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ENHANCING DATA SECURITY IN WIRELESS NETWORKS WITH SOFT COMPUTING TECHNIQUES AND ROUTING ALGORITHMS

Suman B[1] and Dr. Pramod Pandurang Jadhav[2]
[1]Research Scholar
[1,2]Department of Computer Science & Engineering
[1,2]Dr. A.P.J. Abdul Kalam University, Indore (M.P.) – 452010

ABSTRACT
In wireless sensor networks (wsns), sensor nodes have significant constraints on power usage and operational lifespan. Mission-critical applications must understand the network's operational longevity to ensure sustained networking functions. Recently, the use of efficient routing protocols has been proposed to extend network lifetime. Soft computing techniques consider the interoperability and adaptability required to address the complex challenges of wsns. Despite extensive research on soft computing techniques, comprehensive analyses of different algorithms' network parameters remain rare. This paper provides an in-depth examination of clustering-based routing protocols that secure data while being cognizant of soft computing techniques. To enhance network longevity, it is crucial to develop strategies to compensate for limited energy resources, ensuring prolonged sensor node activity. Effective power management techniques aim to reduce the energy consumption of each sensor node efficiently. Additionally, adaptive and efficient routing techniques have garnered significant attention for their potential to further extend the operational life of wsns.

Keywords: Wireless Sensor Network, Soft Computing Techniques, Resources.

I. INTRODUCTION
The broad use of technology, as well as the creation of several complicated technological solutions for safe communication between distant systems, have contributed to recent advancements in next-generation information systems and global communication. As a result, the technological environment we live in is becoming more adept at communicating with humans. Improvements in modern and smart technologies may be attributed to a wide range of biologically-inspired algorithmic approaches, including neural computation, AI, and genetic programming, as well as the most recent developments in soft computing and cognitive computing models. These techniques have recently made feasible the management of secure data communications and the analysis of patterns from almost every aspect of human existence. The area of pervasive computing has benefited from these developments in technology and security. For wireless networks built with sensors to work better, the right routing algorithm is needed to avoid link failures by using less energy and keeping transmission times as short as possible. Many methods of routing, both reactive and proactive, have been developed to save energy and protect the network from link failures. Out of all the routing methods that have been made, evolutionary- based routing, which is based on how a species changes over time or how it hunts for security ,was found to be the most efficient and secure way to find the best routes.

Wireless sensor networks (WSNs) are groups of dispersed, self-sufficient devices that are able to detect data, process it, and exchange information with one another using wireless connections. Ina WSN, nodes are very limited in how much power, memory, and processing they can do. Because sensors run on batteries, their life spans and, by extension, the life span of the WSN are at risk. By adding or removing nodes, the size of the network can be changed in a flexible way, and this will change the way the network is built in an unpredictable way. The biggest problems with WSN are batteries, bandwidth, and processing power. Keeping the network's power and energy levels constant will extend its lifespan. Therefore, WSNs rely on routing and clustering methods to facilitate inter-node and inter-domain communication. Routing in wireless sensor networks is different from routing in fixed networks. In WSNs, the best routing doesn't always mean picking the shortest path between a source and a sink. Because sensors don't have much power, the routing protocol in WSNs has to be smart. So, power-aware routing algorithms should be used to save WSN power and, as a result, make the network last longer.

Traditional WSN routing protocols may be broken down into three categories depending on whether they are flat-based, hierarchical-based, or location-based. After WSN implementation, researchers are interested in the possibility of applying embedded soft computing approaches. This is due to the smarts and adaptability of soft computing paradigms in dealing with nebulous and unreliable information in intricate settings.

Characteristics

Because of its effectiveness and dependability in so many different contexts, wireless sensor networks (WSN) have quickly risen to prominence as one of the most vital communication technologies. From whatI've read, WSNs have the following features that make them standout:

- Self-deployment in a dense way: WSN is a very large distributed computing system. In the network environment, there are a lot of sensors that are spread out and put there at random. Sensors are set up on their own because each sensor handles its own communication in the network.
- Having limited processing and storage capacities is a major drawback of sensor nodes because of their nature as tiny, independent, battery-operated physical units.
- Insufficient means of generating power. It is frequently difficult to replace or recharge these batteries since WSN applications are complicated to operate and sensor nodes relyon batteries for power.
- Sensor heterogeneity: Physical damage or failures may render sensor nodes unreliable and inconsistent, and their continued existence is not assured during the lifetime of a WSN.All the more so during a tough deployment.
- Data redundancy: Data can be sent to the central node in different ways by more than one node. This is because sensor nodes need to work together and talk to each other, and because sensor nodes are physically different.
- Focused on a specific application: Wireless sensor networks are often created and utilised for a single purpose before being retired or replaced. Specifically, this has an impact onthe network's energy consumption, routing needs, and size requirements throughout the design phase.
- Broadcast communication: In a WSN, sensors often use a variety of flooded routing mechanisms to communicate with one another and a sink node.
- Topological inconsistency: Because sensor nodes don't have a lot of power and the environment is harsh, the network's topology usually changes often, such as when a connection fails, a node dies,a new node is added, energy is used up, ora channel fades.
- There is a limit to how far data can be sent. This is usually caused by the physical limitations of the sensor nodes, which affect the coverage network and quality of communication.

Because WSN energy resources are kept secret, making the network last longer is seen as a challenge problem. Even though the limitations of battery-powered devices affect how long a network will last, the length of the path, how the load is spread out on each path, and how reliable each path is will also have a big impact. Data in a WSN travels from its origin node to a successor node chosen by its neighbours. It does this movement over and over again until it gets to the sink node, based on how it was chosen. Routing in WSN can be grouped by either how the network is set up or how the protocols work. Here are a few ways to explain what routing protocols are. Using energy efficiently in WSN is a bottleneck problem that affects the network's performance and lifespan. Researchers have recently looked at ways to deal with this problem by paying attention to how much energy is used and by managing power. The optimal routing method and use of energy optimization have a big effect on the performance of WSNs and guarantee that the network will last longer.Due to the limitations of WSNs, especially the limited energy of sensors, a smart routing should be done to make sure that nodes use the same amount of energy. This will make the network last longer and ensure network coverage.

II. LITERATUREREVIEW

In wireless sensor networks, routing plays a crucial role. The connection and network stability must be maintained while the performance is optimised. Numerous routing strategies were developed for the WSN to maximise energy efficiency and service life.

Singh et al(2022) .'s Firefly Algorithm (FA) imitates the way swarms of tropic fireflies look and move. FA is better than other computer algorithms because it has two important tools. Local attractions and automatic regrouping are two things that make the FAstandout. Since the strength of the light and the distance are related, the absorption coefficient tells us whether the fire flies are attracted to each other all overthe world or just in one area. This enables access to both global and regional settings. Depending on how desirable their surroundings are, FA may break off and reform into smaller groups. This improves the legitimacy of FA as a solution for clustering issues. Users are responsible for determining their own bundle requirements. By adding one to the unit counter in each concentration until the objective job is done, we can see that the group has shifted its emphasis. The same may be established, and both ideal CHs and the connection between CMs and CHs can be avoided. The weights used by dynamic k-means may evolve over time.

Bao et al. (2020) developed a VANET PSO-based efficient clustering V2V routing (CRBP) system to improve V2V. Cluster creation, particle coding, and cluster routing comprise the protocol. CHs are selected among vehicles with similar shifting paths. Second, the route particle, speed, iteration processes, and fitness functions optimize routing. Third, strategies are provided to considerably enhance routing. To create a stable cluster, each node's location, speed, and neighbours are considered, and link fitness is evaluated to find the optimum path immediately. The simulation indicates that CRBP's performance depends on the number of nodes, their contact radius, and the number of hops between the CH and each member node. CRBP has 20% greater PDR and 47% lower latency than CBVRP and QoS-OLSR. Brittoetal.(2019) recommended soft computing with cameras and microphones for WSN multimedia applications. SGP joins clusters. Three artificial neural network layers are proposed. The algorithm adds back propagation. The approach split the network into two groups. The reinforcement node changes the cluster once the eigen vector chooses the cluster technique. The simulation showed that the hybrid SGP clustering approach helped the network endure longerthan the previous one. A three-layer artificial neural network determines the optimum number of energy-efficient nodes in all CH and the optimal number of CHs for transmission.

III. RESEARCHMETHODOLOGY

The Soft-Computing Based Dynamic Route Selection (SCDRS) method has different steps, such as Node Extraction, Cluster Head Detection, Node Energy Analysis, and Dynamic Route Selection. How well a network works depends on many things, such as throughput, redundancy, and how packets are routed. All three of these parts work together, and there are different traffic risks for the packets that move through the network channels. Current challengers perform different traffic like adjustment, deceiving, sink openings, and some more. Academics have come up with different ways to cover the network packets from these events using different packet characteristics. Still, there are many things that don't help solve the problem of network risks. For example, routing strategies use things like payload, title, jump count, and bounce addresses, but they never thought about how the delay could affect change attacks.

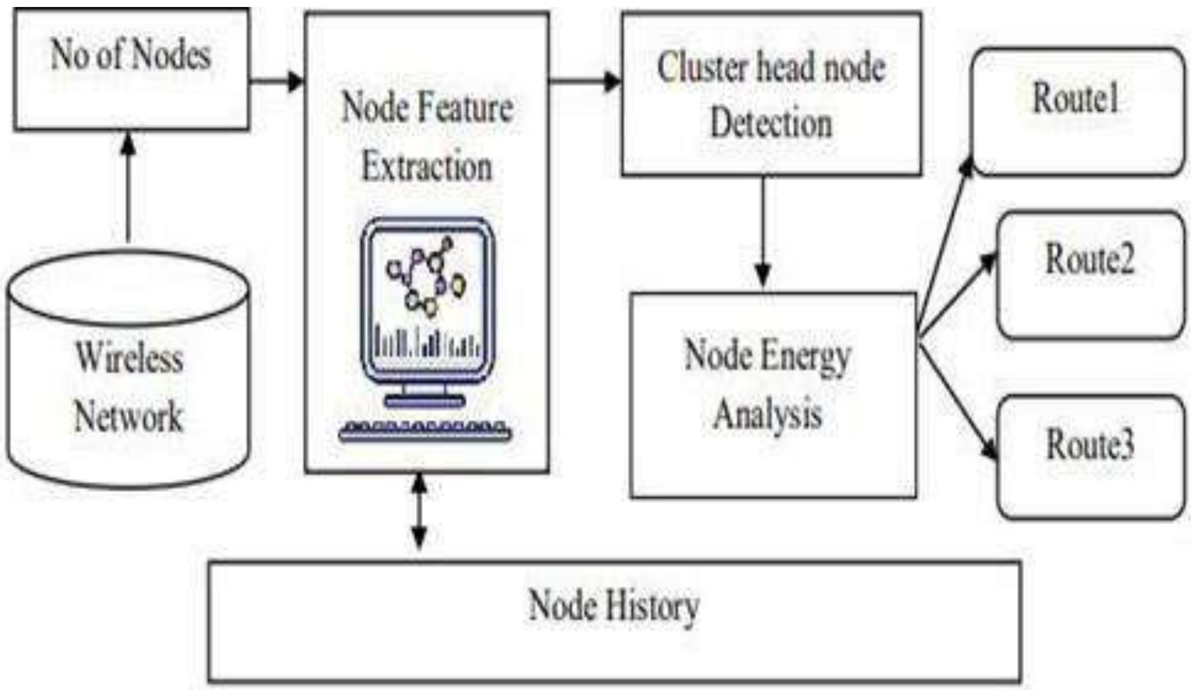

Figure 1: ArchitectureFramework

In the same way, there are many situations where cluster-based routing is not thought of. In this part, we talk about how well structures like distinguishing route, dynamic route choice, and stream construct guess work. The proposed strategy uses different points of interest, just like previous methods, but there should be a routing approach in each path. The proof of cluster head is found by exchanging data between the nodes of any network, which creates more traffic in a straight line. For every packet that goes through the network, the highlights are taken off, and the separated highlights have neighbor addresses 119 through which the packet goes.

From the history of getting previous packets and the current element vector, an arrangement of an unusual way to traverse is being found. Based on how routing is set up, a set of regular nodes through which packets pass can be identified. With the help of network topology, the set of routes that can be used to reach the service point is also identified. Whether or not a node is a cluster head is determined by using both the accessible route and the unique traversal route, as well as the current host succession.

It finds the best route based on the energy of each node. Any request for a route to be delivered by the source must bed one on time with little room for error. In this case, this property of network packets is used to find out if any of the cluster nodes are changing or copying the packet while itis in transit. Also, the network kept track of how long each packet took to travel and how many hops it went through. This soft computing paradigm is a computer system that imitates intelligent human behavior in computerized tasks and problem solving. It is based on the biological abilities of humans. AIS hasn't shown that it works well with routing in WSN, and it's not used very often in WSN. Recently, AIS has shown that clustering and selecting the head of a cluster can be used effectively. Routing and clustering problems in WSN depend mostly on how many clusters are static and fixed in the network. AIS could be a new area of study that hasn't been well looked into yet. Few papers were only able to show that it works with clustering.

Wireless Sensor Networks (WSNs) are crucial to the IoT environment and have garnered interest from the networking and IoT sectors. Micro Electro Mechanical Systems made clever and intelligent sensors change. WSN sensor nodes perceive and monitor ambient conditions to gather and provide the correct data to the user through the base station.

Proposed: Soft-Computing Based Dynamic Route Selection (SCDRS) algorithm

1) Select a family of successors by identifying the neighbors that are most similar in terms of gender, job title, and city
2) Search for a successors using the family of successors identified in step1 and the criteria stated in step 1
3) Choose the success or that is the best match for the query

The Soft-Computing-Based Dynamic Route Selection algorithm is a routing algorithm that is based on artificial intelligence. It is used to analyze a set of network nodes and recommend a path between them that would provide the best possible serving experience. The algorithm is applied to a network of nodes, and is able to learn over time.

In order to solve the separation issue in a mixed VANET-WSN network, this article suggests the Soft Computing Based Dynamic Route Selection (SCDRS). It presents the SCDRS system paradigm. For navigation, SCDRD makes use of physical locations. The nodes send signals (also known as Hello messages) on a recurring basis that include their node ID, present location, speed, direction, and energy level. The node's ID is mapped to its present address by the location server. The foundation of SCDRS is opportunistic sending. As a result, no path finding is done before data transmission. The routing protocol's hello module, which produces HELLO signals, is a component of the protocol. These communications seek to identify close peers and ascertain their level of vitality and movement. (velocity and heading).

How to transmit messages quickly and reliably over a number of steps from the source to the targe t is the central issue. In this study, the SCDRS, which usually consists of two modes—greedy modeand Delay Tolerant Networks DTN mode—uses data keptin then eighbor's data base to forward the message toward the target. The instrument or car that is nearest to the target and has the least weight receives packages in the hungry mode. When there is a local maximum issue, the forwarding in the SCDRS switches to DTN mode when the sending point (sensing or car) is nearest to the target with the least amount of weight. The sensor will cache the packet when anode cannot locate any wanted neighbors, and the vehicle will transport the packet for some time until it can forward the packet to some desired neighbors.

Algorithm-Packet Receiving

If packet has Deferred Route Output Tag it then

Create a Query Entry for packet and store the packet id Return.

if Delivary of the packet then Local Delivery Callback. with id of packet network id Return.

else

Request information of node from Location Service Lead Priority - Lookup Routing Table for minimum weight on priority if Local-Maximum then

Add Deferred Route Output. Nodes with id

Create Route for Local Delivery.of packet in the network with next node Settle Unicast Forward Callback.

Return. else

Create Route for selected node. Select Unicast Forward Callback. Return.

endif endif endif

IV. RESULT&ANALYSIS

Network Simulator2(NS2)is used to simulate a mobile wireless sensor network and compare the proposed method. In our proposed methods, we compared Soft-Computing Based Dynamic Route Selection (SCDRS) with existing algorithms (Optimized Route Cache Protocol-AODV (ORC-AODV) and Hidden Markov Model (HMM)).

Throughput: The number of packets sent to the destination at any point in the time interval is used to figure out the average throughput. It is a way to measure how quickly a node can send data through a network. During a communication, the average throughput is the rate at which messages are sent and received over a channel. Transmission time = file size / bandwidth (sec)

Throughput=SizeofFile/TimetoSend(bps)

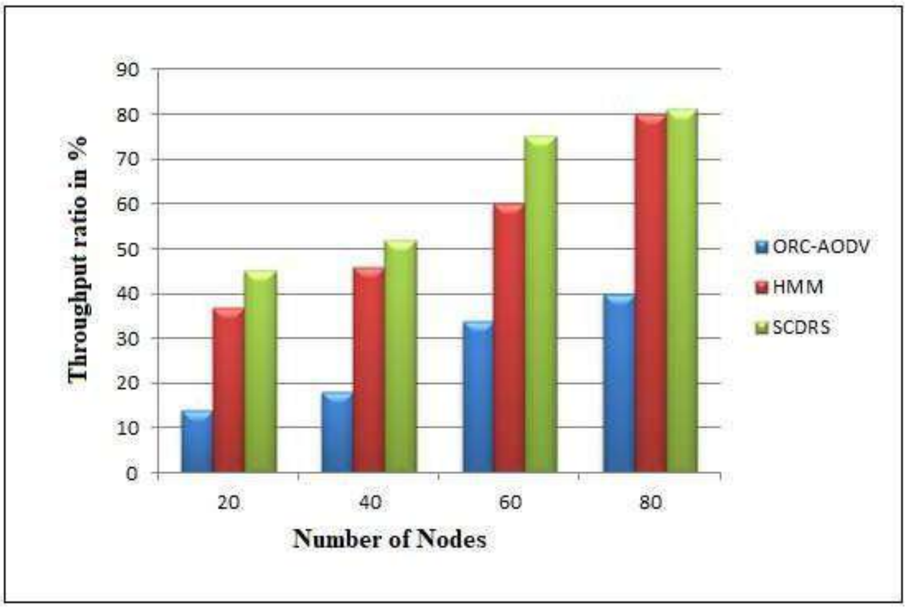

Figure 2: Throughput

Figure 2 shows the percentage of the throughput. The number of nodes is shown on the x-axis,and the percentage of throughput is shown on the y-axis. The proposed system has a higher level of data delivery and a higher throughput than other systems that are already in place.

Averageene-To-Enddelay: Finding a route, retransmitting, transferring, and propagating determine the average end-to-end latency. The average latency or end-to-end delay may be calculated by summing these timings (khawatreh et al. 2017). It's a packet's entire travel time. This formula calculates end-to-end latency.

Average end-to-end delay=TR-TS

Where TR is the time the packet was received and TS is the time it was sent.

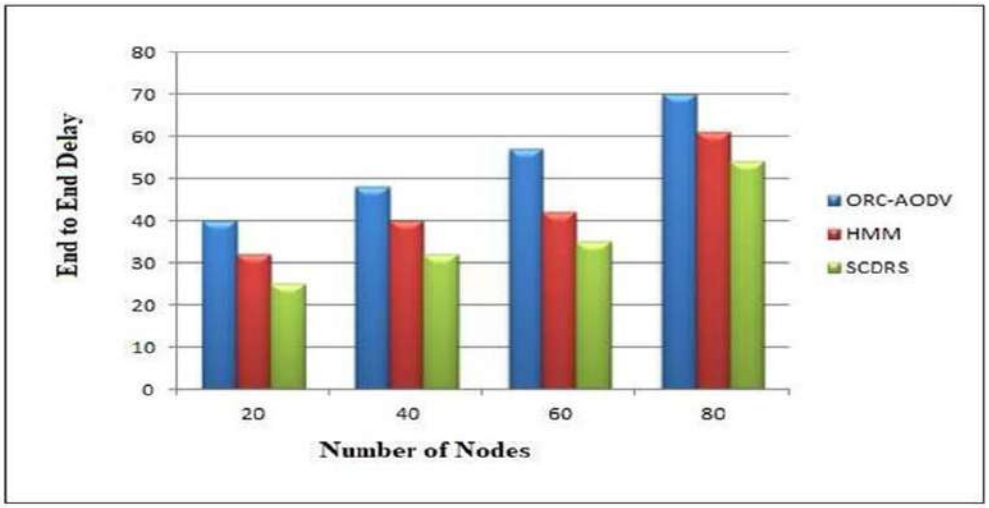

Figure3: Evaluation of Average Endto Enddelay

Figure 3 shows the percentage of throughput. The number of nodes is shown on the x-axis, and the percentage of throughput is shown on the y-axis. When compared to other systems, the proposed system has a better data delay ratio and a lower level of data delay.

In this wireless sensor network, the cluster method has the least amount of routing overhead and the most accurate detection of all the systems. In the end, you can see the results of all these methods on this page, which shows that SCDRS works well. With this method, performance is better and data transmission as a whole works better. Also, the proposed system will improve how well the network works.

V. CONCLUSION

In a mobile wireless sensor network, clustering techniques that use time division and frequency division will be used to connect more devices. Most clustering protocols for MWSNs are based on existing WSNs and focus on low-power, duty-cycled schemes. When compared to the current system of small sensor nodes, this system makes the network work better. All of the proposed systems use the shortest delivery time to send data. Cluster-based fuzzy and bee colony models for route optimization have shown that the proposed technique improves the Throughput by 81% and the End-to-End Delay by 54%. The strategies used for networks that are all the same would not work for networks that are not all the same. When an event is found, the sensor nodes that are close to it should quickly form a cluster around it. So, clustering should be used based on the techniques that work well with a heterogeneous network. WSN research will keep going in the future, andthe theoretical methods willbe used in the real-time sensor network platform.

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