Wireless Sensor Networks: A Review on Sensor Deployment and Routing Protocols for Different Application

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Abstract. - In the past years, many research works has been performed on the basics of the wireless sensor networks for different application namely precision agriculture, environment, medical care, security and surveillance. Whereas, WSN faces the different kinds of challenges that includes energy consumption, routing protocol algorithm and selection of the sensor node from the particular application environment. Therefore, the implementation of the wireless sensor networks has overcome a numerous amount of challenges in the practical life. In this paper, we mainly focused on the two issues which mainly affect the transmission of the data to the base station they are sensor node deployment which is used to improve the coverage area of the environment and the routing protocol which is used to select the node to maintain a particular route for a network. Atlast, we have discussed about design challenges that are faced during the designation of the wireless sensor networks.

Keywords- wireless sensor networks, energy consumption, sensor deployment, routing protocols, nodes

1.INTRODUCTION

Recent years, WSN have become the specialist in the field of the precision agriculture, military, medi-care and environmental challenges. The main reason for choosing WSN is its able to determine the parameter namely sound, temperature that are in the sensor nodes. The communication of WSN is through the source and end of the sink by the multihop communication. The application of the WSN’S require the sensor deployment and routing protocol in the network field. The fact growth in the wireless networking, data communication and MEMS which is used to develop the low cost, low energy consumption and less number of sensor nodes. [1] When the number of sensor nodes are grouped together, can gather the data such as sensing and capturing and communicating wirelessly to the particular location for analysing and evolution. The sensor nodes of the WSN has the self configuring technique. There are wide variety of the sensor nodes available in the WSN’s, they are sensor node, sensor router node and the sensor sink node. Therefore, the performance of the above-mentioned sensor network are, the sensor node is used to gather the sensory information and send it to the multi hop communication by using the wireless technology namely zig-bee, BLE and wi-fi. The data close the nearby node moves in routes the data in the direction of nearby node which is closer to the sink node. The sink node is also known as the base station.
The base station is the place where all the information about the wireless sensor network is gathered in the particular area and transfer the information to the remote solution and slows that information for the future analysis and evolution purpose. After the analysis and the evolution has been completed, the routing protocol is used to give the better path through which the data can be transfer from the base station to the remote station which is achieved in the less time consumption and energy efficient. The wireless sensor network nodes have their own specific protocol which includes the data communication, integration of data and networking and routing protocols. The routing protocols of the WSN’s has 5 layers namely physical layer, data link layer, network layer, transport layer and application layer. The design of the WSN depends particularly on the application requirements known as the number of nodes, the power consumption and life time of the sensors and information to be gathered and send to the remote station. The main components of the wireless sensor networks are sensing node and the transmission technology. Further more, the main reason for using the WSN in the field of agriculture, military, medi-care, security is that they have the several advantages over the traditional method.

2. ROUTING PROTOCOL IN WSN

To improve lifetime of the network for particular applications of the wireless sensor environment, the sensor nodes are mannered to restricted resources of it, in-order to design a successful and energy aware protocol. The sensor nodes do not have specific ID for identification purpose and more data is collected at the destination nodes. Therefore, while designing the routing protocols for wireless sensor networks, the design process must meet some requirements that are energy efficient, fault-tolerance, accuracy level and power consumption.

The routing protocols in the wireless sensor networks are mainly classified as data centric routing protocols, hierarchical-based routing protocols and location-based routing protocol based on the structure of the network and their applications in WSN [5]. In data centric based routing protocols which is also known as attribute-based routing protocol, the sink sends queries only to the selected region and the sink waits for the reply data from that sensor in the selected region.

Since the nodes in the wireless sensor network plays a different role, the hierarchical-based routing protocol is used to give efficient communication. As gives an efficient communication, it is a special advantage of all routing protocols so the hierarchical-based routing protocol is also known as cluster-based routing protocols. The location-based routing protocol is used to upgrade the routing performance and to give the new type of service

3. SENSOR DEPLOYMENT IN WSN

In WSN, the nodes are deployed in different ways based on their applications. The deployment methods are nearly based applications of the wireless sensor networks. The two main classification of the deployment methods in the wireless sensor networks are deterministic-based deployment and random deployment. In deterministic-based deployment method where the application status of the environment known, the sensor node can be fixed at the selected area of the application and the operation status can be fixed in the selection area of WSN.[3]
The deterministic-based deployment method is the unique one and simplest in WSN. In deterministic-based deployment model, full coverage of the large environments is possible also where the man-made deployment is difficult. In random deployment method, the full coverage of particular environment is difficult. The random deployment is also known as the economical deployment. In order to achieve the full coverage of the selected environment by the random deployment method, numerous amounts of the nodes should be deployed in the sensor network. But this random deployment is implemented only at the environment where the full coverage of the network field is not mandatory. Although in some areas, where the sensor deployment is difficult, it can be made easy by increasing the coverage effect by implementing the large number of sensor nodes in-order to get a successful coverage effect of that selected field.

4. APPLICATION REVIEW OF WSN

Here we surveyed two applications where the wireless sensor networks are most commonly used. The WSN are basically used in military, security and surveillance, agriculture, industries and Medicare. The review is based on two applications namely agriculture and health care.

4.1 WSN For Agriculture Field

A huge amount of wireless sensor networks has been used in the agricultural field. But the researchers faced many problems namely, calibration in the sensor nodes, poor condition of the signal, more power consumption by the nodes and low throughput. Based on the past review of the researchers, here we came to know about the problems that they faced during the sensor deployment of the wireless sensor networks in the agricultural network.[7] In the paper titled sensor deployment based on agriculture automatic system, the automatic agriculture system is based on the wireless sensor network consists of 25 nodes, 1 actuator node and 3 sink nodes.

To manage the servers in the subsystem namely database server, application server and the web server, the sink node transmit the data over TCP/IP protocol, to get an energy efficient system. The system runs using Li-iron battery and uses sleep-awake method. The time interval between sensing and sleep takes 20 seconds where it senses luminance, temperature and humidity and it goes back to sleep for 5 minutes. In their paper, author has explained a clear implementation of the system architecture but it also has low routing power and poor communication system. In the paper titled Design and Deployment of the wireless sensor network for the precision agriculture, the author prescribed the data that are collected through the simulation process namely humidity, temperature and soil level in the agricultural field and also it gives accuracy in the 78% for temperature monitoring and 85% in case of humidity monitoring.[10] In the paper titled Precision agriculture for green houses using wireless sensor networks, the author uses high level sensor to get the temperature and humidity level accurately. They used NIC temperature sensor and HR202 humidity sensor to determine the temperature and humidity automatically by using the fan and water pump. The great advantage of this paper is that it uses a smart device application to control the fan and water pump by manually being in the place wherever instead of going to the field and controlling.
4.2 WSN for Health Care Applications

The past research in the health care applications are based only on the wireless medical care system as it faces many challenges in the security to the patients in the carer, the upcoming research was based on the wearable health devices. Almost in the health care applications, wireless sensor networks are used. Whereas the WSN is also known as the wireless medical sensor networks. By using the WSN in the health care environment is improvement in the edge cutting component of the medical equipment and increasing the quality of service to the patients without any discomfort to the carer. The main aim of using wireless medical sensor network because it includes light weight devices which includes the special specifications like finite memory, finite computation and processing unit, usage of the battery power and bandwidth in the limited way.

Upto date, the researchers has paved the way only some of the health care application in a very accurate manner such as, glucose level determination, ECG, blood pressure, stress level detector. The sensing units are placed on the patients body and data are collected for each of the particular persons and sends the recorded data to the health care professions of that particular to a get better related the data that gathered through the sensors by using the wireless devices namely, android mobile, laptops.[4] The paper tilted Efficient and strong Authentication protocol for health care application using wireless medical sensor networks. The wireless medical sensor network has resulted many advantages like monitoring the Patients health condition continuously. In the above mentioned paper, the author prescribed about the requirements purpose to make the secure transformation of the data from patients body to the carer. The WMSN, was a fast mode of data transmission to detect the happenings in the patients body, delivery time of the data, power consumption. The another important thing in the health care application is that continuous status update about the patients body. As the wireless medical sensor network is used in the health care environment which uses the wireless devices to transform the data there may occurs no data loss, data send fastly and easily since it uses android phone, laptops. [6] There is a disadvantage in the above mentioned paper, it has some unauthorised data collection.

5. DESIGN CHALLENGES OF THE WIRELESS SENSOR NETWORKS

To design a wireless sensor networks one must have the proper planning about the design process. The communication and the signal processing, hardware technology, embedded system design and software knowledge are the required knowledge to deploy the wireless sensor network. The design process involved in the WSN has a wide variety based on the application which requires the deployment of the WSN.[8] The major factors affecting the design process of the WSN are, fault tolerance, scalability, production, transmission mode, power consumption, cost and hardware units. Figure-1 depicts the arrangement of sensor in the WSN.

Apart from all these genera issues, the WSNs are mostly irrespective of their applications. But energy consumption is the most important thing. Here we discussed about the effects and methods to overcome the issues mentioned above.
5.1 Scalability

The application requirements must known because the deployment of the nodes depends on the application needs. Based on the application density may vary from few nodes to the thousands of the nodes. To work under the different density of the nodes in the network communication and the data aggregation algorithm are needed. Figure-2 depicts the flow of data through data aggregation. As the variation in the density faces issues, in low density network, the data was shared only by few nodes. Whereas in the highly populated network, the data was shared by the multiple nodes which inorder produces a multiple data of the same algorithm at the same time. To determine the duplicacy in the data, the data aggregation algorithm is used. The major disadvantage in the WSN is that battery gets drain faster as it uses the multiple nodes.
5.2 Communication

In WSN, it has a individual set of challenges in the networking domain. To achieve a successful implementation in the field of the networking, the sensor node must use the radio frequencies or the optical communication, which are managed by using the radio units which has the electromagnetic spectrum in-order to pass the information from source to destination.

5.3 Data Collection

In WSN, the data collected by the sensor is given to the bases station, sometimes it is given to the cluster head. Figure-3 depicts flow of data from sensor to the base station. The frequency range of the data collection which is given to the transmitter is based on the application. Sometimes, the data collected by all the sensor and the data that is transmitted to the base station is inefficient and it requires a large amount of energy.[9] On order to reduce the energy consumption, data aggregation process is used to transmit the data to sensor node or-else to the intermediate node, to reduce to data packets that are transmitted which leads to the reduce the energy consumption.

5.4 Hardware Components

In wireless sensor networks, the 4 important hardware units are; a processing unit, a transceiver unit, sensing units and a power unit. Figure-4 shows the packages of the hardware components. Whereas most of the applications uses the small hardware components where all the four hardware units are packed together in small square shaped box. It must also have to be in light weight where the nodes have to pass the data easily. Because nodes must have the following parameters in the range such as, low power
consumption, it must be able to operate in the high volumetric density, production cost must be low and suitable to all kind of the environment.

![Figure 4. Hardware components of the WSN](image)

5.5 Power Consumption

In wireless sensor networks, power consumption is the key where the nodes must be operated under the battery. Mostly the battery, is replaced or recharged in-case of the drained out condition. Because at the drain out condition, nodes stops working and becomes dead. When the dead node gets increased the data collection and transmission to the base station gets reduced. It leads to the uneven operation for the particular application environment. Therefore, the researchers are researching in-order to increases networking life span by reducing the energy consumption.

6. CONCLUSION

In this paper, we discussed about the application areas sensor deployment and routing protocol in the WSN which includes the WSN in agriculture field and healthcare, whereas in agriculture research in ongoing in order to make a low cost, low power WSN which are easy from farmers to yield their production and healthcare security to the patients is the major issues. It also gives way to the research area and problem faced during the deployment of WSN by the researchers. It also covers the design challenges in the wireless sensor networks for the modern applications.

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