Energy Efficient and Node Localization Approaches in Wireless Sensor Networks

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Abstract

A localized kind of network in which sensor nodes are positioned at large distances from one another is known as wireless sensor network (WSN). The nodes used in this network utilizes a lot of energy since the nodes are deployed far away and the size of nodes is very small which also limits the size of their batteries. For improving the lifetime of WSNs, the most efficient technique to be applied is clustering. Determining the position of unknown sensor nodes also called the target nodes, with the help of known positions of anchor nodes is called node localization. In this paper we have reviewed various techniques employed for improving the lifetime and energy of sensor nodes in WSNs. Also various node localization approaches as utilized in WSNs have also been discussed.

Keywords

Clustering, node localization, lifetime

Introduction

Several applications use WSNs because of their growing popularity. The demands are increasing because of the large benefits provided by these networks due to their important characteristics. The sensor nodes that are deployed in WSNs are very small in size due to which they have less battery power [1]. Data obtained through the nearby nodes is collected by means of nodes. Results are forwarded ahead for the transition of network. The regions in which these networks are deployed are monitored and important information related to various physical aspects is collected. There are lightweight small sized sensor nodes spread all across the regions to be monitored. For each sensor node, limited power, memory and computational capacity is provided [2]. In WSNs every node faces someresource restrictions which result in limiting their performances. Based on the application, several design constraints also exist and depending upon the monitored environment, these constraints can cause affects. The deployment mechanism is defined completely based on the surroundings. Further, the size of network and its topology is also defined through this definition [3].For the internal scenarios, few nodes are needed. However, in the external surrounding applications, large numbers of nodes are required. The communication among the nodes themselves or the nodes and base stations can be performed in this network. A very significant role is played by the battery for the improvement of the lifetime of WSNs [4].Various power optimized methods have been proposed for the enhancement of the utilization of the battery used in these nodes.Radio signals are used to perform communication among the sensor nodes. A lot of applications use WSN and protocol architecture is used to include non-conventional paradigms. Routing mechanism is applied for the determination of paths commencing base to destination node. Different properties are the foundation of categorization of many routing protocols. Mainly there are two types of

protocols one is reactive type protocol and the other is proactive type protocol.Fordirecting the traffic of the routing paths and states before the requirement, the proactive type protocols are used [5].For the transmission of data between different sensor nodes, the reactive routing

protocols take different routing decisions.Routing protocols are differentiated through destination initialization and origin initialization. According to the requirement of source node, routing path which originates from the source node is allocated by the origin started protocol. While in target commencing protocol, initialization of routing path is implemented with the help of destination node [6]. The categorization amongst homogeneous nodes and heterogeneous nodes is done for the routing protocols depending upon the sensor network architecture. Based on the type of topology being used which is either flat or hierarchical, the classification of protocols can also be done. The sensor nodes are addressed using location in the location-based protocol. For calculating the distance that exists among two nodes, network needs the position report of nodes.Thus, the energy being consumed by the node can be estimated [7]. In order to conserve the energy of nodes in these networks, a commonly known protocol applied is named as Geographic Adaptive Fidelity (GAF).

To make the monitoring data more meaningful, the nodes are located and tracked by applying node localization technology. Without the presence of localization information of nodes in the network, the data collected at sink node will have no actual meaning. The process that uses the known positions of anchor nodes to determine the positions of unknown sensor nodes also known as target nodes is called node localization [8].Certain measurements like angle of arrival, maximal likelihood, time difference of arrival and so on are used in the localization process. Although the global positioning system (GPS) can also be used in each sensor node to resolve the localization issue in WSNs, the parameters such as cost, size and energy create an issue. Thus, for localizing the sensor nodes, an efficient and better alternative is necessary. Several non-GPS-based localization algorithms have been applied by researchers. They can be categorized broadly into range-based and range-free. The

point-to-point distance or angle-based estimations among the sensor nodes are used in range-based localization algorithms [9]. The trilateration of anchor nodes is used to estimate the location. However, no range information among target node and anchor node is required in case of range-free localization algorithms. The topological information is the major parameter used in them. Although the range-based algorithms are not so economic, they provide better accuracy level in comparison to range-free localization algorithms. For handling the node localization issues of WSN, several approaches have been proposed previously. The positions of sensor nodes are localized using different algorithms like genetic algorithm (GA), particle swarm optimization (PSO), firefly algorithm (FA) and so on.

Literature Review

Mehmmood A. Abd, et.al (2015) proposed a novel approach for controlling total amount of sensor nodes being forwarded [10]. The proposed protocol was given the name of 3-D real-time geographical routing protocol. A limit named Packet Forwarding Region(PFR) wasprovided to the forwarding process. The evaluation of performance of protocol is done through certain simulations in the presence of various densities

and traffic load scenarios. The networking tuning protocols provided through results were used to fulfill the requirements of real-time applications. The proposed approach resolved the Void Node Problem (VNP) in three dimensional networks. VNP was resolved using this proposed protocol even when no network partitioning exists. The performance of routing protocols was improved by the means of continuous setback and miss ration parameters.

Kamalrulnizam Abu Bakar, et.al (2015) proposed a protocol named TERP which was applied for the identification and removal of the malicious nodes entering the network [11].The belief, remaining energy and stepcount of associated nodes were provided by a combined routing system provided within TERP. This system helped in taking the decisions of routing.When routing mechanism was used with the help of routing data including shorter paths,equilibrium of the energy consumption was easy to build between the nodes that trust each other. Consumption of the energy is reduced;throughput is improved along with the overall lifetime of network as per the simulation results achieved at the end.

Shalli Rani, et.al (2016) presented a novel guidance broadcast relied power conscious routing protocol named as PDORP protocol and that was built on directional transmission energy aware routing mechanism [12]. This was a routing protocol. This newly proposed protocol included the beneficial properties of Dynamic Source Routing (DSR) and Power Efficient Gathering Sensor Information (PEGASIS) routing protocols.This paper provided a comparative analysis of the hybridization approach and proposed approach. It was seen that the amount of energy being consumed, delay and bit error rate were minimized. Further, better quality of service (QOS) results was achieved with the improvement of throughput and thus, the lifetime of network was improved. For comparing and evaluating the performances of routing protocols, the calculating model was utilized.

Guangjie Han, et.al (2015) presented that the popularity of underwater WSNs (UWSNs) is growing lately since they are helping the underwater applications in improving the security levels [13]. It is very important to include the energy efficient routing protocol to transmit the data within real-time applications. Large energy consumption, dynamic structure and high latency are the important properties of UWSNs which have affected the designing of routing protocols. This paper studied the existing routing protocols and provided a comparative analysis of their performances. Depending upon the route decision maker, the routing protocols were broadly categorized into two different categories. It was seen that there was still a need to make several improvements in the protocols as per the results. For achieving better results, future possible improvements were also outlined here.

Lein Harn, et.al(2016) proposed a new approach which included secure end-to-end communication to improve the performance of WSNs [14]. A recently developed group key pre-distribution mechanism was projected in this paper, also known as path key. A unique group key is provided by this presented mechanism. The complete routing path includes a key that is used to protect the transmitted data. To perform encryption or decryption in the networks, several pair-wise shared keys were applied repetitively. The data transmitted across the network was protected here by proposing an end-to-end path

key such that the repetitive usage was prevented from occurring. To establish a path and path key, the protocol was used such that the sensors can be secured through authentication. There was minimization of time required for data processing towards the intermediate nodes by applying the proposed approach.

JingJing Yan, et.al(2016) presented that since the sensors are limited in size and have constrained battery, increasing the lifetime of networks is very challenging [15]. There are several energy-efficient routing techniques utilized lately. Different routing protocols have been designed and based on their orientations; they have been categorized as homogeneous and heterogeneous. Also, according to the specifications, the protocols were categorized as static and mobile. This paper also discussed the important properties and limitations of these protocols. The list of several problems being faced with respect to energy-efficiency of routing protocols was presented here. It was seen through this review analysis that in comparison to static WSNs, the performance of mobile WSNs was better. However, within such networks, the deployment costs are high.

Author Name	Year	Description	Outcomes
SarabF.Al Rubeaai,et.al	2015	A novel protocol was proposed using which it was possible to control the numbers of nodes being forwarded. The proposed protocol was given the name of 3-D Real-time Geographical routing protocol.	The performance of routing protocols was improved by the means of continuous delay and miss ration parameters.
Kamalrulnizam Abu Bakar, et.al	2015	TERP protocol was proposed which was applied to identify and remove the malicious nodes entering the network. This protocol was named as TERP	power consumption is reduced, throughput is improved along with the overall lifetime of network as per the simulation results achieved at the end.
Shalli Rani, et.al	2016	PDORP approach was projected which was based on directional transmission energy aware routing mechanism.	A calculative model was used for the evaluation and comparison of different protocol performances.
Guangjie Han, et.al	2015	This paper studied the existing routing protocols and provided a comparative analysis of their performances. Depending upon the route decision maker, the routing protocols were broadly categorized into two different categories.	It was seen that there was still a need to make several improvements in the protocols as per the results. For achieving better results, future possible improvements were also outlined here.
Lein Harn, Ching-Fang Hsu, et.al	2016	A recently developed group key pre-distribution mechanism, also known as path key has been presented in this paper. This mechanism provided a unique group key	There was minimization of time required for data processing towards the intermediate nodes by applying the proposed approach.
JingJing Yan, et.al	2016	On the basis of design and orientation, various protocols had been already invented. These were	It was seen through this review analysis that in comparison to static WSNs, the performance of

		categorized as homogeneous and heterogeneous. Also, according to the specifications, the protocols were categorized as static and mobile.	mobile WSNswasbetter. However, within such networks, the deployment costs are high.

Conclusion

A localized kind of network in which sensor nodes are positioned at large distances from one another is known as WSN. Two of the major problems being faced in WSNs include the node localization and amount of energy being consumed. A review is presented in this paper which focuses on studying the different approaches proposed to handle these two issues along with improving the lifetime of sensor nodes in WSN. In comparison to all the techniques, the range based and clustering technique was known to be the most efficient technique.

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