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PA FUZZY-NOISE REMOVAL IN WIRELESS SENSORS NETWORKS

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Abstract. In the wireless sensor's network, a large number of sensor device data is sent directly to the base station. So huge amount of noise is also added with data going to the base station and there is no security mechanism for protecting sensor device data in the existing scenario. WSN has numerous applications, including healthcare systems, secure military applications, and monitoring applications. Achievement of noise removal is essential for WSN. Many researchers have focused on enhancing the removal of noise in data and extending the network lifetime. Sensor Nodes (SNs), cluster heads (CHs), and base stations make up the standard WSN architecture. The communication of SNs using the traditional design consumes high energy increases delay and reduces network performance. To address the limitation of the present state of the system, this research work proposed a PA Fuzzy system which is acting like a filter used to remove unnecessary noise with sensor data that is moving toward the base station. And PA Fuzzy system after removing noise, and sensor data is encrypted so that it can be protected from hackers .It makes the network performance better, decreases delay and energy use, and increases the Ratio of packet deliveries and throughput. The execution of the suggested methodology was made using NS2. The proposed's empirical outcomes system outperforms with comparison of the existing WSN mechanisms.

Key words: Wireless Sensor Networks, PA Fuzzy System, Filters, Encryption technique.

1. Introduction. The exponential growth of wireless communication technologies is having a profound effect on wireless sensor networks (WSNs). The conveyance of data is an essential WSN function. Over the past decade, numerous mechanisms have been suggested in an effort to enhance data transmission efficacy. With effectiveness Data transmission is essential for both research and commerce. Wireless sensor networks (WSNs) have a wide range of applications, including but not limited to smart cities, the armed services, and advancements in the healthcare industry [1]. A considerable quantity of dispersed sensor nodes comprise the WSN. Traditional WSNs feature varying degrees of communication. An excessive number of clusters are formed, and one CH is elected for each cluster. The sensor nodes gather environmental data and are utilized in a variety of applications. The CH receives and transmits sensor data from the base station after receiving it from the sensor node. [2].The WSN sensor nodes have limitations in energy efficiently and data transfer. The sensor nodes' connectivity and computation abilities are incredibly poor.The sensor nodes' range is somewhat constrained; thus, improvements are required to boost communication efficiency. The primary component of load balancing is the deployment of WSN. Base Stations and CHs were the primary data transmission devices in classic WSN [3]. Look at the WSN model architecture in Figure 1.1.

The WSNs use a clustering-based approach, with a set of sensor nodes in each cluster. Information about the area is gathered and sent to the CHs by sensor nodes. The Data was gathered by CH's method and forwarded to BS. To gather and transmit the data, each sensor node in the network uses energy Despite the fact that the sensor nodes shut down when their energy runs out. Therefore, creating WSN requires an energy-efficient algorithm. To equalize WSN's energy usage, many clustering techniques have been developed [4], [5]. These algorithms follow the selection of CHs and also shift CH's position among the SNs in a cluster. An energy-efficient hybrid clustering and routing technique has been developed for big WSNs. Design energy efficient mechanism back-off timer and gradient routing to execute the CH selection. In This research work introduced a brand-new PA fuzzy mechanism based on intelligent agents, which minimizes energy consumption, delay and maximizes throughput and PDR [2].

The following sections of the paper are broken down and discussed individually. Section II provides a full study of the most modern WSN energy-efficient approaches. The recommended methodology for deploying

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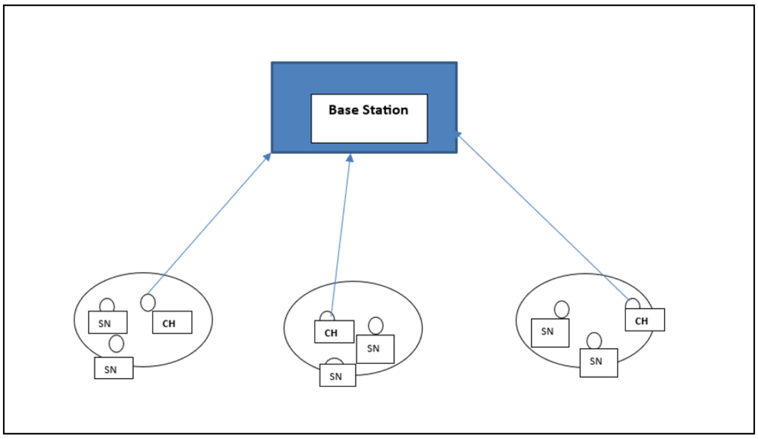

Fig. 1.1: An Illustration of a Wireless Sensor Network Architecture

PAWSN for energy efficiency was discussed in Sections III and IV, discuss the proposed mechanism from the empirical results, and compare the suggested results. In Section V, the paper is concluded with improvements to the suggested mechanism, as well as a discussion of upcoming research efforts.

2. Literature Review. An energy-conscious routing algorithm was developed by F. Fernando Jurado-Lasso et al. [6] as part of an overhead reduction strategy. This algorithm enables industrial services and optimized energy use in WSN. Data packet aggregation is a feature that the implementation of the software-defined multichip WSN to manage the WSN. The suggested system analyses shortest-path strategies in order to lengthen the lifetime of the WSN network. Enhance the PDR performance as well. Even though the recommended solution outperforms the current algorithms in terms of performance. But a revolutionary innovation algorithm is crucial in WSN to lower the network lifespan and the neighbor advertisement packets. Nelofar Aslam et al [7] built an innovative logic data algorithm transmission with clustering and reinforcement algorithm(SARSA). The proposed algorithm is also outlined as combining an ideal solution with SARSA clustering for energy consumption and network stability. The WSN node is designed with taportable wireless charging system The suggested strategy enhances the functionality of the network by drawing its inspiration from an objective function. However, C-SARSA's deployment in WSN led to an improvement in performance. However, the WSN does not have an RWSN with a proper deployment and recharge schema.

Gajendran Malshetty et al [8] For effective clustering in WSN, a self-organization method based on load has been developed. The LBSO approach in WSN employed three unique phases.. The first phase involved choosing the Cluster Head, and the second involved choosing among the sensor node clusters. The third stage is then followed by the rotational phase-based reselection of the cluster head. However, the network's efficiency and network development both increased. But the network performance is poor because of a variety of base station deployments and dead nodes. Muhammad Adil et al [9] A load-balancing routing system that uses little energy was made to make WSNs last longer. A good hybrid routing method has been made with the Dynamic Cluster Based Static Routing Protocol (DCBSRP). Ad-hoc On-Demand Distance Vector (AODV) Routing Protocol and Low-Energy Adaptive Clustering Hierarchy (LEACH) Protocol are both parts of the suggested protocol.create a WSN using a variety of clusters and CHs. The DCBSRP protocol largely behaves as a normal node and does not make current CH nodes from the early cycles public. But the proposed protocol significantly increased network longevity.

A wide variety of real-time applications using WSN are deployed. The WSN uses self-organization and a finite amount of energy. To address energy efficiency's limits Al Xinlu Li et al. [10] presented a load- balancing energy-efficient WSNs using the ant-based routing algorithm (EBAR). The EBAR algorithm effectively lowers energy use Through an opportunistic broadcast technique, EBAR uses and manages overhead in WSN to conserve energy. The EBAR does accomplish Despite being accurate only in homogeneous networks, energy efficiency. Data transmission cannot be supported by the algorithm in a diverse network, which results in excessive energy usage [11].

Wireless Sensor Networks are wireless systems comprising a large number of randomly or regularly distributed sensor nodes. The target of this job is to give network protection to wireless Sensor Networks so as to transmit detection information to the recipient efficiently so the duration of the system is long and within this function, a novel protocol was created with Game Theory [12]. Game Theory gives a mathematical foundation for the evaluation of interactive decision-making procedures. It gives tools for predicting what may (and what should) occur when agents that have conflicting interests socialize. It's not a monolithic method, but a selection of modeling programs that assist in the comprehension of interactive decisions to get issues. The projected Game Theory approaches are implemented effectively for preventing Denial of service attacks, to discover and protect against malicious behavior of sensor nodes in a network of wireless sensors, and verified that the operation of those games considerably decreases misbehavior of tunnels, conserves node power and prolongs the network lifetime economically [13].

Wireless sensor networks are urgently needed and are proliferating as a result of recent advancements in electronics and wireless networks (WSNs) [14]. WSNs are now crucial in a variety of fields, such as infrastructure, healthcare, agriculture, the environment, and military leadership. Several issues affect the healthcare sector, among these are escalating costs, an aging population, a rise in medical mistakes, a lack of manpower, etc. Despite the challenges, healthcare professionals are under pressure to adopt new technology and offer improved services [15]. The availability of universal healthcare can lower long-term expenditures and raise service standards [16]. Wireless sensor networks offer practical remedies for the pervasive healthcare system. Recent developments in medical sensors and low-power network architectures have given rise to WSNs for the healthcare industry. As a result of the wireless sensor network [17].

3. Suggested Approach.

3.1. Status of the Problem. Sensor nodes that are connected to the WSNs communicate with one another to gather information about their surroundings. Whenever sensor data information moves from cluster heads to the base station even noise, and unwanted data also move to the base station there to so much delay, PDR is less, and Throughput is also not accurate. The SNs run in a decentralized, low-energy manner. Use of the WSN in numerous emerging applications, including military applications, applications in industry and the environment, and healthcare systems. The base station, CHs, and SNs are the three operational levels of the conventional WSN. The sensor nodes gather local data and send it to the CH Nevertheless, the CH only receives information for a limited period of time, and the behavior rotates. The changes in the rotation of the cluster head use energy and cause data transfer to be slower., In this scholarly document published a book Intelligent agent PA fuzzy mechanism.

3.2. PA-Fuzzy. The functionality of available resources, portability in sensor nodes, and rotating movements in cluster heads result in excessive energy use and latency in transmission. In order to address the issue with the current state of the WSN, this study effort introduced an innovative PA-Fuzzy is a mechanism which will eliminate unnecessary data, such as a noise which is moving to words base station it will a love only data. And PA Fuzzy system will encrypt sensor data for two times and forwarded to base station for encryption AES 256 key algorithm can be used in PA Fuzzy system. Base station sends data finally to end user so only end user can decrypt data with valid keys. In between no hacker or base station authority cannot decrypt data this is the originality of proposed technic in this article. By this we can improve PDR, Throughput, Delay.

PA-Fuzzy also a love to make unclear data to clear data. There are two ways to transmit data in the WSN. A sensor node to a PA Fuzzy system is the first data transfer type. From one cluster sensor node to another cluster sensor node is the second way that data is sent.. The sensor device and the path arbitrary node are connected directly. Use a different sensor node as an intermediary in sensor-to-sensor transmission, however. Here, choosing the best route between the destination sensor and the sender sensor node depends heavily on the path arbitrary. The path from source to destination arbitrarily defines an optimized primary path as well as alternative routes. The connecting node's node distance and energy levels are taken into account while choosing the how to get from point A to point B. if any of the primary direction links or nodes fail.

In the suggested PA-Fuzzy, the optimize path selection method includes two steps. In the initial stage of

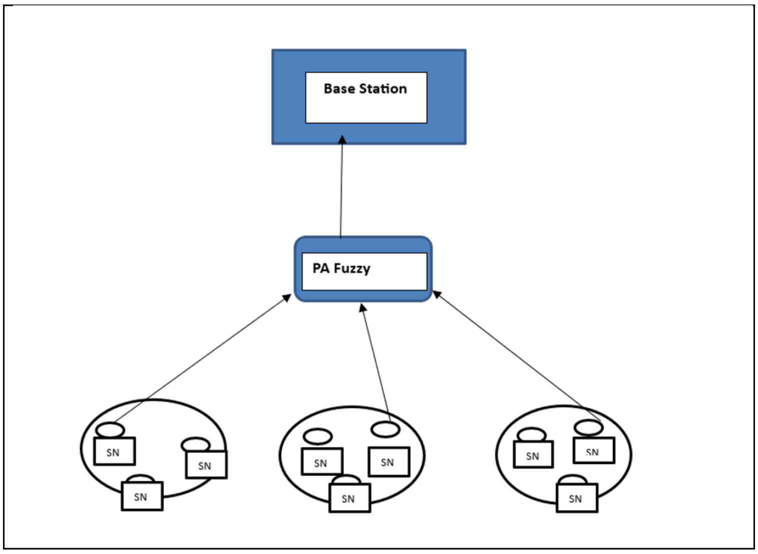

Fig. 3.1: PA Fuzzy in WSN's.

the appropriate optimize path selection process, The source node sends the RREQ packet to the destination node. The RREQ packet is sent by intermediate nodes to the target node. The sensor node has knowledge of the network's preceding and subsequent neighbors' distance and energy values. Finally, RREQ from multiple nodes via various channels is received by the target node.

Algorithm: PA Fuzzy system
Input: Noise removal filers and encryption.
Output: Path optimization.

1. Start up
2. Sensor data is collected by PA Fuzzy system.
3. PA Fuzzy system does not change rational like cluster head.
4. PA Fuzzy it is fixed selected based on particle swarm optimization techniques optimized distance from cluster and base station.
5. PA Fuzzy system act like filter removes noise moving data toward base station.
6. PA Fuzzy system twice encrypt data for protection.
7. Base station receive data and Forword to end users.
8. End user receive keys and decrypt data.
9. End.

All optimized pathways were calculated and arranged using the node value sum. The destination uses the primary optimized path to send a packet of RREP data to the original station. additional network-wide optimized diversions Use the alternative channels for data transfer if a network link or node fails. to improve the path selection algorithm after carefully following the PA Fuzzy implementation steps.

4. Result Analysis. Version 2.35 of Network Simulation (NS) is utilized to implement the unique intelligent agent-based PA- Fuzzy mechanism that has been proposed. The outcomes of the empirical simulation demonstrate how well the PA-Fuzzy performs when transmitting data. The comparative findings are discussed in the subsections below.

4.1. Contextual Simulation. Table 4.1 displays the environment of the simulation. Details about the network parameters utilized in the design of the PA Fuzzy simulation are provided in Table 4.1. The deployment of WSN employs the two-ray ground radio propagation model. The effectiveness of several performance measures

Table 4.1: Simulation Environment

S.No.	System Parameter	System Contribution
1	Model of Antenna	omnidirectional Antenna
2	Length of Queue	50
3	Routing Protocol	AODV
4	Number of nodes	100
5	Data Rate	2 M.B.
6	Basic Rate	1 M.B.
7	Total Simulation Time	100
8	Network Interface	Physical wireless
9	Interface Queue Type	Trial drop
10	Type of Channel	Wireless connection
11	Radio-Propagation	Double-Ray Ground

Table 4.2: Comparing results of IA Fuzzy's PDR performance

Simulation time	PDR Performance			
	PA fuzzy	PSNR	SSIM	MD
0	0	0	0	0
10	12	6	5	4
20	33	15	13	9
30	54	35	27	21
40	77	61	44	41
50	102	82	75	56

is evaluated to judge the suggested systems. The enhanced performance is evaluated based on metrics such as latency, throughput, packet delivery ratio, and energy usage.The peak signal to noise ratio (PSNR), the structure similarity index (SSIM), and the miss detection (MD) technique are compared to the PA-Fuzzy for successfully removing noise in WSN. The section below provides a definition of performance metrics.

4.2. Comparative Metric Analysis. The performance enhancement of the proposed systems is evaluated based on metrics such as latency, throughput, packet delivery ratio, and energy usage.

4.2.1. Packet Delivery Ratio. The ratio of packets transmitted and received at the destination node. The formula given in Equation 4.1.

$$PacketDeliveryRatio = \frac{\sum_{i=1}^{n} R_{Pi}}{\sum_{i=1}^{n} S_{Pi}} \tag{4.1}$$

Showcase the comparing results of IA Fuzzy's PDR performance in Table 4.2. The assuming the suitable simulation period, the performance graph on PDR in Figure 4.1. The empirical findings of the suggested PA Fuzzy mechanism and the currently in the PSNR (peak signal to noise ratio), the SSIM (structural similarity index)and MD (Miss Detection) mechanisms are shown in Figure 4.1. The simulation time for the X-Axis ranged from 0 to 50 seconds. The PDR percentage is shown on the Y-axis. With an increase in simulation time, The projected PA Fuzzy network's PDR increases. Existing mechanisms behave in a similar manner, but according to performance data, the PA Fuzzy mechanism performs better than PSNR, SSIM, MD.

4.2.2. Throughput. The number of bytes and the corresponding simulation time that were received at the destination node. The equation provided in equation 4.2.

$$Throughput = \frac{\sum_{i=1}^{n} Pi}{Time} * 8 \tag{4.2}$$

Showcase the comparison of IA Fuzzy's throughput performance in Table 4.3. Figure 4.2 shows the suggested

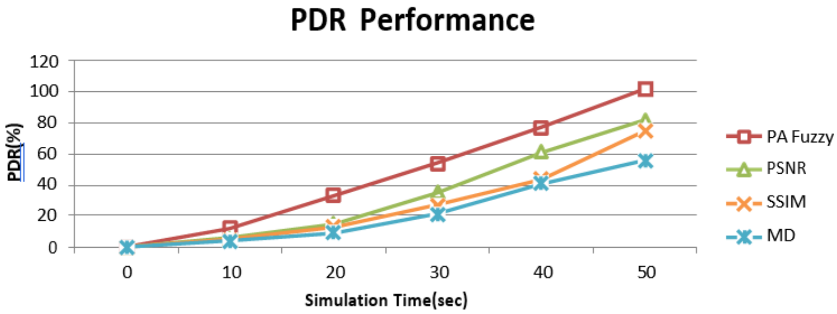

Fig. 4.1: PDR performance comparison.

Table 4.3: Comparison of IA Fuzzy's throughput performance

Simulation time	Throughput Performance			
	PA fuzzy	PSNR	SSIM	MD
0	0	0	0	0
10	75606	50186	41146	38457
20	77097	44697	36147	31457
30	76354	41257	28488	21545
40	81307	37146	23985	18257
50	83375	36456	21457	16962

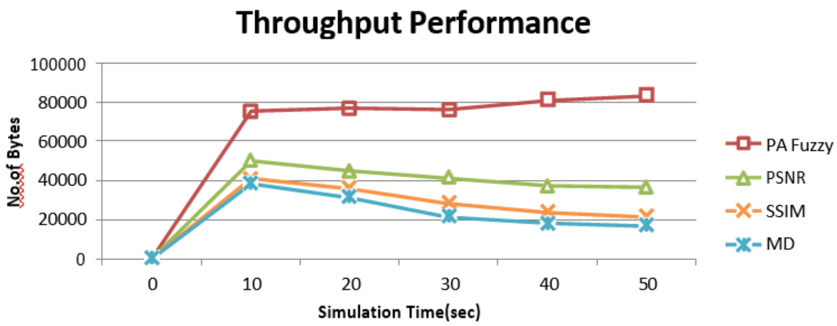

Fig. 4.2: Comparison on Throughput performance.

mechanism's throughput performance together with the corresponding simulation time. The proposed PA Fuzzy mechanism's throughput performance is shown in Figure 3. The X-axis shows the simulation time, which ranged from 0 to 50 seconds. The Y-axis is scaled by the quantity of bytes received at the destination node. Throughput performance significantly improved with the suggested PA Fuzzy technique. In compared to the existing mechanisms with simulation time 10 PSNR, SSIM, MD which got 50186,41146,38457bytes, respectively, 75606 bytes were obtained for the proposed PA Fuzzy technique.

4.2.3. Delay. The interval between the sending and receiving of a packet. The given equation in Equation 4.3.

$$\mathrm{Dl} = \sum_{i=1}^{n} (\mathrm{Psti} - \mathrm{Prti}) \tag{4.3}$$

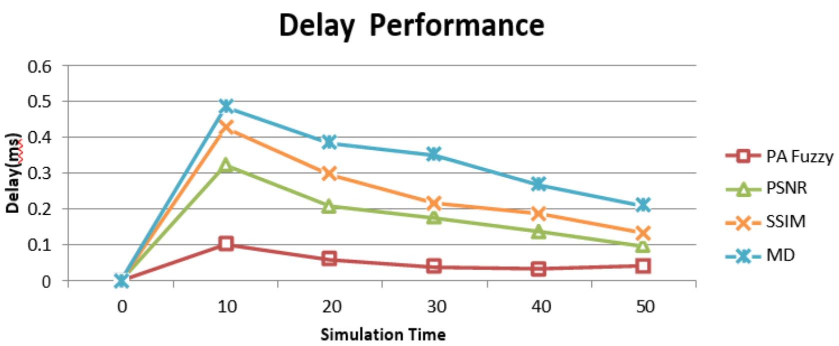

Fig. 4.3: Results of the comparison of delays.

Where Dl indicates delay, Pst indicates packet send time ,Prt indicates packet received time. In Table 4.4 compare the delay performance of PA fuzzy, and show the results. In figure 4.4 demonstrates how the suggested

Table 4.4

Simulation time	Delay Performance			
	PA fuzzy	PSNR	SSIM	MD
0	0	0	0	0
10	0.101	0.323	0.427	0.485
20	0.0605	0.208	0.297	0.384
30	0.0391	0.176	0.215	0.351
40	0.0321	0.136	0.186	0.268
50	0.0404	0.097	0.132	0.21

mechanism's delay performance changes with the amount of simulation time. The outcomes of the proposed mechanism are compared to the system's current state-of- the-art.

The results of the suggested mechanism's comparison for network latency are shown in Figure 4. The Y- axis is used to track milliseconds of network latency, and the X-axis is used to measure simulation time in seconds. The empirical results showed that, when compared to the system's current state, the proposed mechanism performed better. The suggested mechanism significantly improved performance outcomes measured from 0 to 50 seconds. Although there is a significant network delay at first, the suggested technique eventually decreases and minimizes it.

4.2.4. Energy Consumption. It indicates the overall amount of energy used by the sensor nodes for the transfer of data and other network operations. The provided formula in Equation 4.4

$$\text{Energy} = \sum_{i=1}^{n} NE_i \tag{4.4}$$

The evaluation of energy efficiency of PA Fuzzy is shown in Table 4.5. Figure 4.4 shows the amount of energy used for each simulation period. The graph displayed the total energy consumed for each time interval. Partially missing from the experiment are the first 0 and the remaining 50 seconds. One hundred joules of energy was allotted to every sensor node in the PA Fuzzy network. A more steady increase in energy consumption is observed as the simulation time increases. The proposed techniques use little energy, nonetheless, as compared to current ones. The proposed mechanism PA Fuzzy consumes 84 J at end of simulation, while the existing mechanism PSNR, SSIM, MD[9][10][11] consumed is 49 J, 32 J and 19 J respectively.

Table 4.5: Evaluation of energy efficiency of PA Fuzzy

Simulation time	Efficiency in Energy			
	PA fuzzy	PSNR	SSIM	MD
0	100	100	100	100
10	97	86	81	75
20	94	72	65	56
30	92	61	50	33
40	88	51	39	22
50	84	49	32	19

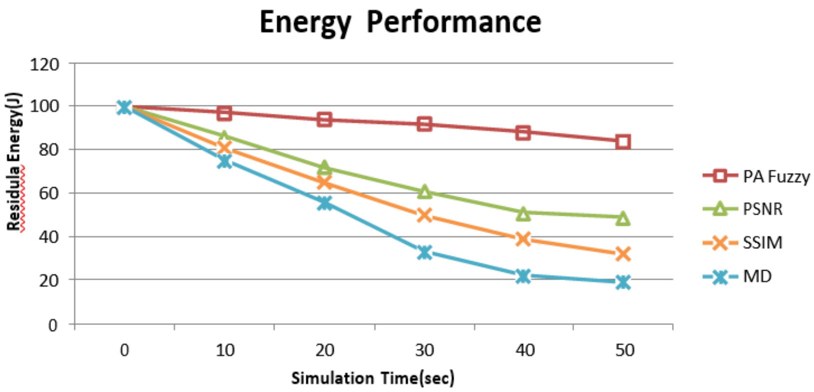

Fig. 4.4: Comparison on Energy Consumption.

5. Conclusion. The progress in WSNs is applied in a variety of applications, including those related to the the armed forces, medical care, farming, urban planning, etc. The WSN is highly efficiently used for data transmission. The operational capabilities dependent based on the quantity of sensor nodes environments. Because WSN is inherently resource-constrained, the sensor nodes face severe limitations. Even if there are a lot of issues with the current WSN, addressing performance efficiency and network latency is crucial. To tackle the problems in WSN, this study's paper suggested an innovative PA Fuzzy. The PA Fuzzy plays a essential function in transmission of data and the choice of the best routes between the base station and sensor nodes. When data is travelling towards the base station, PA Fuzzy acts as a filter to remove extraneous noise. Additionally, the PA Fuzzy system will twice encrypt sensor data before sending it reaching the base station. Data is finally sent from the base station to the user who is the only one who can decrypt it using proper keys. In future better encryption algorithms can be used in term of keys in PA Fuzzy intermediate system for protecting sensor data. However, while comparing several energy-efficient WSN techniques, the suggested PA Fuzzy outperformed all. To improve WSN data transmission, the PA fuzzy is therefore optimized. NS2 simulations are used for the implementation. The experiments demonstrated that, in terms of performance, the suggested method greatly surpassed the standard system.

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