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Emerging Routing Method Using Path Arbitrator in Web Sensor Networks

B.Harish Goud[1,2], Raju Anitha[3]
[1]Research Scholar in Dept,CSE, Koneru Lakshmaiah Education Foundation,Vaddeswaram,Guntur,Andhra Pradesh 522502,India
Assistant professor
[2]Dept.I.T,Chaitanya bharathi institute of technology,Gandipet,Hyderabad,Telangana,500075,india.
e-mail: bhg120109@gmail.com
[3]Dept.CSE. Koneru Lakshmaiah Education Foundation,Vaddeswaram,Guntur,Andhra Pradesh 522502,India
e-mail: anitharaju@kluniversity.in

Abstract— Sophisticated Routing has a big impact on wireless sensor network performance and data delivery. Because nodes join and leave the network on a whim, routing in WSN is not as simple a task as it is throughout sensor networks that are wireless. The fact that the most of WSN devices are resource constrained is another restriction on how routing is implemented in WSN. The WSN uses a variety of routing protocols. However, the primary goal of this research is to determine the best route from the source to the destination using wireless sensor networks and machine learning techniques Which is Particle Swarm Optimization. In this study, an innovative and intelligent machine dubbed the Path Arbitrator or selector, which will store all sensor data and use machine learning methods, is used to develop a new routing mechanism.

Keywords— adaptive, hop, routing, nodes, path arbitrator.

I. Introduction

A sensor network that is wireless consists of a large number of discrete, autonomous, flexible sensors that collect data on various environmental conditions and communicate it to other devices for system administration and control. [1-3] The wireless sensor device may include sensors that measure temperature, humidity, wetness, or pollution. Data collection and transmission to other terminals or network nodes is the sensor's main function. The two basic problems that restrict data transfer from one node to another are data transmission latency and secure data transfer. The data collected by the sensors can only be swiftly communicated to the controlling devices once the objectives of the sensor network have been met.

As the number of Wireless sensor network nodes increases, the traffic problem will worsen, and the performance of the network will decrease as a result. The number of intermediary nodes and cost factors are used to determine routing in wireless sensor networks (WSNs), where nodes currently experience traffic and end-to-end time delays.

1.1 Routing Protocol Types in WSN

The wireless sensor networks have several alternative routing techniques. We list those as [4]

routing in a hierarchical network
Routing in a flat network
route depending on location
route based on negotiations
the use of multipath routing
routing based on queries
Routing based on QOS
route based on coherence

Table 1. Routing protocol types in WSN

Routing protocols are divided into adaptive and non-adaptive types based on the flexibility of the protocol. While in non-adaptive protocols the routing is fixed, in adaptive protocols the routing changes as needed based on the traffic and other factors. [5].

The literature review component of this essay focuses on the earlier works of the leading researchers who have made significant contributions to the field of wireless sensor network routing. The introduction section of this essay discusses the foundations of wireless sensor network routing. The section on the proposed system, titled "Proposed System," describes the model's viewpoint, terminology, and operational features. The research paper is concluded in the conclusion section, and the references section then includes the research that was used to develop this proposal.

II. RELATED WORK

Because there are many large nodes in wireless sensor networks and there is a great deal of congestion in everyday operations,

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routing is slow in these networks. Each sensor node will gather information from the environment, use actuators to respond appropriately, and then send the information to the central node.

The cutting-edge routing protocol Efficient Node Stable Routing Suzan Shaky [6] suggested. This strategy conserves less energy. When choosing a reliable mobile node, factors including residual power, the required number of hops and the link quality to get there are taken into account. It is known as stable routing because The path the data takes a stable energy and node conserving protocol since it uses less energy.

Another energy-efficient routing technique called LEACH was introduced by YAN XU et al [7]. The LEACH extension is a protocol called Low Energy Adaptive Clustering Hierarchy. By using less power when routing, this protocol's main objective is to increase the lifespan of the wireless sensor network.This agreement divides the entire wireless sensor network into clusters, with a head node chosen for each cluster to route data to the cluster nodes..

Given that wireless sensor networks are dynamic and autonomous, reliability is a crucial factor that must be taken into account. Reliability is ensured through a protocol created by G. Yang et al. The Betweenness centrality is calculated in this protocol to determine the node's dependability. The nodes that will serve as backtracking nodes to the source nodes are chosen based on the Betweenness centrality. In this protocol, the node with the highest Betweenness centrality is chosen, and data is sent through the node. This methodology has produced more reliable outcomes..

W. Heinzelman et al presented an adaptive protocol [9]. This protocol essentially serves as a means of distributing data to the wireless sensor network. The data is transmitted using this each wireless sensor network node using a protocol. This protocol makes it simple and quick for other nodes or users to acquire data. This protocol is known as SPIN, or Sensor Protocols for Information through Negotiation.

Katayoun Sohrabi[10] et al. proposed sequential assignment routing, which belongs to the multi hop routing scheme. The Single Winner Election and Multi Winner Election algorithms are used in this protocol to produce cooperative and seamless data transport between source and destination nodes. The network with nodes that often turn on and off their radios as well as nodes that dynamically tune to multiple carrier frequencies is best suited for this protocol.

In their proposed routing algorithm, A. Mehmood et al.[11] used artificial neural networks to determine the optimum path. In this experiment, an ANN was created, trained on a sizable dataset, and evaluated using test dataset. It has been observed It has been noted that the protocol results are 42 percentage points better than LEACH.

Any domain can use machine learning to solve its difficulties. The work of Chaya Shivalingagowda in creating the routing protocols serves as evidence for this. In a unique way of routing for wireless sensor networks, Chaya Shivalingagowda et al. [12] applied machine learning algorithms.Stochastic Regression, Identity Maps, and Reinforcement phase learning were used to construct the routing protocol.

Pushpender Sarao [13] emphasised the use of machine learning and deep learning techniques to address routing challenges in wireless sensor networks. The researcher has published a list of machine learning algorithms for wireless sensor routing..Fuzzy based routing was proposed by M.S. Gharajeh and S.

Khanmohammadi [14]. The researchers employed a fuzzy approach to determine the probability of traffic. Based on the anticipated outcomes, the best path is selected, and the data is sent along it.There is a lesser likelihood of traffic on this route. This protocol has been shown to increase network lifetime and packet delivery rates.

To address the energy depletion difficulties in routing, F. Khan et al. [15] utilised the SVMs algorithm in wireless sensor networks. They used Ns-2 to simulate the algorithm and achieved superior outcomes to LEACH approach. In wireless sensor networks, the cluster heads are chosen using the SVMs approach.

Another approach of routing utilising deep learning was developed by Y Lee [16]. For this work, he created a unique method to locate virtual routes. We apply the Viterbi approach to discover virtual paths. This method has a faster overall route finding process than AODV, OLSR, and ZRP techniques.

Underwater wireless sensor networks Tiansi Hu and Yunsi Fei conducted original study on this issue [17]. There are frequently delays in the underwater networks of wireless sensors and disconnections. Wireless sensor networks used underwater are referred to as Delay/ Disruption Tolerant Networks, or DTNs, as a result of these issues. The researchers presented an energy-efficient route that adapts using machine learning techniques by taking all of these factors into account. The results of the simulation showed that this method produced superior outcomes in the DTNs at transient connection problems.

Authors	**features**	**drawbacks**
Chaya Shivalingagowda and coworkers[12]	In constructing the routing protocol, distributed regression, self-organizing maps, and reinforcement learning were used.	No intelligent agent exists to watch over the routing procedure.

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M.S. Gharajeh and others[14]	suggested routing using fuzzy logic In this study, The investigators used a fuzzy technique to determine the likelihood of traffic. Based on the anticipated outcomes, the best path is selected, and the data is sent along it. There is a lesser likelihood of traffic on this route. It has been demonstrated that this protocol improves the packet delivery rate and network longevity.	When routing data is uncertain, it cannot be changed to clear data.
Rajesh Verma and others [1]	Gather information on various environmental factors and send it on	Large sensor data cannot be stored in a single database
4Tiansi Hu and others[17]	Wireless sensor networks used underwater are referred to as Delay/ Disruption Tolerant Networks (DTNs) as a result of these issues.	Less traffic and fewer packets are delivered.

III. PROPOSED SYSTEM

The cloud-based path Arbitrator or selector is a special mediator is used in the proposed system to perform source node to destination node routing. An extremely clever machine called the route arbitrator will make a choice by using machine learning particle swarm optimization techniques to determine the optimum route between the beginning and ending nodes at the Path arbitrator. Additionally, route Arbitrator will compile all sensor data and use M.L. algorithms and particle swarm optimization techniques found in clouds with enormous amounts of storage.

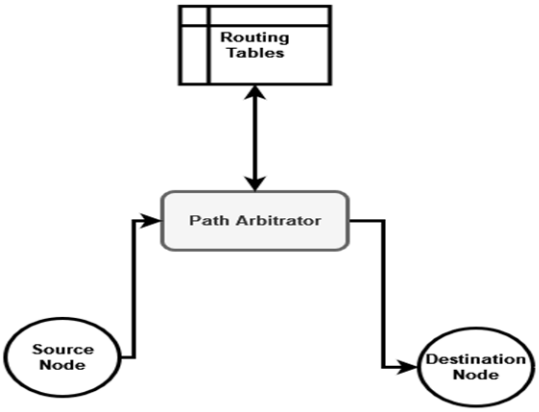

Figure 1.Path arbitrator with source and destination node.

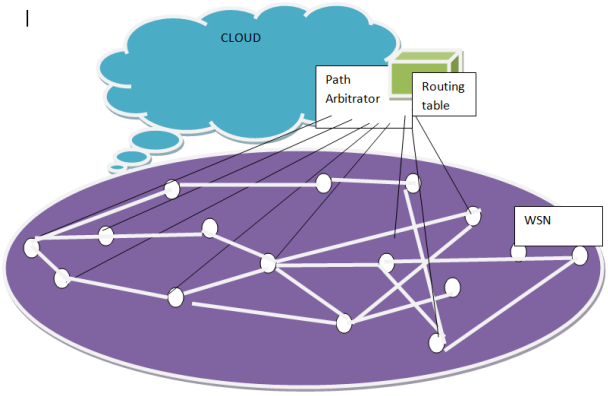

Figure 2 Path arbitrator with cloud based

The history of the routing tables is contained in the route arbitrator. The arbitrator keeps up-to-date routing data. Two methods are used to often update the route information. Those fall within the categories of router- or path arbitrator-initiated attacks.

The arbitrator sends a query signal to each network's routers to obtain the routing information in a path arbitration triggered routing information updating. The query signal is often and periodically broadcast. The routers provide the routing information to the arbitrator when the arbitrator issues a query signal. The arbitrator modifies the routing tables after receiving the routing data from the routers.

In router-initiated routing information, the router immediately communicates the updated routing information to the arbitrator if there is any change in the subdomain of the network, such as the arrival or departure of a new node. By either broadcasting a signal of enquiry to all wireless network routers or taking the most recent routing information from the routers routing table is frequently updated in this manner.

The target node from the source route arbitrator chooses the optimum route. Applying machine learning techniques to the data in the path arbitrator's routing tables results in the optimum route selection.

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The packet delivery ratio has improved using the suggested strategy. The following equation is used to determine a measurement known as the packet delivery ratio.

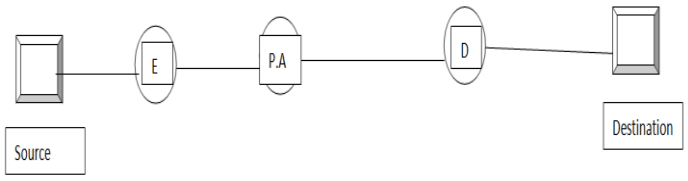

Figure 3 Complete interaction with P.A

Here, I'm employing asymmetric key techniques and double encryption to safeguard data from unwanted users. To improve security from hackers, two-time decryption processes are carried out: one for encapsulated data from the source and another for encrypting data at the path arbitrator. Similarly, at the destination side.Encryption:

$$\mathbf{eP} = [\mathrm{DA(e)(PVK0)} + [\mathrm{E.PVK1(pa).da}]] \_(1)$$

Data is encrypted using a private key (PVK0) and a second-time encrypted key (PVK1) at the path arbitrator to increase security, as shown in the equation by eP and DA, respectively.

In this project, I'm employing fuzzy logic in path arbitrators or selectors to transform unclear routing table data into clear routing table data. We can achieve ideal values without any ambiguity by using fuzzy logic. In addition to being utilized here to obtain decimal values from clear-cut data, fuzzy logic can also be found in many other locations, such as autonomous braking systems, washing machines, smart cameras, etc. Path arbitrators are intelligent machines that can perform computations on their own using various machine learning methods to choose the optimum path.

The cloud, which is internet-based storage where routing tables can be stored and retrieved, is where path arbitrators are kept**.**

Algorithm

Step 1: Launch

Step 2: Establish a network of wireless sensors

Step 3: Create an internal storage path arbitrator to store routing tables in the cloud.

Step 4: All router routing data is gathered by Path Arbitrator

Step 5: To find a route that connects the point of origin with the destination. source contacts the path arbitrator or selector.

Step 6: The path arbitrator predicts the optimum path using machine learning methods the target node from the source.

Step 7: Information is sended to receiveing sensor via the best path.

Step 8: Finish

IV. RESULTANT AND EXAMINATION

According to results in the NS3 simulation, we see that traffic per node is 34 kb/s when data item size is 100 KB, 65 kb/s when data item size is 200 KB, and 85 kb/s when data item size is 300 KB. Path arbitrator will function better than conventional WSN routing.

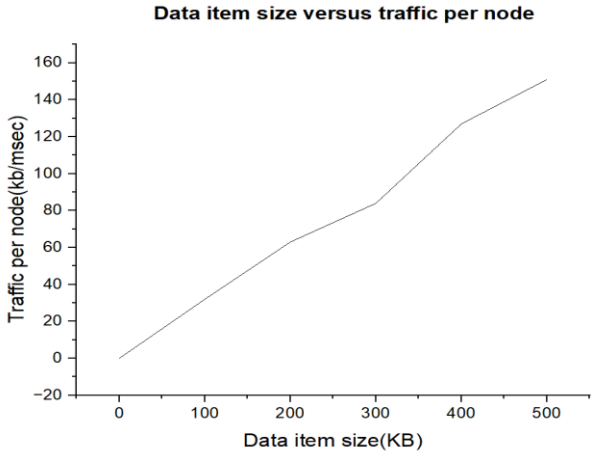

Fig 4. data item size VS traffic per node.

Table2

Data item size (KB)	0	100	200	300	400	500
Traffic per node(kb/s)	0	34	65	85	128	151

Ratio of Delivered Packets

The proportion of packets delivered in comparison to those obtained at the destination node is shown by the equation**.**

$$\textit{Ratio of Delivered Packets} = \frac{\sum_{s=0}^{c} \mathrm{PTs}}{\sum_{s=0}^{c} \mathrm{PTr}} \quad \ldots (1)$$

Where PTs is packet sent and PTr are packet received. Below (Table 3) shows comparison between traditional methods PS, PAWSN, LBSO, LEACH. Novel method PS (path selector) will give better performance over all as experimental results.

Table3 PDR Performance

Simulation Time	PDR Performance			
	PS	PAWSN	LBSO	LEACH
0	0	0	0	0
3	7	4	3	2
6	13	11	9	5
9	26	17	13	11
12	34	24	21	14
15	46	33	26	21
18	60	47	36	31
21	71	58	41	39
24	82	69	52	47
27	91	81	71	52
30	97	88	77	59

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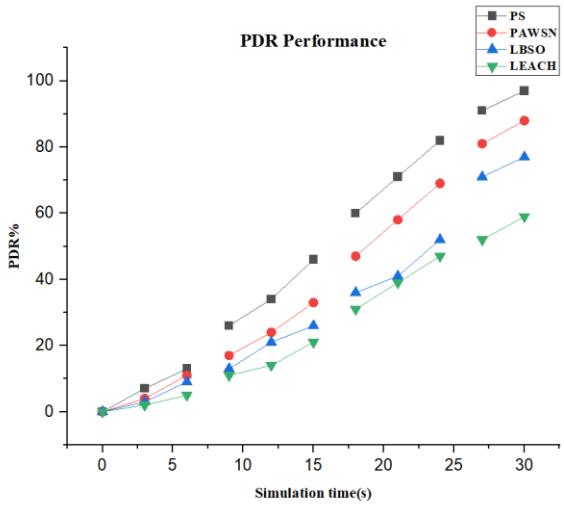

Figure 5. PDR Performance

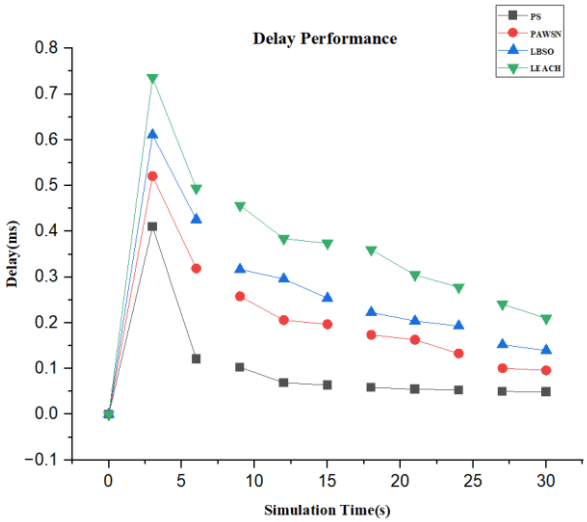

Figure 6. Delay Performance

For 3 simulation time PS has 7 packet delivery ratios, PAWSN has 4, LBSO has 3, LEACH has 2 as shown in (figure 5). Finally for 30 simulation time PS has 97 PDR very high when compared to PAWSN 88 PDR,77 PDR LBSO, and LEACH has 59 PDR.

Delay

the interval between the sending and receiving of a packet.

$$\text{Delay} = \sum_{s=0}^{c} \text{PTs} - \text{PTr} \quad \ldots (2)$$

Table 4 Delay Performance

Assume Time	Performance in Delay			
	PS	PA-WSN	LBSO	LEACH
0	0	0	0	0
3	0.4101	0.521	0.611	0.736
6	0.121	0.319	0.426	0.494
9	0.1029	0.258	0.317	0.457
12	0.0692	0.206	0.296	0.384
15	0.064	0.197	0.254	0.374
18	0.0588	0.174	0.223	0.360
21	0.0548	0.163	0.204	0.305
24	0.0533	0.133	0.193	0.278
27	0.0501	0.101	0.152	0.241
30	0.0490	0.096	0.140	0.21

Path selector or Arbitrator has less delay when compared to all other exiting techniques. For example experimentally if we see from (table 4) in 15 simulation time PS has 0.064 delay,PAWSN has 0.197,LBSO has 0.254,leach has 0.374 respectively.

Energy Performance

It shows the total amount of energy that the sensor nodes consume when transmitting data and doing other network tasks.

$$\text{En} = \text{so} \quad \text{n} + \sum_{p=1}^{c} \text{in1} + \text{in2} - - - - - - - - - - \text{Eq}(4)$$

Where En indicates energy, so n indicates source node in 1,in 2…. Indicates intermediate nodes respectively.

Table 5 energy performance

Assume Time	Performance in Energy			
	PS	PA-WSN	LBSO	LEACH
0	0	0	0	0
3	1.2	2.3	2.9	3.7
6	2.9	4.1	5.4	7.8
9	3.1	5.4	8.5	11.5
12	5.1	7.1	11.8	14.8
15	6.0	9.2	14.2	19.5
18	7.1	11.1	17.1	22.7
21	8.2	13.4	20.2	27.8
24	10.2	14.8	23.4	31.0
27	11.4	16.2	26.8	35.1
30	12.3	18.1	29.2	38.2

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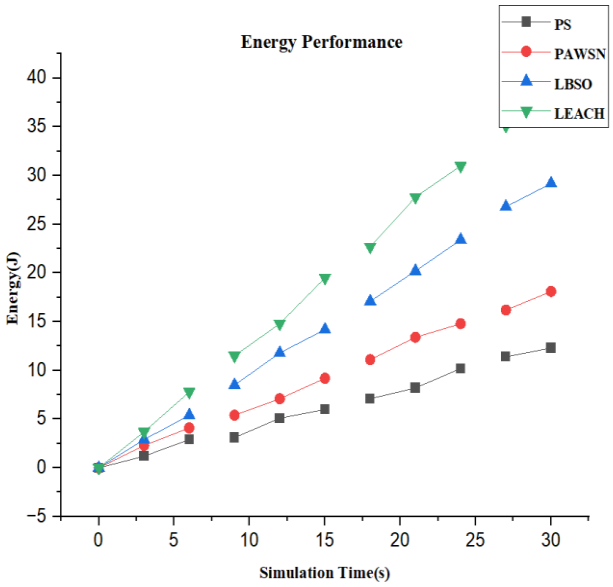

Figure 7. Energy Performance

V. CONCLUSION

Routing is a pretty difficult task, as was already mentioned. Numerous researchers worked on wireless sensor network routing to make it better. In the area of wireless sensor network routing using a cloud-based path arbiter, this paper represents one approach. All node routing data, including information about adding and removing nodes from the network, is contained in the path arbitrator. The centre path arbitrator may have access to all recently updated routing tables. The suggested protocol performs better than the current traditional classical routing protocols because it was created utilising machine learning algorithms based on PSO. The NS3 simulator can emulate this protocol. This method's primary goal is effective path using a sensor system reduced energy consumption and latency.

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