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PERFORMANCE ANALYSIS OF WIRELESS SENSOR NETWORK USING CLUSTERING ROUTING PROTOCOLS AND GREY WOLF OPTIMIZER

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Abstract: - This paper presents a vivid view of developments going on in the field of Wireless sensor networks (WSNs), especially the routing protocols that are used for transmission of information among nodes of WSN. WSN is made up of thousands of nodes. One of the major areas of concern in WSNs is energy consumption which is required to be optimized for enhancing the network lifetime. Among various available solutions one of the most promising solution to this issue is utilization of energy efficient routing protocols. In this paper one such routing technique namely-clustering method is discussed at large. Also various routing protocols under the category of clustering technique are presented in detail. A brief introduction of Grey wolf optimizer is presented for further enhancing the routing capabilities of WSNs.

Keywords: Wireless sensor network, clustering routing protocols, TEEN, PEGASIS, Grey Wolf Optimizer, energy efficiency, network lifetime.

1. Introduction

1.1. Wireless Sensor Networks (WSNs)

WSN is one sort of wireless networks that contains hundreds or thousands of small size, battery-worked sensor nodes (SNs). Temperature, humidity, pressure, smoke and fire in buildings can be sensed by these sensor nodes. The sensor nodes are mini devices that contain four basis units 1) sensor unit, 2) processing unit, 3) wireless communication unit'4) energy supply unit. A few of the sensor nodes are dispersed across the area under surveillance in a random manner. The memory capacity and battery of sensor nodes are likewise limited because of their small size. A genuine and suitable solution for this issue is to execute routing protocols that perform effectively and using the small amount of energy as feasible for the communication between nodes. The sensor nodes gather, process and forward the significant data assembled from surroundings. To change over the analog signal made from sensors into computerized structure, the Analog to Digital convertor (ADC) is utilized.

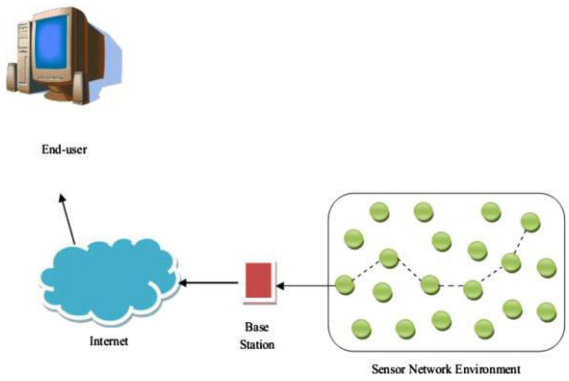

Figure 1.1 Wireless Sensor Network [1]

The signals are sent to the controller to perform processing. The processor is accountable for executing the tasks and handling with the execution of parts. The pre-programming and loading of services of processing unit is performed in the processor of sensor nodes. The based station receives the

outcomes at the end. Among the nodes and base station the transmission and receiving of information is performed [2].

1.2. Design Challenges of WSNs

While designing a WSN, numerous difficulties are confronted in any application. Few of the difficulties which are generally found are mentioned below:

i. Power consumption

Managing the power is a significant issue in sensor systems. In this manner, it is exceptionally important to design of power aware algorithms and protocols for WSN.

ii. Computational power and memory size

Each node stores the data independently and some of the time more than one node spared same information and transmits it towards the base station that misuse the power and storing limit of nodes. So useful plans are important to diminish the repetition in the WSN [3].

iii. Security

Security is a vital issue in WSN. Therefore it is hard to distinguish whether the data is validated or not. Invalid information can change the manner in which a system could be forecasted. Quality of information should be sustained. Information should not modify and the end user must receive the exact data.

iv. Deployment

Deployment means executing the wireless sensor network in the actual world area. At areas which are difficult to approach, sensor nodes are released from the helicopter and can be in not many areas sensors are put down as stated by some topology.

v. Constrained memory and storage space

A sensor is a small deice that has modest quantity of memory and storage space for the code. So as to assemble a valid security system, it is mandatory to restrain the size of the code of the security algorithm.

2. Related Work

The principle operational maintainability worry in wireless sensor network is its energy limitations. Among various available solutions one of the most promising solutions to this issue is utilization of energy efficient routing protocols. There are a few numbers of sensors nodes present in the systems which help in identifying the data from the surroundings through WSN. In this procedure, the detected information is transferred to the base station. A sensor node collects the physical as well as the environmental conditions present around that zone. The energy utilization is huge in the sensor nodes due to the little size of the nodes. The literature survey shows that a variety of energy efficient routing protocols latterly were created usually in the view of the structure of network like hierarchical routing, location routing and flat based routing. The broad literature survey also shows that the current routing protocols as yet facing the issue of limitation of energy efficiency.

Marwa Sharawi, et.al (2017) proposed a optimization model to expand the lifetime of wireless sensor network. It implements the grey wolf optimizer a comparison between the proposed model and LEACH routing protocol is done. Four distinct deployments of wireless sensor network are studied [5].

Arati Manjeshwar, et.al (2001) proposed a conventional arrangement of sensor systems, in view of their method of working, as proactive and reactive systems. This paper also introduces a energy efficient protocol, TEEN. Also analyse the performance of this protocol for temperature detecting application. Regarding energy effectiveness, this protocol has been seen to be better existing traditional sensor system protocol [6].

N.A. Al-Aboody, et.al (2016) presented a three level hybrid clustering routing protocol model depend on the grey wolf optimizer. Energy efficiency, lifetime of network and security period has been analyse by this model. The outcomes of the proposed model is better regarding energy efficiency, extended lifetime of network and extended stability period when compared with different models [7].

Amit Sarkar, et.al (2016) aimed to classify routing issues and analyzes the routing related improvement issues. Different highlights that are identified with energy, security, speed and reliability problems of routing are talked about [8].

Ashish Agarwal. et.al (2018) proposed a review on different current protocols analyze on different parameters like characterization, probability, control use, adaptability and multi-way correspondence. In this paper data centric, hierarchical based and meta-data based routing protocols are utilized to enhance the lifetime of network and energy efficiency [9].

Hossam Faris, et.al (2018) studied and précised many research publications dependent on Grey Wolf Optimizer. Preliminary information about GWO is given. The principle operation of GWO is procedurally examined and hypothetical base is explained [10].

Priya Rana, et.al (2017) showed that the clustering or hierarchical routing protocols have exceptional merits such as decreasing unnecessary data, energy efficiency etc. So it presented several current clustering protocols

and methods. Apart from it their merits and demerits have been studied [11].

Pranjali Diwan, et.al (2016) aimed to achieve energy efficiency by utilization of fuzzy logic for forming cluster and grey wolf optimizer for selecting cluster head. The outcomes of the presented model as far as lifetime of networks and throughput are compared with the LEACH protocol [12].

Yogesh Pant,et.al (2017) proposed importance on analyzing the optimization strategies of routing protocols as for sensor nodes lifetime in wireless sensor networks. It mainly focused on the utilization of optimization of algorithms for protocols resulting in the better results as compared to the traditional algorithms [13].

J. Gnanambigai, et.al (2014) presented another hybrid routing protocols known as Quadrant Based Low Energy Adaptive Clustering Hierarchy (QB-LEACH). This protocols helps is extending the lifetime of network by utilizing constrained number of nodes for data transfer due to which energy of each node is decreased [14].

3. Routing Protocols

3.1. Routing Protocols

The procedure of detecting appropriate path from source node to destination node is known as routing. The principal operation of routing protocol is to identify the appropriate route between sensor nodes and sink nodes and send. The routing issue causes reduced lifetime of network with extended energy consumptions. Hence to limit the energy utilization and to extend network lifetime, several routing protocols have been created [8].

3.2 .Categorization of Routing Protocols in WSN

Mode of function:

Proactive: At every node, a routing table is produced and data of routing is regularly upgraded.

Reactive: In this no Routing table is produced and route revelation is accomplished on demand. The route data is stored for further resource.

Hybrid: It is the merging of reactive and proactive protocols. Moreover, the hybrid protocol diminishes the expense of the system. Initially it figures all routs and afterward at the time of routing it enhances the route.

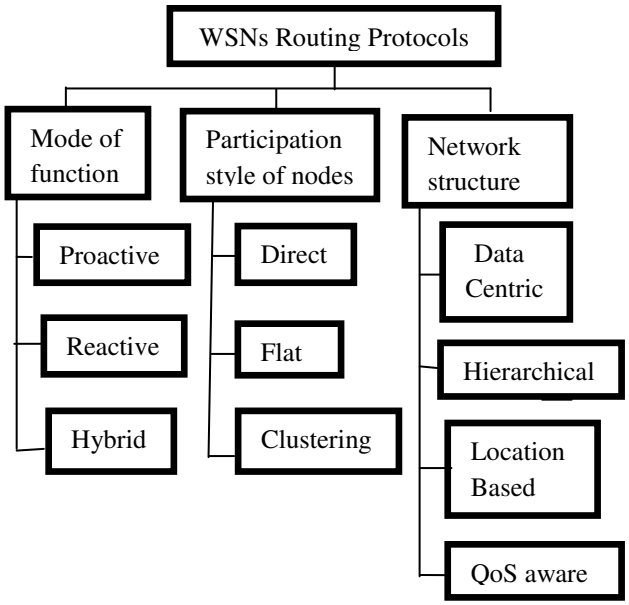

Fig.3.1 Categorization of Routing Protocols [1]

Participation style of nodes:

Direct: Enables nodes to transmit data straightforwardly to sink.

Flat: In case that any node wants to transfer information, firstly it aim to detect a best route towards the base station and afterward transfer it.

Clustering: In this the entire region is separated into various little clusters. In which cluster head will straightly interface with the base station.

Network structure:

Data-centric: It is question depended, which rely on the tag or label of the ideal information, along this they are liable for removing unnecessary communications.

Hierarchical: Utilized to carry out routing which are energy efficient and uses higher energy nodes to operate and transfer the data while lower energy nodes are utilize in detecting the zone of intrigue.

Location-based: Demands the location information of sensor nodes.

QoS aware: It mainly targets on various network layer needs such as delay and dependability [1].

4. Clustering Routing Protocols

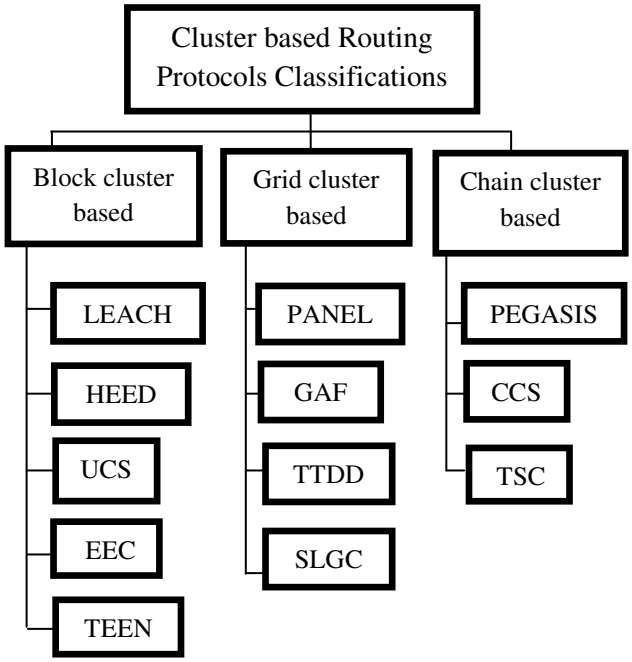

Fig.4.1 Categorization of Cluster Based Routing Protocols [15]

4.1. LEACH

Low-Energy Adaptive Clustering Hierarchy (LEACH) is the first clustering routing access in WSNs. The primary aim of LEACH is the cluster formation depends on the got signal power and to select the cluster heads to transfer the data towards the base station.

4.2. HEED

Hybrid Energy-Efficient Distributed clustering (HEED) is an energy efficient multi-hop clustering method in WSNs. The major aim of HEED is to obtain the uniformly allocated cluster heads all over the systems. The outcome of HEED is superior to LEACH in term of network period because of multi-hop inter cluster routing instead of large interval transmission straightforwardly towards the base station from the cluster head.

4.3. UCS

Unequal Clustering Size (UCS) algorithm was presented to limit the energy use of cluster heads and extend the lifetime of network.

4.4. EECS

Energy Efficient Clustering Scheme (EECS) is suitable for time based applications. With regard to energy utilization and transmission load, EECS builds a much better network.

4.5. TEEN

The major aim of Threshold Sensitive Energy Efficient sensor network (TEEN) is to manage the changes in time critical applications; energy utilization is less in this protocol due to data communication is carried out less consistently.

4.6. PANEL

Position-Based Aggregator node election protocol (PANEL) is a location depended clustering routing method in wireless sensor network. The selection of cluster head for dependable and continuous storing of data operation is the main function of the PANEL. The process of selecting cluster head make sure load sharing in PANEL due to every node in the cluster can be cluster head having nearly similar possibility.

4.7. GAF

Geographic Adaptive Fidelity (GAF) is an energy conscious routing protocol. GAF can expand the network lifetime through limiting the energy utilization. Its restrictions are large traffic injection and the delay is unpredictable.

4.8. TTDD

Two Tier Data Dissemination (TTDD) presents information transfer towards various mobile sinks in wireless sensor networks. Demerits of TTDD is large delay, large energy consumption and sensors nodes are movable which are not manage by TTDD [15].

4.9. SLGC

SLGC is a single-hop routing algorithm. This provides reduced energy utilization than the LEACH and consequently expands the lifetime of network. Its limitations are large overhead due to complex data transmission [16].

4.10. PEGASIS

Power Efficient Gathering in Sensor Information System (PEGASIS) is advancement in LEACH. For every node the major goal of PEGASIS is to just communicate with their near to neighbors and switch to head for communication to the sink.

4.11. CCS

Concentric Clustering Scheme (CCS) decreases the energy consumptions. It also decreases the data flow from base station.

4.12. TSC

Track-sector Clustering (TSC) is mainly a method in which every cluster consists of one elected cluster head. TSC including tracks and divisions diminishes unnecessary data communication in the network by splitting large chain into short chain as well it diminish the overall distance for data communication to their particular cluster heads from nodes and lastly to the base station [15].

5. TEEN and PEGASIS

5.1. TEEN

TEEN protocol handles clustering algorithm like the LEACH, but the TEEN is a routing protocol proposed for reactive WSNs. During procedure of setting up cluster, TEEN protocol puts two thresholds of hard and soft, diminishes the amount of data communication by the process of filter. The information transmission is reduced in the hard threshold; soft threshold determines the change range of information sensed. The protocol diminished the amount of data transmitted by putting soft and hard threshold importantly, which are able to sensed a number of unpredicted tasks and difficulties, but the threshold avert from some data, unsuitable for the approach of periodic reporting of data. Merits are (i) depend upon the two threshold, information communication may be restrained honorably, that is, just the sensed information we request may be send, in order to reduces the energy usage and upgrades the efficiency of the accepting information; (ii) TEEN is supplement for responding to enormous variations in the detected characteristics, that is reasonable for time basic application and receptive scenes [17].

5.2. PEGASIS

The major goal of PEGASIS is to just communicate every node with their near to neighbors. In this the energy load is uniformly distributed between the sensor nodes. The nodes are composed to construct a chain. If the nodes themselves framed a chain, they can initial obtain the area information of the nodes and nearly calculate the chain utilizing the insatiable method. It is supposed to form the chain that all nodes have worldwide information on the system and hire the insatiable method. The formation of chain is begun with the farthest node from the base station. To this node the nearest neighbors will be the succeeding node. At the time node expires, the chain will be reproduced likewise to remove the expired node [17].

6. Conclusion

This paper presented an overview of WSNs and various challenges faced by such networks. In WSNs the energy supply is limited due to constrained battery capacities which in turn are due to of small size of nodes and thus energy efficiency presents one of the major challenges to WSN became the major issue. This paper shows various clustering routing protocols that enhance energy efficiency of WSNs and thereby increasing the network lifetime. TEEN and PEGASIS protocols are discussed in depth which seems to be the best contenders in clustering routing techniques.

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