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Enhancing Node Lifetime In Wireless Sensor Networks Using Itdms With Apteen Protocol

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Abstract

Wireless Sensor Network (WSN) applications are expanding every day, and wireless sensor networks are being used to access a variety of applications and resources. Furthermore, while fast adoption of wireless sensor networks enhances network usage, it suffers from power shortages owing to the low active power of wireless sensor nodes. A variety of power management techniques have been tried to enhance lifespan maximisation, however they all have flaws in terms of quality and effectiveness. An Improved Time Division Multi attribute Sleep (ITDMS) protocol using the popular APTEEN algorithm has indeed been explored in this study to address this issue. Cluster formation was accomplished using the APTEEN protocol, and the suggested approach exchanges info about the status with its neighbours at every data collecting time slot. The technique selects the condition using approximation based on neighbour information, neighbor's power parameters, as well as its own metrics. The technique determines the condition and shifts its mode among sleep and wake up depending on the approximated level. With a total throughput of 98.4%, the suggested technique extends the life of WSNs and increases data collecting efficiency.

Keywords: Lifetime, APTEEN, Depletion, EavesDropping, Denial of Sleep and multi-attribute.

Introduction

The wireless mesh network is made up of several kinds of sensors nodes, each of which has its own radio for packet data transmission and receiving. Sensor networks come in a variety of shapes and sizes, but some of those contain data storage areas where data may be accessed by destination node. Every sensor node is powered by a battery that provides electricity to the radio, allowing it to broadcast and receive packets of data [1]. There at sensor nodes, there are significant energy loss during each transmission and receiving of data streams. As a result, every transmission or receipt of packets causes the sensor nodes to lose a certain quantity of energy, resulting in power degradation. This has an impact on the sensor node's lifespan as well as the sensor network's lifespan.

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The convenience of a sensor network is that it may be set up in minutes. This is useful in a variety of scenarios, including combat zones, extreme circumstances, and so forth. Not only that, but most businesses utilise their own network to execute a variety of activities that need data collection and provide a variety of services that may be accessible via sensor nodes [2]. The sensor nodes' finite energy is a major danger to the network's longevity, and if a set of nodes in any location loses all of their energy, the network's goal will be impossible to fulfil. In order to offer services for an extended length of time, the network's lifespan should be maximised.

In wsns, the Low Energy Adaptive Cluster Hierarchy (LEACH) method aids in the grouping of sensor nodes. TEEN and APTEEN algorithms are similar. APTEEN, a TEEN variation, is a protocol that seeks to collect periodic data and respond to time-dependent events. It's also in charge of cluster formation. As seen in Figure 1, cluster leaders in APTEEN are in charge of data gathering and energy conservation. Three types of persistent inquiries are supported by the protocol for event monitoring. With the problem of overhead and complex multiple levels cluster creation, as well as the use of threshold-based functions, simulation analyses show that it outperforms LEACH [3-4]. The protocol divides the nodes into clusters, each of which aids in the transmission of data packets to the sink node. A variety of energy management approaches have been explored in order to extend the lifetime of the wireless sensor nodes. Because not all nodes can transmit data at the same time, there are a variety of methods for scheduling them, including time division multiple access, round robin, and so on. The round robin approach involves the network's nodes performing data transmission in a cycle. The data transfer in the TDMA method is done in a separate cycle. The whole time frame is divided into a number of shorter cycles, with each period of time allowing a different group of nodes to transmit data.

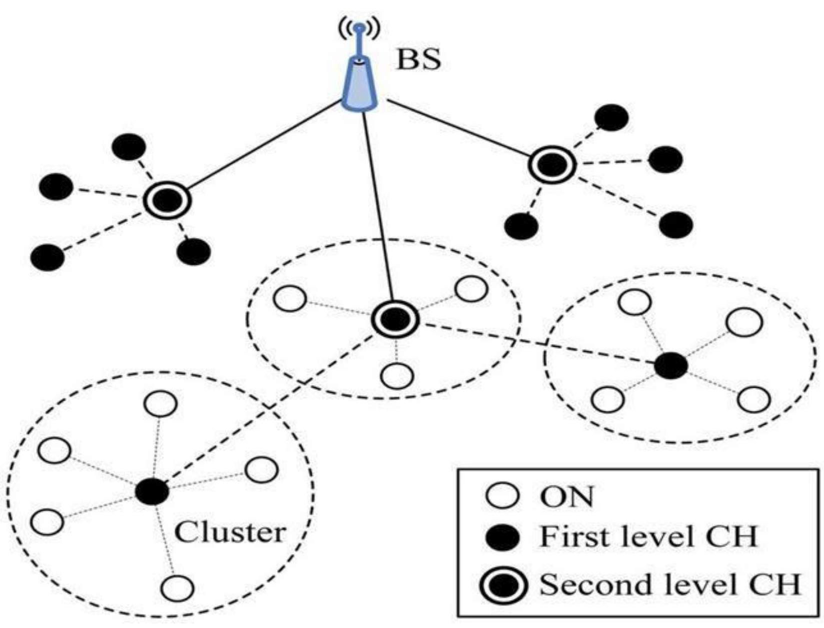

Figure 1:Basic clustering in APTEEN

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Adaptive sleep is a method of sleeping that is adjusted to the network's circumstances, and there are several protocols for doing so that have already been explored. The goal of this research was to improve the lifespan of a wireless sensor network rather than clustering. The specialised APTEEN protocol is utilised to cluster the sensor nodes. When there is no data transmission in a specific path in the present time cycle, the node will switch to the sleep node in adaptive napping. Only when there is a data transmission in the specified path will the node enter finally woke mode. Furthermore, attacker node may shorten the lifespan of a sensor network [5]. The malignant node sends out packets that cause different network risks and shorten the network's lifespan. This was aimed at extending the life of wireless sensor networks and assisting in the avoidance of various network attacks. It incorporates an improved time division multi attribute scheduling algorithm with APTEEN to plan the sleep and wake-up modes of node based on different network characteristics.

Literature Survey

The past efforts to improve network lifespan in WSN are addressed in this part, along with its drawbacks and restrictions. To solve LEACH's traditional problems, an energy-efficient procedure is based on LEACH was presented [6]. LEACH is a heap routing system that builds clusters and collects data before transmitting it. This novel routing method incorporates fuzzy C-means clustering (FCM). Clustering centres are computed using FCM, and if the cluster centre is fulfilled, the nodes join the cluster depending on distance. If the cluster centre is not satisfied, the cluster centre is regenerated. Clusters may be improved further by adjusting characteristics such as node degree of membership, power weighting ratio, and distances weighting component. Clustering a head were chosen at the specified centre using these parameters. Even if the factor is not up to the level, the centre associated CH selection can pick nodes existing exclusively in that region. To balance the energy, an improved 3 layered hybrid clustering method (ETLHCM) was used to restrict the control messages [7]. The sensors are split into several tiers in this work based on the energy. A grid header was chosen to collect data from CHs. The grid head was chosen using an FCM technique that included distance and remaining energy estimates, depending on which the most highly prioritised node was chosen. Then, following the standard LEACH process, CH was chosen, with residual energy included in. For data transmission, TDMA-based multiplexing with identical time slots is used, which necessitates wait period if the nearby node is in the resting state.

The Cuckoo-Search (CS) method and the LEACH protocol were used to create a mixed residual energy-based distributed grouping and routing (REDCR) system [8]. The CH locations and overall number of CHs were determined using the CS method. Super CHs were stationed closer to BS to collect data from CH and deliver it to BS. For data transfer assistance, this super CH was chosen through cooperation of all the elected CHs. The data sending nodes are only engaged where it has been determined that the rest of the residual CM is sleeping. Because any of the CM can transmit, the CH and mega CH must be active at all times. As a result, energy usage at the CHs will be greater, necessitating frequent head selections. Using an inter decision-making method, optimum

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CH selection were thoroughly explored in different WSN in balancing the energy constraints. The difficult difficulties and limits in WSN for optimising network lifespan are discussed, and our suggested approach overcomes the prior restrictions based on this study[18-20].

Proposed Methodology: ITDMS-APTEEN:

The suggested time division multi attribute sleep method, which uses the leach algorithm, begins by gathering the neighbours' state at every time cycle. The technique conducts estimate related to current cycle transmit participants based on the state of neighbours such as energy, mode, and depletion rate. The technique selects the involvement to optimise the network's lifespan based on the attributes found and estimated above. TDMS Scheduler, Neighbour Situation Discovery, and Energy while Traffic Estimation are the steps that make up the whole process. In this part, each level will be thoroughly described. Figure 2 depicts the design and functional components of the Improved Time division multi-attribute sleep scheduling protocol including the APTEEN algorithm.

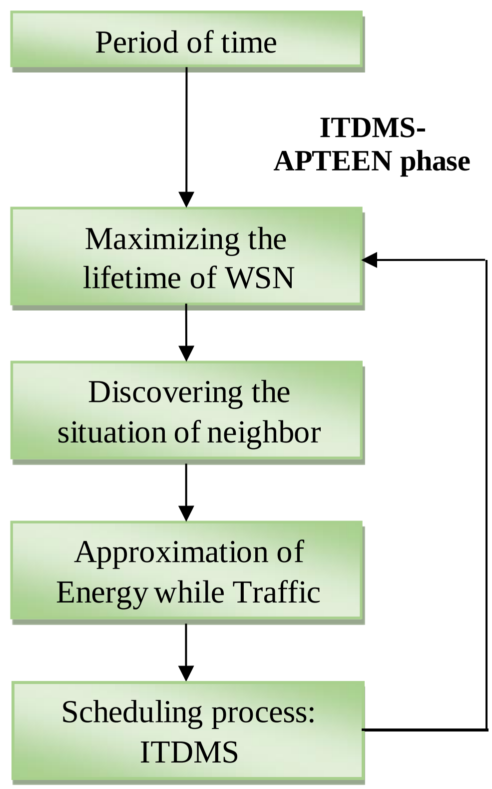

Figure 2: ITDMS-APTEEN architecture

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Condition detection: Neighbor

Every time cycle, the node generates a network status message that includes an energy variable, preceding cycle status, and energy minimization rate. The network receives the produced neighbour condition message [9]. When the neighbour receives a message, he or she responds with a conditioned reply message. Similarly, network nodes send out messages and receive responses from their neighbours. The node obtains the above-given characteristics from the response, that will be used to approximate energy transport in the following stage.

Algorithm: Detecting neighbor condition

Initialize
 	
Neighbor state Matrix N. Generate NRequest poin.
NRequest ={NodeNo., Energy E, Reduction Rate R, Preceding Status P}.
Transmit NRequest point
Start
Transmit Timer TT
While (TT==True)
{
Obtain NReply point
Extort NodeNo.,Energy, Reduction Rate, Preceding status
Update N = Σ Ni(N) U {NNo., E, R, P}
}
Obtain NRequest point
Extort Node No.,Energy, reduction rate, preceding status
Update N = Σ Ni(N) U {NNo., E, R, P}
Create NReply point
NReply = {NNo., E, R, P} Throw
NReply point.
End

The method mentioned above gathers information about the node's neighbours, such as energy, depleting rate, and prior state. The data collected is saved in the NCMs matrix. In the following stage, the knowledge gathered might be utilised to approximate.

Approximating energy while traffic occurs

Based on the above-mentioned attributes, the node makes a guess regarding energy and traffic rate at this step. The technique first calculates the energy factor based on the surrounding nodes' energy state, then calculates the traffic factor based on the depleting rate and preceding stage. The

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technique calculates the existing transmission supporting factor, which indicates the node's demand to be in wake-up state, regarding the two factors calculated.

Using the characteristics of the nodes discovered in the previous step, this approach calculates the energy factors and traffic factors to calculate the current transmission assistance factor. For node schedule process and selection, the computed broadcast support factor would be employed. The Transmission assistance factor describes how effective a node may be in a sensor network for cooperative transmission.

Scheduling with ITDMS

The energy traffic approximations is being used to conduct better time division multi-attribute sleep scheduling at each time cycle. Every time cycle, each node approximates energy traffic utilizing network variables gathered during the neighbour condition detection stage. The transmission assistance factor is calculated for each node in the network using the Improved Time division multi-attribute scheduling method. The node will be scheduled with the state based on the computed transmission supporting factor [10,11,12] and the number of clusters with a broader support factors than the threshold. The following equation is used to compute the fix position (1).

$$\textbf{CPTPF's threshold} = \sum_{j=1}^{size(N)} \frac{CPTPF}{size(N)} \text{-------------} \quad \textbf{(1)}$$

Where, CPTPF - Calculate Present Transmission Provision Factor. If $CPTPF_j$ > Threshold then the Set position as in sleeping state Else Fix position as waking state.

Numerical Results

The performance of the suggested improved time division multi attribute sleep scheduling algorithm including the leach method has been tested. The approach has achieved effective results in all aspects of wireless sensor network lifespan. Table 1 displays the simulated details that were employed to measure the suggested protocol's efficiency.

Table 1: Simulating Setup

Parameters	**Value**
Node count	150
Tool Used	NS 2
Transmission Sort	150 meters
Simulation Zone	50* 50 meters
Simulation Period	3 Minutes

There are numerous nodes in the network, each with its own status, energy, and traffic characteristics. The transmission provision factor (TPF) can be calculated as follows based on the scenario:

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$$\text{TPF} = \text{N}.\frac{\text{Energy}}{\text{No. of nodes with lesser energy rate than threshold value}} * \frac{\text{N.R}}{\text{NN}} * \ \psi \text{ -------- } (2)$$

Energy, depleting rate, transmit, count of neighbours, and other factors are used to calculate the transmission support factor. The protocol organizes the nodes to work in wake up or sleep state based on the computed broadcast support factors.

The energy component is the target of the denial of sleep attack in wireless sensor networks. Even though it has been planned for sleep mode, the compromised node does not go into it. The scheduling is done in a distributed way by using the ITDMS-APTEEN method. A node never arrange time for itself; nodes can only schedule time for their neighbours. Furthermore, if the attacker is able to wake up a node with a low energy parameter, the destination node can escape it by checking itself and neighbor's energy parameters. This aids in the prevention of a sleep denial assault in a sensor network.

The comparison findings on energy efficiency created by different ways are shown in Figure 3, and it is apparent that the suggested approach has generated significant energy savings than other methods. Figure 4 compares the energy minimization ratios produced by various approaches, demonstrating that the suggested method produces a lower depletion rate than previous ways.

Figure 5 depicts a comparing of throughput performance achieved by various approaches, demonstrating that the suggested method produces significantly greater throughput over previous methods.

Figure 6 compares the lifetime maximisation performance of various approaches and clearly indicates that the suggested method has delivered greater lifetime maximisation than other methods.

Figure 7 depicts a comparison of mitigating performance provided by various approaches, with the outcome indicating that the suggested method created more mitigation than another approaches.

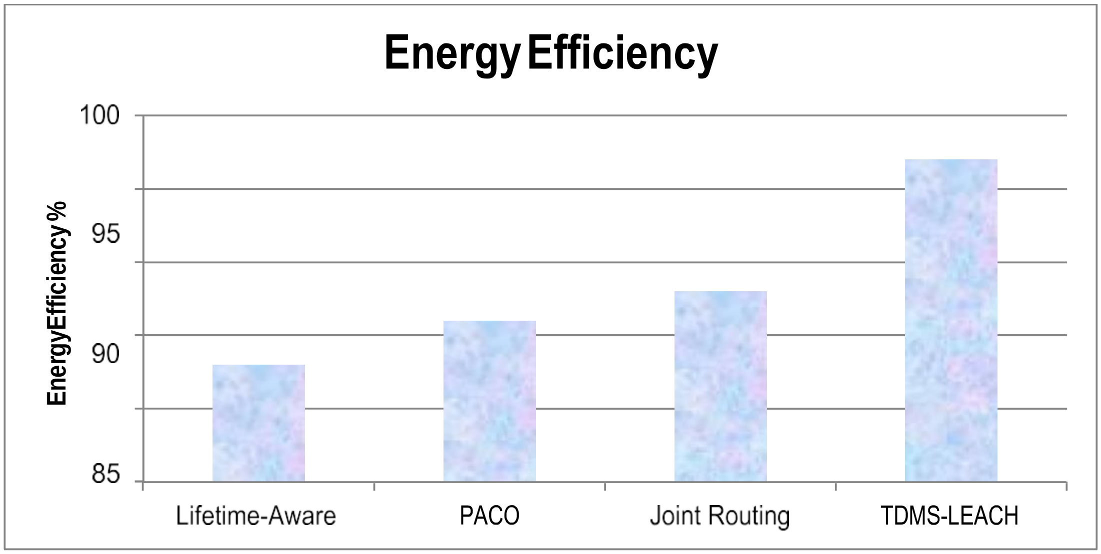

Figure 3: Assessment of energy effectiveness

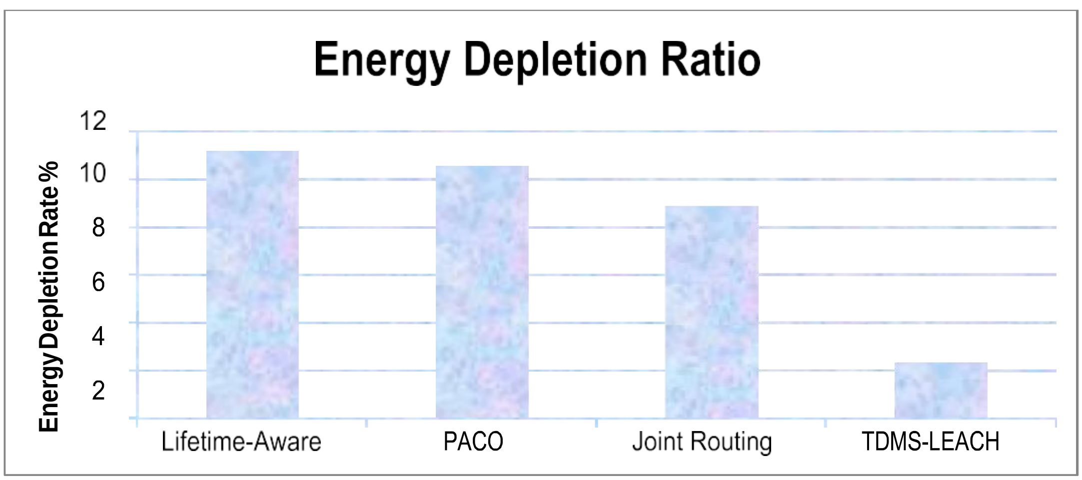

Figure 4: Assessment of energy depletion rate

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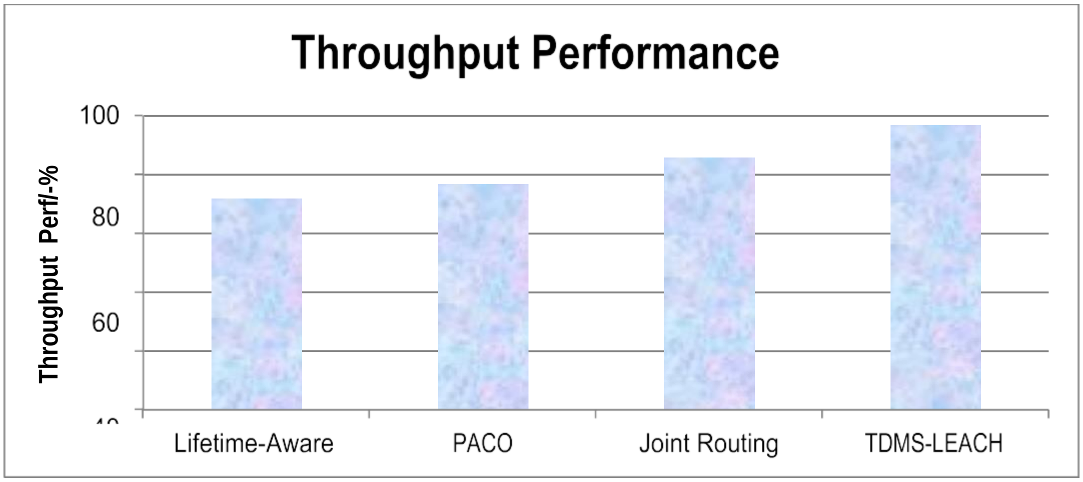

Figure 5: Assessment of throughput

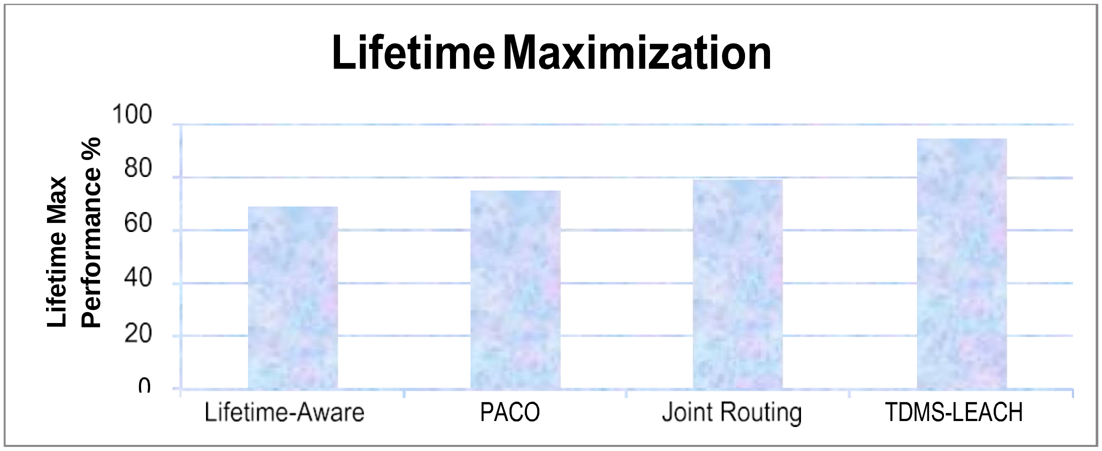

Figure 6: Assessment of lifetime maximization

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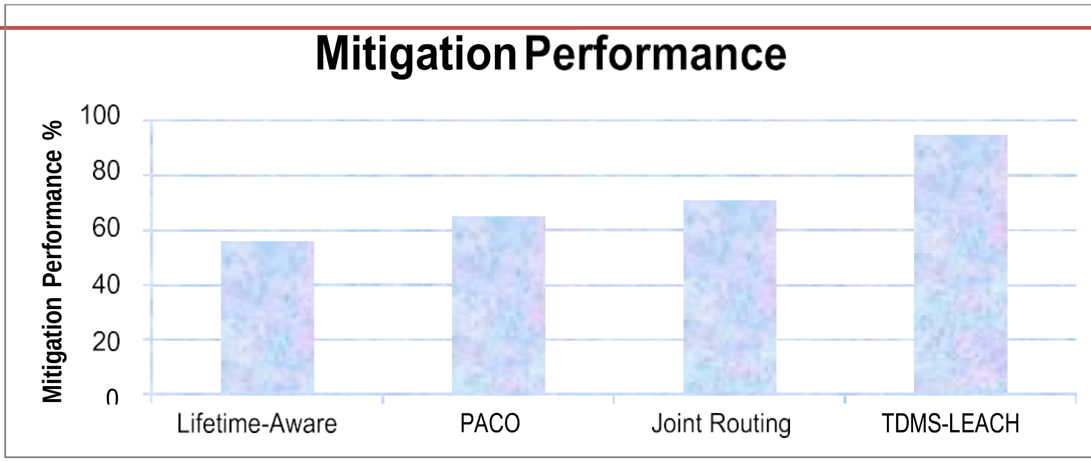

Figure 7: Performance assessment of mitigation

Conclusion

To extend the lifetime of wireless sensor networks, a improved time division multi-attribute sleep scheduling (ITDMS) protocol using the APTEEN algorithm is presented in this protocol. The technique begins by discovering neighbour conditions via neighbour condition request-response messages. After that, the technique approximates the energy traffic for each node. The technique chooses the status of the node based on the threshold value and the transmission assistance factor calculated with each of the nodes. The suggested technique extends the life of the wireless sensor network and enhances its throughput by up to 97 percent. In addition, the algorithm is much more effective at dealing with a variety of network threats, which increases security and performance.

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