Section A-Research paper
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ANALYSIS OF VARIOUS METHODS FOR CLUSTER HEAD SELECTION AND ROUTING IN WIRELESS SENSOR NETWORK (WSN)

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Abstract:

Wireless Sensor Networks (WSNs) is used to sense the data and communicate with others by wireless. The nodes involved in this network consist of small and minimum powered. To process their function these nodes organised and configured itself. In recent year WSNs are used many applications due its features such as low cost, scalability, throughput, easy deployment, flexibility and efficiency. Even though it has best features lifetime of network and security of routing are stills challenges one in WSNs. These challenges exit because of insignificant cluster head (CH) selection and insufficient trust worthy path selection. So, it is necessary to analyse the various routing and cluster head selection techniques to proposed new methods to solve these challenges. This paper reviewed the various techniques like LEACH, LEACH-C, BO-LEACH, SMOTECP, PSO, DT, HAS, ESD, BCDCP of CH selection and routing methods based on some parameters such as methodology, contribution, existing methods used and result of their work. Finally, we produced analysis of various techniques based on the following parameter: energy consumption, throughput and lifetime.

Keywords: wireless Sensor Networks (WSNs), Cluster Head (CH), Energy Consumption, Throughput, Lifetime.

I. INTRODUCTION

Wireless Sensor Network (WSN) has been developed as a standout amongst the most encouraging innovations for the future. This is empowered by advances in innovation and accessibility of small, economical, and smart sensors bringing about practical and effortlessly deployable WSNs. A WSN has expansive quantity of cooperating small-scale nodes, called sensor nodes, which are spatially dispensed and work cooperatively to impart data gathered from the monitored field through remote connections. The information gathered by the different nodes is sent to a sink which either utilizes the information locally or is associated with other networks. WSN technology offers various features of curiosity over conventional networking solutions, such as, lower prices, scalability, reliability, accuracy, flexibility, and ease of organization that empower their utilization in an extensive variety of assorted applications. With progressions in technology and sensors obtaining smarter, smaller, and less expensive, billions of wireless sensors are being deployed in numerous applications such as in military, environment, healthcare, and security (Sohraby et al. 2007).

Each sensor node is made out of low-power sensing devices, embedded processor, power module and communication channel. The embedded processor is generally utilized for gathering and handling the signal information taken from the sensors. Moreover, these sensor nodes are equipped with constrained resources. Sensor component delivers a measurable response to a change in the physical condition such as temperature, humidity and so forth. The wireless communication channel gives a medium to exchange the data extracted from the sensor node to the outside world which might be a computer network and inter-node communication. As sensor nodes have restricted transmission range and constrained battery power, system lifetime gets to be essential issue while designing any WSN applications. So, the power of the sensor nodes is to be utilized productively to prolong the lifetime of the network.

II.ROUTING IN WSN

A crucial goal of the wireless sensor networks is to report events of a predetermined nature or transmit detected information to sink nodes or the base station for further analysis. Each sensor node in the network plays the role of data originator and a router. That is, sensor nodes sense the data and transmit the data to the sink through single hop or multi-hop. Since, a sensor node carries limited and irreplaceable battery sources, the transmission should be energy efficient. The design of routing protocols in WSNs is challenging because of several network constraints with an emphasis on energy efficiency.

Most routing algorithms for sensor networks focus on finding energy efficient paths to draw out the lifetime of sensor networks. Accordingly, the power of sensors on efficient paths exhausts rapidly, and therefore sensor networks become incapable of observing events from some parts of their target areas. Consequently, ideally, routing algorithms ought to consider energy efficiency, as well as the amount of energy remaining in each sensor, subsequently keeping away from non-functioning sensors because of right on time power exhaustion [1]. Data transmission is the significant source of energy utilization and it is a serious challenge to design an energy efficient routing scheme for prolonging the network lifetime.

III. ROUTING CHALLENGES IN WSN

- The design task of routing protocols for WSN is quite challenging because of multiple characteristics, which differentiate them, from wireless infrastructure-less networks. Several types of routing challenges are involved in wireless sensor networks. Some of the important challenges are mentioned below[19].
- It is almost difficult to allocate a universal identifiers scheme for a big quantity of sensor nodes. So, wireless sensor motes are not proficient of using classical IP-based protocols.
- The flow of detected data is compulsory from a number of sources to a specific base station. But this is not occurred in typical communication networks.
- The created data traffic has significant redundancy in most of the cases because many sensing nodes can generate same data while sensing. So, it is essential to exploit such redundancy by the routing protocols and utilize the available bandwidth and energy as efficiently as possible[12].
- Moreover wireless motes are firmly restricted in relations of transmission energy, bandwidth, capacity and storage and on-board energy. Due to such dissimilarities, a

number of new routing protocols have been projected in order to cope up with these routing challenges in wireless sensor networks[13].

IV.REVIEW OF EXISTING WORK

Ahmed, M. M., Taha, A., Hassanien, A. E., & Hassanien, E. (2018) to seek sink node proposed a novel KNN classification method with whale optimization. Because sink node collect all information from all sensor and also maintain the lifetime of network. In this research calculation of fitness function used as main parameter to predict the best location with high residual energy to maintain lifetime. Experimental result proved the performance of proposed method. Finally proposed method increase 11% of lifetime of network

Lee, J. G., Chim, S., & Park, H. H. (2019) proposed the sampling-based spider monkey optimization and energy-efficient cluster head selection (SSMOECHS) method to solve the issues such as computational time, poor accuracy and replica node caused by location-based approach by selecting the energy efficient cluster head. So the proposed method improve the lifetime and firmness of the WSNs. This research described the way of selecting cluster head and sampling approach by using spider monkey optimization (SMO). The experimental results are compared to existing similar methods such as low-energy adaptive clustering hierarchy centralized (LEACH-C), particle swarm optimization clustering protocol (PSO-C), and SMO based threshold-sensitive energy-efficient delay-aware routing protocol (SMOTECP). The proposed method proven the better result than existing methods. Finally it is increasing the lifetime and stability.

Wang, J., Gao, Y., Liu, W., Sangaiah, A. K., & Kim, H. J. (2019) introduced genetic algorithm with optimal leach energy efficient method to find the optimized route based on fitness value. Hierarchical leach method is used to predict the cluster head. GA is used to find the best route. Simulation results proved the efficiency of proposed method with reduced energy consumption rate.

Arora et al(2019) introduced novel energy efficient and self-organized Ant Colony Optimization (ACO). In his work cluster head selection based on maximal energy. Multiple paths developed in between cluster head and members of ACO after that dynamic route are created. Implementation results proved that the proposed methods have better network lifetime.

Rahiminasab et. al.(2020) developed a novel method based on multi-feature decision making. It considered the four issues such as energy efficient, distance to base station and data queues length. To solve these issues Cluster Splitting Process (CSP) algorithm and the Analytical Hierarchy Process (AHP) methods have used. Then these issues are examined by proposed method. The experimental result shown the better result than existing Base station Controlled Dynamic Clustering Protocol (BCDCP) method. The energy consumption decreased and lifetime of WSNs increased by new approach.

Umbreen et. al (2020) addressed the problems based on inappropriate selection of cluster head. Most of the clustering protocols are dedicated to prolonging of network lifetime. But it doesn't focus the selection criteria for CH, stable clustering, more energy consumption. So it needs to address these issued to introduced a new clustering technique. To solve these issues the proposed method focused on energy efficient and flexibility based cluster head selection. In this approach cluster head selection based on following criteria such as mobility of nodes, energy residual, distance to sink and adjacent node. The simulation result of proposed

method shows the better result than existing method such as CRPD, LEACH, and MODLEACH.

Visu, P., Praba, T. S., Sivakumar, N., Srinivasan, R., & Sethukarasi, T. (2020) developed energy efficient Dual Cluster Krill Herd Optimisation (DC-KHO) method to solve the problems in conventional methods such as packet delivery delay, time and high costs. Suitable solution only based on optimization. In the existing methods random selection path for transmission with end to end delay and energy consumption is high. Thus this research select an optimal route based on path trust value. This proposed method overcoming the challenges caused in the time of transmission, time of computational and residual energy.

Safa's et. al(2021) introduced IE2 -LEACH method to address the issue lifetime of node. This work focused to enhance LEACH by selecting cluster head based on energy consumption. The effective cluster head selection will improve the degree of energy consuming. The proposed method developed based on extend the lifetime of network. So it can be any other clustering approach. Instead of selecting the CH randomly the new technique have used in the proposed approach. The experimental result shows the significant result than existing.

Jagan, G. C., & Jesu Jayarin, P. (2022) introduced fully connected energy efficient clustering (FCEEC) approach. The proposed method create a completely connected network based on distance of the path and select the cluster head(CH) based on electrostatic discharge method. It increasing the lifetime of the network due to electrostatic discharge approach. FCEEC reduced the count of dead nodes. So it increased the network lifetime. The performance of the proposed method evaluated by energy consumption, packet delivery rate and dead node count.

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V.RESULT AND DISCUSSION

Author & Year	Contribution	Methodology	Network Type	Evaluated with exiting Method	Result
Shankar et al., (2016) [19]	To obtain a comprehensive search with faster conjunction for energy-efficient CH selection	Hybrid HSA and PSO Harmony Search Algorithm (HSA) and Particle Swarm Optimization (PSO)	Heterogenous	LEACH DT HAS PSO	Energy Consumption 72.89% Throughput:67.23% Lifetime: 65.12%
Rao et al., (2017)[20]	To preserve the energy of nodes for prolonging the lifetime of the network	PSO-ECHS	Homogeneous	E-LEACH LEACH-C PSO-C LDC	Energy Consumption 80.89% Throughput:77.23% Lifetime: 73.12%
Lee et.al(2019)[1]	To solve the poor computation time, low accuracy based on location approach	sampling-based spider monkey optimization and energy-efficient cluster head selection (SSMOECHS)	homogeneous and heterogeneous	LEACH-C PSO-C SMOTECP	Energy Consumption 63.29% Throughput:81.23% Lifetime: 77.12%
Mu, J., Yi, X., Liu, X., & Han, L. (2019)[16]	It focused on diffusion based routing only.	Directed Diffusion Routing consider query based routing(DDRQR)	homogeneous	LEACH, LEACH-C	Energy Consumption 62.89% Throughput:83.23% Lifetime: 80.12%
Arora, V. K., Sharma, V., & Sachdeva, M. (2019)[8]	No consider node security	Novel energy efficient and self-organized Ant Colony Optimization (NSOACO)	homogeneous	E-LEACH LEACH PSO	Energy Consumption 72.89% Throughput:80.23% Lifetime: 76.12%
Jagan, &Jesu Jayarin, P. (2022)[2]	To Establish fully Connected Shortest path routing	novel fully connected energy efficient clustering (FCEEC) mechanism	homogeneous	LEACH-C BO-LEACH ESD	Energy Consumption 86% Life Time: 32.28% Throughput:66.32%
Rahiminasab et. al(2020)[3]	To select an appropriate cluster head	Cluster Splitting Process (CSP) algorithm and the Analytical Hierarchy Process (AHP) method	Homogeneous	BCDCP LEACH LEACH-C	Energy Consumption:85.34% Throughput: 85.14% Lifetime:78.24%
Abdurohman, M., Supriadi, Y., & Fahmi, F. Z. (2020)[18]	No focus on Data Security and node security. It focused on lifetime of network.	Modified E-LEACH Routing Protocol	Homogeneous	E-LEACH LEACH	Energy Consumption:94.34% Throughput: 86.14% Lifetime:80.24%
Visu, P., Praba, T. S., Sivakumar, N., Srinivasan, R., & Sethukarasi, T. (2020)[11]	It doesn't focus the shortest path	energy efficient Dual Cluster Krill Herd Optimisation (DC-KHO)	Homogeneous	LEACH-C BO-LEACH ESD	Energy Consumption:88.34% Throughput: 87.14% Lifetime:83.24%
Safa's et.al(2021)[4]	To enhance LEACH by identifying proper CH based on energy	IE2 -LEACH	Heterogeneous	E-LEACH LEACH	Energy Consumption: 82.12% Throughput:72.23% Lifetime: 80.26%

Table 1 Analysis of various Cluster Head (CH) selection and routing Techniques

Table 1 shows the analysis of various techniques based on Cluster Head (CH) selection and security of the routing. The various techniques have analysed based on various parameter such as contribution of proposed work, methodology, type of network, existing methods used their work and result. The performance of various techniques analysed based on various metrics such as energy consumption, throughput, lifetime of network. Energy consumption means total energy consumed for transmission. Throughput is used to measure the number of

packets received at destination per second. Lifetime of network is the measure of the time until the first sensor's energy runs out. Table 2 shows the comparison of various methods based on the energy consumption, throughput, lifetime of network. This work analysed various techniques such as HAS-PSO, PSO-ECHS, SSMOECHS, DDRQR, NSOACO, FCEEC, CSP&AHP, E-LEACH, DC-KHO and IE2-LEACH. Figure 1 shows the comparison of these methods. According to the analysis E-LEACH scored the high 94.34% of Energy consumption, DC_KHO scored 87.14 as highest throughput and DC_KHO scored 83.24% as highest lifetime.

Table 2. Comparison of various methods

Methods	Energy-consumption	Throughput	Lifetime
HAS-PSO	72.89	67.23	65.12
PSO-ECHS	80.89	77.23	73.12
SSMOECHS	63.29	81.23	77.12
DDRQR	62.89	83.23	80.12
NSOACO	72.89	80.23	76.12
FCEEC	86	32.28	66.32
CSP&AHP	85.34	85.14	78.24
E-LEACH	94.34	86.14	80.24
DC-KHO	88.34	87.14	83.24
IE2-LEACH	82.12	72.23	80.26

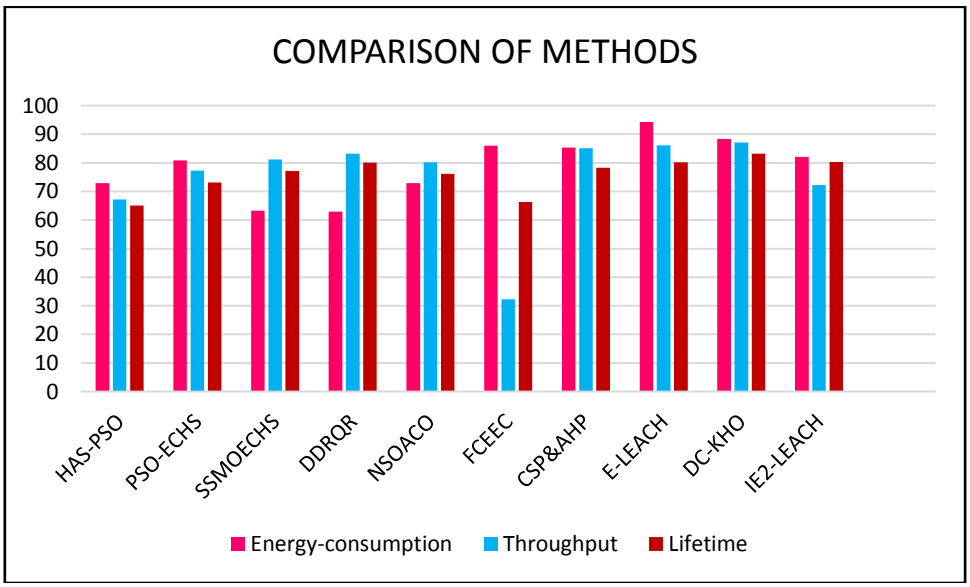

Figure 1. Analysis of various methods

VI. CONCLUSION

This research work reviewed various WSN algorithms based on cluster head and routing techniques. The analysis based on various factors such as contribution of proposed work, existing methods used in their work and results of their work. Based on the analysis of various techniques efficient cluster head selection will increase the network lifetime, throughput, energy consumption rate. This work found that the E-LEACH gave better energy consumption, throughput and lifetime.

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