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The Energy Efficient Techniques of Wireless Sensor Networks

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Abstract*: The wireless sensor networks are the type of sensor networks which is used to sense the environmental conditions like temperature, pressure etc. The energy consumption is the major issue of the wireless sensor networks which is raised due to far deployment and small size of the sensor nodes. The clustering is the technique which reduces the energy consumption of the wireless sensor networks. In this paper, various techniques which are proposed for the energy consumption reduction is reviewed and discussed in terms of various parameters.*

Keywords*: WSN, LEACH, HEAD, Clustering*.

1. INTRODUCTION

There are large numbers of applications of wireless sensor networks due to their various properties. There are a lot of benefits of these types of networks which are the reason of their increasing demands. Wireless sensor networks consist of sensor nodes which are small in size, cheap, and also have self-contained battery powered systems [1]. The input received from the adjacent sensor is processed by the sensor nodes. Further, the result is transmitted to transit network within the network. The WSNs are used to monitor the surroundings of the area in which they are placed and gather the important information according to the physical parameters such as pressure, temperature, etc. They are dispersed type of networks which have lightweight, small sensor nodes. There is a limited power, memory as well as computational capacity in each sensor node [2]. There are various resource constraints such as limited amount of energy, low bandwidth, storage and limited processing present within each node of a WSN. There certain design constraints as well, which are completely application dependent and are also based on the monitored environment. It completely depends on the surroundings to define the deployment scheme, network topology as well as the size determination of the network [3]. There are few nodes required for the internal environments whereas a large number of nodes are required for the purpose of external environments. The sensor nodes of a network can communicate with each other or also with the external base stations of a network. The important part of a sensor node is the battery which is very important as it affects the network's lifetime directly [4]. There are various energy-optimized solutions proposed at various levels of the system for improving the battery consumptions of sensor nodes. The communication amongst the sensor nodes is done with the help of radio signals. There are various applications which use WSN and also include non-conventional paradigms which help in protocol design which involve various constraints. For the purpose of path determination from the source to the destination node, the routing method is utilized. There are various categories according to which the routing protocols are classified. The reactive and proactive are one of the types of classifications of routing protocols. Before the demand of a routing traffic, the routing paths, as well as the states, are provided in the network using the proactive routing protocols [5]. The protocols which trigger the routing actions when the data is to be sent to various nodes is known as the reactive routing protocol. On the basis of their initiation which is source-initiation (Src-initiated) or destination initiation (Dst-initiated), the routing protocols are classified. On the demand of source node, the source-initiated protocol provides the routing path which begins from the source node. The routing path is initiated from the destination node in case of the destination-initiated protocol [6]. On the basis of the sensor network architecture also the routing protocols are classified which are the homogeneous nodes as well as the heterogeneous nodes. The protocols can also be here classified further on the basis of the topology they use which is mainly the flat topology or the hierarchical topology. The protocols in which the sensor nodes are addressed using the locations are known as the location-based protocol. For the purpose of calculating the distance between two specific nodes, the location information of nodes is required by the network. This also helps in estimating the energy consumption of the node [7]. The Geographic Adaptive Fidelity (GAF) is an energy-aware routing protocol which is used for the purpose of energy conservation mainly.

II. LITERATURE REVIEW

Sarab F. Al Rubeaai, et.al (2015) proposed in this paper, [8], a novel 3D real-time geographical routing protocol (3DRTGP) for WSNs. The numbers of forwarding nodes within the network are controlled by this protocol. This is done by limiting the forwarding to a unique packet forwarding region (PFR). Under the different network densities and traffic load conditions, the performance of this protocol is evaluated by performing certain simulations. The needs of real-time applications are fulfilled with the help of the

network tuning parameters that are provided by the results. Within the 3D deployments, the Void Node Problem (VNP) is solved by the 3DRTGP heuristically. Even when there is no network partitioning, the 3DRTGP helps is resolving the VNP. With respect to the end-t-end delay and miss ration parameters, this protocol has shown better performance than the other routing protocols.

Adnan Ahmed, et.al (2015) proposed in this paper [9], a Trust and Energy-aware Routing Protocol (TERP). For the purpose of detection and isolation of malicious nodes, this distributed trust model is used. A composite routing function is included in TERP which provides trust, residual energy as well as hop counts of neighboring nodes which will further help in taking the routing decisions. The energy consumption amongst the trusted nodes is balanced when the routing data utilizes the shorter paths with the help of this routing strategy. According to the simulation results achieved there is a reduction in the energy consumption, enhancement in the throughput as well as lifetime of the network when the TERP is used as compared to other protocols.

Guangjie Han, et.al (2015) proposed in this paper [11], that for various underwater applications, the underwater WSNs (UWSNs) are being used a lot. For the purpose of data transmission and other real-time applications, the energy efficient routing protocol is very important. There are some special characteristics of UWSNs which include dynamic structure, high energy consumption, as well as high latency. These properties have made it difficult to build certain routing protocols for this network. The already existing routing protocols are to be studied in this paper and their performances are to be compared with respect to each other. The routing protocols are classified into two categories on the basis of the route decision maker they use. The results have shown that there are still many enhancements to be made in this technology. In the future work, new technologies are to be evolved to provide better results.

Gurbinder Singh Brar, et.al (2016) proposed in this paper [10], a directional transmission based energy aware routing protocol namedas PDORP is proposed. The properties of Power Efficient Gathering Sensor Information System (PEGASIS) and DSR routing protocols are combined in this newly proposed protocol. A comparison in between the hybridization approach and the newly proposed approach is given. The performance analysis shows that there is a reduction in the bit error rate, delay and energy consumption within the network. There is also an improvement in the throughput which results in providing better QoS and which further results in increasing the lifetime of the network. For the purpose of evaluating and comparing the performance of both the routing protocols, the computation model is used.

Lein Harn, et.al (2016) proposed in this paper [12], a novel design of secure end-to-end data communication. A newly designed group key pre-distribution method is proposed here which provides a unique group key which is also known as the path key This key is used for protecting the transmitted data which is present in the complete routing path. There are many pairwise shared keys used in repeated form for the purpose of encryption and decryption in the network. To avoid repetitive use, the unique end-to-end path key is proposed here which protects the data which is transmitted across the network. The sensors can be authenticated using this protocol for the purpose of establishing path as well as the path key. Through this protocol, the time which is needed to process data through intermediate nodes is reduced, which is an important advantage here.

Jing Jing Yan, et.al (2016) proposed in this paper [13], that it is very important to increase the lifetime of a network due to the limited battery available in the sensors. For this purpose, the energy-efficient routing techniques are very widely used. The routing protocols that are already proposed are studied and classified into homogeneous and heterogeneous categories as per their orientations. Also, the static and mobile protocols are classified accordingly. The characteristic properties, the limitation as well as applications are also discussed. The various issues which are related to the energy-efficiency of the routing protocol designs are enlisted here. The mobile WSNs provide more enhanced results as compared to the static WSNs which result in improvement in terms of energy efficiency, energy balance, and higher coverage. The implementations, as well as the deployment costs, increase, however, in these types of networks.

Author Name	Year	Description	Outcomes
Sarab F. Al Rubeaai, Mehmood A. Abd, Brajendra K. Singh, Kemal E. Tepe	2015	In this paper, a novel 3D real-time geographical routing protocol (3DRTGP) for WSNs. The numbers of forwarding nodes within the network are controlled by this protocol.	With respect to the end-t-end delay and miss ration parameters, this protocol has shown better performance than the other routing protocols.
Adnan Ahmed, Kamalrulnizam Abu Bakar, Muhammad Ibrahim Channa, Khalid Haseeb andAbdul Waheed Khan,"	2015	A Trust and Energy-aware Routing Protocol (TERP) for the purpose of detection and isolation of malicious nodes. The energy consumption amongst the trusted nodes is balanced when the routing data utilizes the shorter paths with the help of this routing strategy.	According to the simulation results achieved there is a reduction in the energy consumption, enhancement in the throughput as well as lifetime of the network when the TERP is used as compared to other protocols.
Gurbinder Singh Brar, Shalli Rani, Vinay Chopra, Rahul Malhotra, Houbing Song, Syed Hassan Ahmed	2016	A directional transmission based energy aware routing protocol named as PDORP is proposed. The properties of Power-Efficient Gathering Sensor Information System (PEGASIS) and DSR	There is also an improvement in the throughput which results in providing better QoS and which further results in increasing the lifetime of the network.

		routing protocols are combined in this newly proposed protocol.	
Guangjie Han, Jinfang Jiang, Na Bao, Liangtian Wan, and Mohsen Guizani	2015	For the purpose of data transmission and other real-time applications, the energy efficient routing protocol is very important. There are some special characteristics of UWSNs which include dynamic structure, high energy consumption, as well as high latency.	The results have shown that there are still many enhancements to be made in this technology. In the future work, new technologies are to be evolved to provide better results.
LeinHarn, Ching-Fang Hsu, OuRuan, and Mao-Yuan Zhang	2016	A novel design of secure end-to-end data communication is proposed. A newly designed group key pre-distribution method is proposed here which provides a unique group key which is also known as the path key.	Through this protocol, the time which is needed to process data through intermediate nodes is reduced, which is an important advantage here.
JingJing Yan, MengChu Zhou, and ZhiJun Ding	2016	The routing protocols that are already proposed are studied and classified into homogeneous and heterogeneous categories as per their orientations.	The mobile WSNs provide more enhanced results as compared to the static WSNs which result in improvement in terms of energy efficiency, energy balance, and higher coverage.

CONCLUSION

In this paper, it is been concluded that various techniques which are proposed in the recent times to reduce the energy consumption of wireless sensor network are been reviewed and discussed. It is been analyzed that LEACH is the most efficient type of clustering protocol which increases the network performance in terms of a number of alive nodes, the number of dead nodes.

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