aids in attaining the extended time of the network with 387.94% as the network lifespan was maximized, and a 19% increase in network power, the packet sent to the sink was also increased with having the slight rate of energy loses.

Sharma et al. (2015) presented an adaptive duty cycle and encoding method to reduce consumption energy in the sensor field. Together the adaptive combination of duty cycle and encoding techniques aided in the implementation of the effective communication method. In the sensor field, the energy efficiency would grow as more amounts of information were transmitted to BS, having an equal amount of data for transmissions. Hereafter, this caused a rise in the WSN's lifespan. The offered paper archives the energy efficiency improvement in the sensor field, which results in the overall enhancement of the network lifespan by bearing in mind the coded adaptive duty cycle WSN. This paper concludes that the linear network does not depend on the data which was presented by the packets, the sensor nodes take several packets and merge them for communication and this communication applies to the sensor field. The above method benefits in the enhancement of the general increase network lifespan of the nodes. The entire proposed idea investigated the approx. methods of the enhancement of the lifespan of sensor nodes.

El-Sayed & Zainab (2021) reviewed different protocols and attempted to find the superlative parameter of the network. At the initial stage, numerous methods like the Developed DEEC (DDEEC), the Distributed Energy Efficient Clustering (DEEC), Improved DEEC Protocol (IDEEC), Enhanced DEEC (EDEEC), and Threshold DEEC (TDEEC) were verified under dissimilar situations. At that juncture based on this assessment, it is considered that the efficiency centered on stability duration of network lifespan and throughput. TDEEC and EDEEC achieve better in all situations in terms of network lifespan. At that point, it was decided that TDEEC was the greatest method for the stability of the network. Though, in terms of overhead the IDEEC was bringing into being better than the DDEEC, but TDEEC was greatest among all. Alongside the varying heterogeneity characteristics of the network, DEEC and DDEEC were extremely affected.

Wang (2018) presented the Enhanced Power-Efficient Gathering in Sensor Information Systems (EPEGASIS) to minimize the four main challenges from four different aspects. The first aspect, during data transmission the use of power was at a high rate, so the best transmission coverage was determined to reduce it. The second aspect, the use of threshold value was proposed for the defense of the nearly dying nodes and to stabilize the energy consumption amongst the sensor nodes, the mobile base station technology was adopted. The third aspect, EPEGASIS protocol aids in modifying the distance to base station nodes based on the transmission range. The fourth aspect, a huge

investigation was carried out to showcase the efficiency of the EPEGASIS in terms of lifespan, power consumption, and network propagation delay.

Anastasi & Giuseppe (2009) suggested an analysis of the power consumption for the section of the basic sensor nodes and deliberated the significant routes for conserving energy in WSNs. Then, the research offered a structured and global taxonomy of the power conservation structure which was deliberated in depth later. Attention was focused on the favorable result for energy-efficient information gaining, which had not gained wide consideration in the rewired literature. Lastly, an intuition on the research gives an insight path about power conservation in wireless sensor networks.

Zhang & Cai (2022) recommended some vital features for the WSNs in the Internet of Things (IoT) were vital techniques, for some particular applications. Then, the paper suggested analyzing research on cell membrane algorithms and their features, also the paper offered a power equilibrium clustering algorithm to solve challenges of energy limitation in WSN; the result was centered on the cell membrane optimization algorithm to achieve the energy stability of nodes and dissemination network cluster head. By conserving the energy factors, this algorithm splits the sensor nodes, and then by joining the distance factors, the proposed result divides the nodes globally, this division factor was able to resolve the challenges of irregular sharing of CH and unstable global energy utilization in sensor nodes. Thus the paper also presents the QoS ideal, which is centered on routing protocol, clustering protocol, and data fusion scheme. This is proven in studies by many experiments, that the proposed technique attains flexibility by 78% improves power consumption, and achieved well in every aspect as compared to preceding research.

Firdaus & Hasan (2016) indicated the efficiency of the WSNs in computing environments in critical ways for many applications. The inadequate energy is reflected as the restricted energy in the WSNs. taking the characteristics of energy-saving quality, the WSN plays a vigorous role in computing environment, in such computing environment the pool of sensor nodes is required in other to be able to work self-sufficiently and unattended. In other to use the nodes efficiently, the method of clustering algorithms is used. The clustering method similarly aids in getting the better spreading of loads in the network. The paper also takes a survey and deliberated numerous dimensions and ideas for clustering. Moreover, the paper also offers a comparative review of many clustering algorithms and debates about the possible research areas and problems of clustering in WSNs.

Reddy (2017) in his study is built on the enhancement of the wireless sensor networks and presents energy depletion methods to solve the challenges. The information was convoked by each sensor and then was transmitted across the system to process the centermost feature which all the communicated data sent to the individual nodes. Then cut down the constrained power ability, the signal travelling technique would be pre-calculated. All cluster heads were gathered to be in touch with the data

cluster head so that the CHs could interchange the shared data at a time and preserve energy. The area of focus in this research was the conjoint cluster characteristics and clustering algorithms.

Table 1: Summarized literature review, Method used, contributions, and Research drawback

Reference	**Method used**	**Contribution (s)**	**Research drawback**
Chun & Liping (2023)	MMSCM with multiple sinks	Improve data throughput and solve delays in the network	This algorithm unable to resolve bigger sensor networks covering thousands of WSN sensors
Pathak (2020)	Bee colony method for clustering.	Performance improved	Signal findings
William (2022)	SCADA approach for LEACH	Throughput and CH selection were improved.	High residual energy consumption
Afia et al (2023)	VANET fuzzy system based and 10% increase	Extended the network life cycle	Time synchronization was not considered
Madye & Salah (2023)	EEMCL using multi-hop sensing	Improves energy dissipation Improves network stability Enhanced network lifetimes	Cluster head selection needs to be improved.
Shahriar & Kiaksar (2022	Threshold-based sorting algorithm	Improves faster cluster head selection process	Some sensors are far from the sensor field is not discovered.
Bila et al (2023)	LEACH based on Firefly Algorithm	Better performance and improve the network lifetime	Poor performance al the initial stage of the network
Zahoor et al (2023)	HMGEAR-based using 4 deep learning	The network is robust against vulnerabilities	Nodes organization in big datasets

	techniques		
Rehab (2020)	LEACH & multi-hop LEACH based	Larger area coverage especially in security applications	The larger area was never specified
Shuyu & Chengdu (2018)	Using ant colony & particle swarm algorithm to enhance the LEACH	performance improved artificial using AI imbalance concerning data sending/receiving and network power wastage is resolved	Local optima occurred in some of the round
Abdallah & Geoges (2023)	LLL-LEACH based algorithm	Improves: ▪ Identity length 50% improved, ▪ The average energy per packet is 13%, ▪ Network lifetime 16% improved.	▪ Propagation delays. ▪ Effective exclusively for cluster-based network or topologies
Haibo et al (2019)	LEACH using the Voronoi Diagram approach.	Considerably prolonged the lifetime	A slight propagation delay was observed in the network
Mishra & Shashi	Multipath approach to LEACH protocol.	Improvement in: ▪ Number of broadcasted packets. ▪ Longevity of the network lifetime.	Network duration is required to be longer.
Sharma et al (2019)	Based on: ▪ Network coding ▪ Adaptive duty cycle	Achieves well better than other LEACH protocols that were compared	Battery Energy intake is moderately high
Orumwense & Khaled (2022	Monitoring algorithm through the recharging of the sensor nodes	▪ Improves energy dissipation. ▪ Improves network stability. ▪ Enhanced network lifetimes.	Battery power intake is still high in the middle of the lifetime.
Bangotra & Kumar (2022	▪ Intelligent opportunistic routing protocol	The TBSIOP performances considerably	Rapid reduction of residual energy at the

	(IOP) ▪ The trust-based secure intelligent opportunistic routing protocol (TBSIOP)	maximize the network size	initial stage of the network
Babu & Vasim (2022)	hetHEED-III protocol	▪ Extended network time by 387.94%. ▪ Network lifespan by 19%. ▪ Increase in network power & packet sent to the sink.	The base station location was never discussed or specified.
Wang (2018)	EPEGASIS	Improves network lifespan, power consumption, and network propagation delay	Uneven distribution of CH
El-Sayed & Zainab (2021)	TDEEC	Load distribution and energy utilization were improved.	CH formation needs to improve and redundant data to be excluded
Zhang & Cai (2022)	Cell membrane algorithms	The technique attains the flexibility by 78% and improves the power consumption.	Transmission losses/fading observed
Firdaus & Hasan (2016)	Hybrid -LEACH	Extended network lifespan and reduced transmission delay.	Experience early death of sensor nodes.
Reddy (2017)	Energy depletion methods	Extended the residual energy of the network.	Rapid running down residual energy at the end of the network.

3. Conclusion

WSNs have a finite number of properties however the most vital component is power, since the durability of the network depends on the existence of sensor nodes, then the power retains the survival nodes. An in-depth analysis of reviewed literature discovered that the majority portion of sensor node power is consumed during the transmission phase. Therefore, the most vital issue in minimizing power consumption during data transmission is an effective routing approach. This paper reviewed and discussed the research of selected current publications to observe their methods and approaches for minimizing the power consumption of sensor nodes and maximizing the network time. It has been perceived from the survey that clustering is the effective routing protocol that is broadly employed. Nevertheless, the effectiveness of a wireless network, in this case, relies on the power of the cluster head node. Hence, it is tremendously vital to optimize the power consumption in cluster head nodes so that the general lifetime of the network is improved.

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