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Energy Efficient Routing Protocol for Wireless Sensor Network Using AI Technique

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ABSTRACT

The creation and use of sensor networks has piqued a lot of interest. Remote sensor network is an assortment of countless little hubs which goes about as switches too. The limited power supply that these nodes carry is non-replaceable and non-rechargeable, making energy consumption a significant issue. In order to extend the network's lifespan, energy conservation is a crucial issue. The choice of routing method is crucial to regulating energy consumption because the sensor nodes also function as routers. Energy Efficient Routing in Wireless Sensor Networks is the subject of this paper's analysis and research, which also includes a description of the wireless sensor network framework.

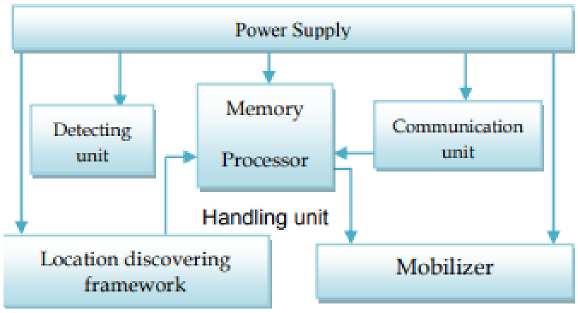
Keywords : Remote Sensor Network, Wireless Sensor Network Framework, WSN, Microcontroller

I. INTRODUCTION

Due to the development of wireless communication technology and a rapidly expanding research area, wireless sensor networks have become increasingly popular in recent years. A system of sensor hubs connected by a wireless medium is referred to as a WSN [1][2]. Every hub has handling capacity (at least one CPU, DSP chips, and Microcontroller), which can include a variety of memory types (such as program, information, and flash memories), a power source (such as solar cells or batteries), and a variety of sensors and actuators [3]. Energy protection is a major issue in WSN as sensor centers convey restricted non-battery-powered power source and it isn't not difficult to supplant the hubs which makes power saving essential to increment the lifetime of hubs. In order to extend the lifetime path of the network while data is being transferred, energy-efficient routing protocols are required [4].

1.1 Wireless Sensor Network

WSN is a network of small, independent devices called sensors that gather various types of Physical or Environmental Conditions, such as temperature, sound, vibration, weight, and movement at various locations, process the information, and then transmit the detected data to customers [5]. The environment's data are gathered and transmitted to the base station by means of these sensors. A base station connects the collected data to the real world, where it is processed, broken down, and presented to useful applications [2] [6]. These sensor hubs are found in a lot of WSNs. These sensors can send data to an outside base station directly or between each other. Numerous sensors can be used in a variety of applications to detect various events like fire, object movement, pressure, and so on. 7]. Figure 1.1 depicts the sensor node's fundamental design.



Framework of Sensors

The sensing (detecting), processing (handling), communication, and power supply are the primary four components of the self-governing sensor hub [1]. The sensor unit: are typically made from two subparts: analog to digital converters and sensors Sensors sense data in the form of analog signals, which are then converted by an ADC into digital signals and sent to the handling unit. Unit for handling: It is related with a little memory and manages the procedures that make the sensor center point work along with substitute center points to finish the designated recognizing endeavors. Unit of communication: It relates the center points to the organization.A sensor hub's most crucial component is its power source. It very well may be maintained by sun-controlled cells. In addition, there are various application-subordinate subunits. Most of steering methods and identifying endeavors require the data of region with high precision. As a result, it is typical for a sensor hub to have a framework for finding its location[3].

II. ROUTING IN WSN

Data transfer between sensor nodes and the base station necessitates the use of routing strategies [1] [2]. WSN routing differs from traditional IP network routing in a number of ways, including the fact that it is impossible to create a global addressing scheme for a large number of sensor nodes and the fact that, in contrast to conventional correspondence systems, every use of sensor systems requires the flow of detected information from multiple sources to a specific BS [8]. Different methods of routing exist. proposed for remote sensor network and these conventions can be classified as per different parameters. The classification of routing methods is shown in figure 1.2[1].

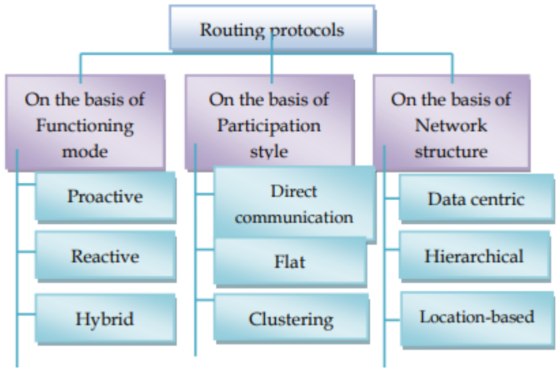


Fig 1.2 classification of routing protocol

Functioning mode based routing protocols The function of a wireless sensor network specifies its application. Therefore, routing protocols can be categorized according to the operation used to satisfy a WSN function as follows: Proactive Protocols: These protocols are also called as• table-driven protocols. In Proactive, the data is transmitted to a BS through the predefined route. For example LEACH, PEGASIS. Reactive Protocol: In Reactive Protocol the route is• established on demand. The route is established dynamically i.e.Network -based route is found when needed. TEEN, AODV, DSR are some reactive protocols. Hybrid protocols: All the routes are found initially and then• improved at the time of sending data. These protocols possess the concepts of both reactive and proactive. For example APTEEN.

2.1 Energy Efficient Routing Protocols

WSN routing protocols that save energy The energy efficiency of a network is a major issue in wireless sensor networks (WSNs). These days, networks are getting bigger, which means more and more information is being collected. All of this takes a lot of energy, which causes a node to die early. In order to extend a network's lifespan, numerous energy-efficient protocols are developed to reduce the power required for data sampling and collection. Some energy-saving routing protocols are as follows:

1. LEACH, which stands for "Low-Energy Adaptive Clustering Hierarchy," is a type of hierarchical protocol in which the majority of nodes communicate with cluster heads (C.H.) [1] [8]. There are two phases to it: i). The Arrangement Stage: in this stage, the bunches are requested and afterward Group Head(CH) has been chosen. The cumulation, wrapping, and transmission of the information to the base station (Sink) are the responsibilities of CH [2]. ii). The Review State Stage: in the past express, the hubs and the CH have been coordinated, yet in the second province of "Drain", the information is imparted to the base station (Sink). This phase lasts for longer than the previous state. The duration of this phase has been increased to reduce overhead. Every hub in the organization, contact with the bunch head, and move the information to it and after that CH will foster the timetable to move the information of every hub to base station [8] [2].

2. PEGASIS Power-Proficient Get-together in Sensor Data Frameworks" It is a "chain-bases convention" and a redesigning of the "Filter". Every node in "PEGASIS" only moves with a close neighbor to direct and acquire information. It receipts goes conveying to the BS, hence diminishing the amount of energy consumed per round [9]. The hubs are in this manner that a chain ought to be created, which can be finished by the sensor hubs alongside utilizing a calculation. Then again, the BS can process this chain and transmission of it to all the sensor hubs. [10]A greedy algorithm and universal system information at each node are expected in order to develop the chain. Accordingly, the design of the chain will start from the distant hub to the closer hub. To avoid a dead node, the chain is rebuilt in the same way if a node passes away [11].

3. TEEN “Threshold sensitive Energy Efficient sensor Network protocol” The TEEN is a hierarchical protocol designed for the conditions like sudden changes in the sensed attributes such as temperature. For a reactive network, the first developed. protocol was TEEN [12]. The reduction of the number of transmissions is the purpose of a hard threshold, which is done by allowing the nodes to transmit only when the sensed attribute is in the range of interest. The number of transmissions is reduced by soft threshold by avoiding all the transmissions which might occur when the sensed attribute is changed slightly or not changed. TEEN is well applicable for time important problems and is likewise quite efficient in terms of saving energy and response time. It also allows the user to manage the power utilization and accurateness to suit the application [13].

4. Energy-Effective Sensor Steering (EESR)

EESR is a level directing calculation [16] proposed especially to decline the power use and information inertness, and to give adaptability in the WSN. The Gateway, Base Station, Manager Nodes, and Sensor Nodes make up the majority of it [17, 18]. They are tasked with: The Base Station, which has a higher specification than standard sensor nodes, receives messages from the Gateway or from other networks. It sends and gets

messages to/from Passage. It also sends queries and gathers data to and from sensor nodes. Manager Nodes and Sensor Nodes transmit environmental data within a one-hop distance of each other until the Base Station [16].

5 Direct Diffusion

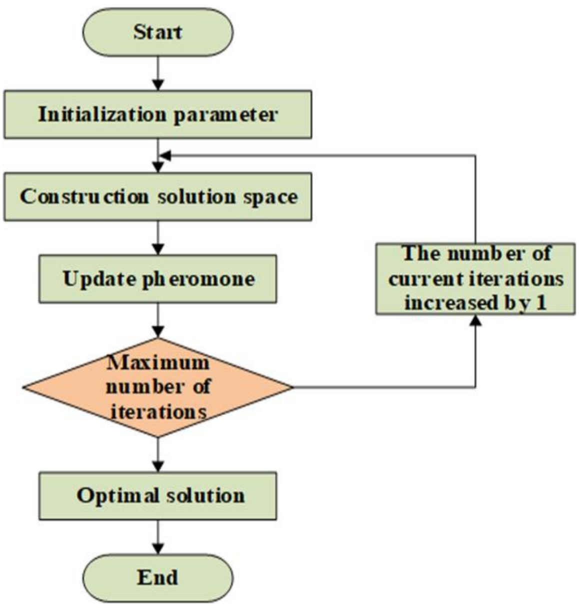
Data-centric routing protocol for collecting and publishing information in WSNs is directed diffusion [15]. It was created to address the need for data to flow toward the sensors from the sink, i.e. when the sink requests specific information from the sensors. Its fundamental goal is broadening the organization lifetime by acknowledging fundamental energy saving. It must use message exchange to keep the nodes' interactions contained within a limited environment in order to achieve this goal. This protocol is unique in that it provides multipath delivery through a localized interaction. Together with the sink's ability to respond to nodes' queries, this unique feature saves a lot of energy [1] [15].

6. The "Adaptive Threshold sensitive Energy Efficient Sensor Network" (APTEEN) is an extension of the "TEEN" and aims to respond to time-sensitive events as well as collect episodic data. After the BS creates the clusters, the C.H sends the features, threshold values, and transmission schedule to all nodes[12]. The C.H then performs information accumulation, which helps conserve power. The fact that nodes consume less power is the primary advantage of "APTEEN" over "TEEN." On the other hand, the most significant drawbacks of APTEEN are its complexity and extended deferment times [14].

Network-based routing protocols Network-based routing protocols depend on the strategy how the network is prearranged. Such protocols fall under three categories: Data Centric protocols: These are query based and they depend on the naming of the desired data. The BS sends queries within a certain region to get information and waits for a reply from the nodes. Nodes in a particular region collect the specific data based upon the queries. SPIN is a data-centric protocol. Hierarchical protocols: In this, the nodes with lower energy are used to capture information and nodes with higher energies are used to process and transfer it that is why it is used to perform energy efficient routing. TEEN, APTEEN are hierarchical protocols. Location Based: In these, the location of nodes must be known to find an optimal path using flooding.

III. PROPOSED WORK

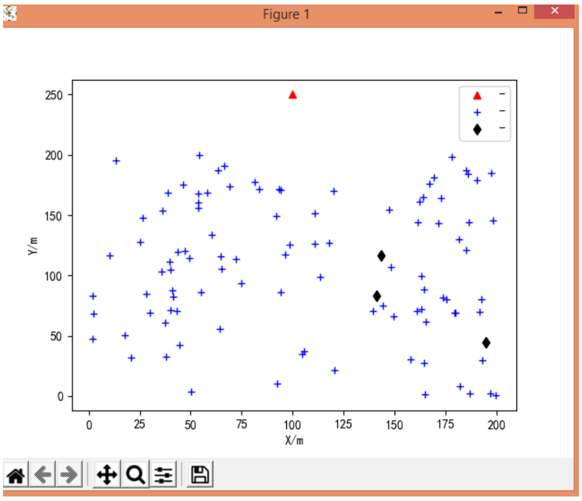
The majority of nodes using LEACH transmit to cluster heads, who then aggregate and compress the data before sending it to the base station (sink). Each round, a stochastic algorithm is used by each node to decide whether it will head the cluster this round.



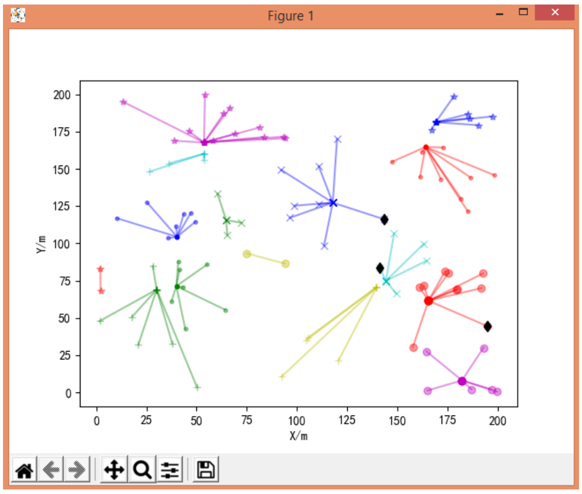
Leach Flow Diagram

Proposed model initiate the leach simulation using the following parameters.

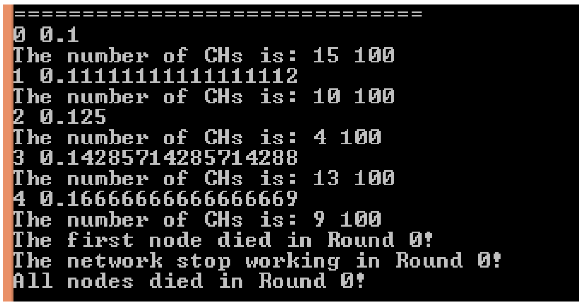
xm = 200 # Length of the yard
ym = 200 # Width of the yard
n = 100 # total number of nodes
sink = None # Sink node
nodes = None # All sensor nodes set



Sensor Nodes



Nodes in Data Trnasmission



```
==============================
0 0.1
The number of CHs is: 15 100
1 0.11111111111111112
The number of CHs is: 10 100
2 0.125
The number of CHs is: 4 100
3 0.14285714285714288
The number of CHs is: 13 100
4 0.16666666666666669
The number of CHs is: 9 100
The first node died in Round 0!
The network stop working in Round 0!
All nodes died in Round 0!
```

Simulation Output

2. WSN Simulation

A simple WSN simulator in Python for routing, power consumption, and congestion purposes. Used to test for routing protocols.

Configuration

The user (as of now) must provide a network bi-directional graph with

a. *list of nodes* with corresponding *inherent unreliability values*,

b.Connected edges between nodes and their corresponding distances along edges, and

c. Simulation run time (where nodes are actively sending messages) and *cool down time* (where nodes cease sending messages and messages currently in the network continue to reach the sink), both of which are in units of steps.

Setup Experiment

NODE_LIST = ["A", "B", "C", "D", "E", "F", "G", "H", "I"]

NODE_RELIABILITY = {}

NODE_RELIABILITY["A"] = 0.91

NODE_RELIABILITY["B"] = 0.63

NODE_RELIABILITY["C"] = 0.66

NODE_RELIABILITY["D"] = 0.54

NODE_RELIABILITY["E"] = 0.71

NODE_RELIABILITY["F"] = 0.80

NODE_RELIABILITY["G"] = 0.71

NODE_RELIABILITY["H"] = 0.92

NODE_RELIABILITY["I"] = 0.81

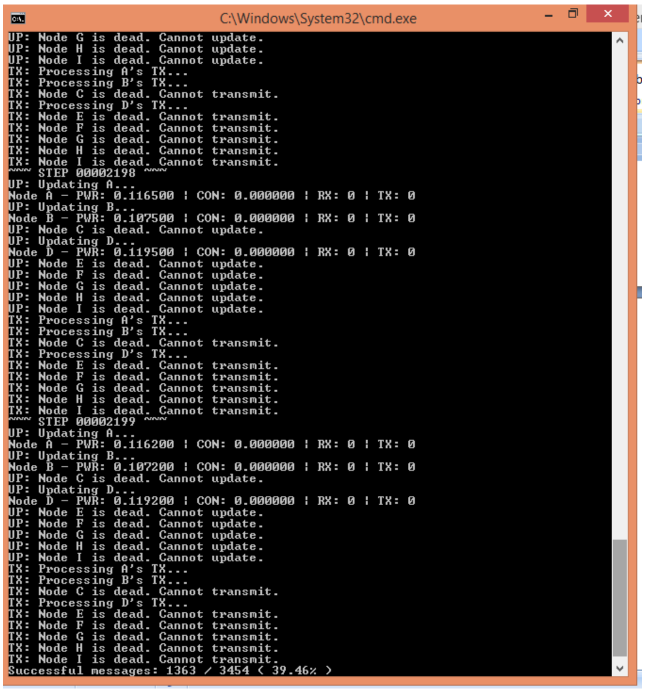
SINK_BUFFER_SIZE = 20000

NODE_BUFFER_SIZE = 2

MESSAGE_SEND_RATE = float(1.75 / len(NODE_LIST))

STEPS = 2000

COOL_DOWN = 200



Simulation Run

Comparison Table of Various Routing Protocols

Protocols	Class	Lifetime	Energy Efficient	Throughput	Scalability
Leach	Hierarchical	Very Good	High	Very High	High
Pegasis	Hierarchical	Very Good	High	Very High	Good
Teen	Hierarchical	Good	Good	Satisfactory	Good
APTEEN	Hybrid	Very Good	Good	High	Good
Direct Diffusion	Flat	Good	High	Satisfactory	Restricted
EESR	Flat	Very Good	High	High	High

IV. CONCLUSION & FUTURE WORK

In addition to numerous applications for wireless sensor networks, it is necessary to transmit information in a manner that is appropriate for power consumption, network lifespan, and the network's limited esources. The main trouble in such organizations is directing and moving information to the objective hub in consistence with the energy issue. Thusly, energy-effective steering conventions have critical what's more, viable jobs in remote sensor organizations. Based on data, network structure, and dependability, they are divided into three main groups.

In this study, wireless sensor networks were used to investigate energy-efficient routing protocols. The essential classifications were then presented, and the parameters of the corresponding protocols were compared to one another in light of these classifications. Even though these protocols are doing a good job of saving energy, quality of service (QoS) issues should be addressed to ensure that the most energy-efficient data transfer method is used and that data transfer rates or delays are guaranteed. The fact that the majority of current routing conventions acknowledge that the is another intriguing aspect of routing sensor hubs and the sink is stationary. In circumstances, for example, on the battlefield where the sink and maybe the sensors should be versatile. In such cases, new routing techniques are required keeping in mind the end goal to deal with the overhead of portability and topology changes in such power constrained circumstances. Integrating WSN with wired networks(i.e. Internet) is other possible future research for routing protocols.

V. REFERENCES

[1]. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks", ELSEVIER Inc., 2007.

[2]. N. A. Pantazis, S. A. Nikolidakis, and D. D. Vergados, "Energy-efficient routing protocols in wireless sensor networks: A survey," IEEE Commun. Surv. Tut., vol. 15, no. 2, pp. 551-591, 2013

[3]. Y. Li, M. T. Thai, W. Wu, "Wireless sensor networks and applications", New York: Springer Science+Business Media, LLC pp. 7-11, 2008.

[4]. Pallavi S. Katkar and Prof. (Dr.) Vijay R. Ghorpade, "A Survey on Energy Efficient Routing Protocol forWireless Sensor Networks", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6, 2015.

[5]. Jayashri Deb Sinha and Subhabrata Barman, "Energy Efficient Routing Mechanism in Wireless Sensor Network", IEEE conference on Recent Advances in Information Technology,2012

[6]. Liu W. and Yu J., "Energy Efficient Clustering and Routing Scheme for Wireless Sensor Networks", IEEE International Conference on Intelligent Computing and Intelligent Systems, pp: 612-616, 2009.

[7]. Jamal N. Al-Karaki and Ahmed E. Kamal, "Routing techniques in Wireless sensor networks: a survey", IEEE Wireless Communications, pp:6-28, 2004.

[8]. J. N. Al-Karaki, and A. E. Kamal, "Routing techniques in wireless sensor networks: A Survey," IEEE Wirel. Commun., vol. 11, no. 6, pp. 6-28, 2004.

[9]. S. Lindsey and K. M. Sivalingam. "Data Gathering Algorithms in Sensor Networks Using Energy Metrics." IEEE Transactions on Parallel and Distributed Systems, 13(9): 924-934, 2002.

[10]. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks.",2005 John Wiley & Sons, Ltd. ISBN: 0-470-09510-5

[11]. Jayashri Deb Sinha and Subhabrata Barman, "Energy Efficient Routing Mechanism in Wireless Sensor Network", IEEE conference on Recent Advances in Information Technology,2012.

[12]. Roseline, R.A., Sumathi, P, Local clustering and threshold sensitive routing algorithm for Wireless Sensor Networks, Devices, Circuits and Systems (ICDCS), 2012 International Conference, IEEE, 2012.

[13]. A. Manjeshwar and D. Agrawal," TEEN: A routing protocol for Enhanced Efficiency in Wireless Sensor Networks," In Proceedings of 15th International Parallel and Distributed Processing Symposium (IPDPS'01) Workshops, USA, California, 2001, pp. 2009-2015.

[14].] A. Manjeshwar, D. Agrawal," APTEEN: A Hybrid Protocol for Efficiency Routing and Comprehensive Information Retrieval in Wireless Sensor Networks," In Proceedings of International Parallel and Distributed Processing Symposium, Florida, 2002, pp.195-202.

[15]. K.Sohraby, D.Minoli, T.Znati "WIRELESS SENSOR NETWORKS, Technology, Protocols, and Applications" Published by John Wiley & Sons, Inc., Hoboken, New Jersey. 2007.

[16]. H. Oh and K. Chae, "An Energy-Efficient Sensor Routing with low latency, scalability in Wireless Sensor Networks", IEEE 2007 International Conference on Multimedia and Ubiquitous Engineering, pp 147-152, May 2007.

[17]. H. Oh, H. Bahn and K. Chae, "An Energy-Efficient Sensor Routing Scheme for Home Automation Networks," IEEE Transactions on Consumer Electronics, Vol.51, No.3, pp.836-839, Aug.2005.

[18]. A. Norouzi, M. Dabbaghian, A. Hatamizadeh and B. Berk Ustundag, "An Improved EL Gossiping Data Distribution Technique with Emphasis on Reliability and Resource Constraints in Wireless Sensor Network," IEEE international ISBN: 978-1-4673-5613-8©2013 IEEE Conference on Electronic Computer Technology, Kuala Lumpur, 7-10 May 2010, pp. 179-183.

[19]. 19]. Lindsey S. and Raghavendra C. S., "PEGASIS: Powerefficient gathering in sensor information systems", IEEE Aerospace Conference, pp: 1125-1130, 2002.

[20]. Ahmad A., Latif, K., Javaid, N., Khan, A. and Qasim U., "Density controlled divide-and-rule scheme for energy efficient routing in Wireless Sensor Networks," Electrical and Computer Engineering (CCECE), 2013 26th Annual IEEE Canadian Conference on, vol., no., pp.1,4, 5-8 May 2013.

[21]. Lohan P. and Chauhan R., "Geography-informed sleep scheduled and chaining based energy efficient data routing in WSN," Electrical, Electronics and Computer Science (SCEECS), 2012 IEEE Students' Conference on, vol., no., pp.1,4, 1-2 March 2012.

[22]. Seongsoo Jang, Ho-Yeon Kim, Nam-Uk Kim and TaiMyoung Chung, "Energy-Efficient Clustering scheme with Concentric Hierarchy," RF and Microwave Conference (RFM), 2011 IEEE International, vol., no., pp.79,82, 12-14 Dec. 2011.

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