A Review on Wireless Sensor Network: its Applications and challenges

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Abstract: In latest ten years, wireless sensor network era has a rapid improvement. After a short advent of the wireless sensor network, some predominant research results of energy conservation and node deployment is provide. Then the applications of WSN within the medical health, environment and agriculture, intelligent home furnishing and building, military, space and marine exploration are outlined. In addition, we analyze the advantage of WSN in those regions. Finally, we summarize the main parameter that affects the packages of wireless sensor network.

*Index Terms - **Wireless sensor network, Energy conservation, Node deployment, Application.***

1. INTRODUCTION

A wireless sensor network is defined as a group of a large number of sensor nodes which are low in cost; consume less power and multi functional in nature. The Wireless sensor network is network that transfer physical parameter like pressure, temperature, humidity, sound pollution to a form that can easily measured, analysis and send all data to the central location i.e. server location. The element of sensor network includes the group of localized sensor, communication network, central location for data collection and group of sensor node. The every sensor node is used for the sense the physical parameter, process and communication on that parameter and sends related data to the central location. The Every sensor node has tendency to fail due physical condition, envirmental condition, software fail, hardware fail. The sensor nodes are highly distributed either inside or near by the system which is under study. These nodes are very small in size and consist of components for sensing, data processing and communication etc. The placement of these nodes can be random inside the system. It means that protocols of sensor networks and its algorithms must possess self organizing abilities in inaccessible areas. A wireless sensor network (WSN) or sometimes called a wireless sensor and actor network (WSAN) are spatially distributed autonomous sensors to monitor physical conditions, such as temperature, pressure, sound etc. and to cooperatively pass their data through the network to a main location. The more modern networks are able to pass data in two ways i.e. bidirectional and they also enable control of sensor activity. The development of wireless sensor networks was started for the military applications like battlefield surveillance and today these sensor networks are used in many applications related to industry and consumer applications .This paper tries to explore the important applications of wireless sensor network.

The protocol stack combines power and routing awareness, integrates data with networking protocols, and communicates power efficiently through the wireless medium. The protocol stack consists of the application, transport, network, data link, physical layer, power management plane, mobility management plane and task management plane. Depending on the sensing task, different types of applications software can be built and use on the application layer. The transport layer helps to maintain the flow of data if the sensor networks application requires it. The network layer takes care of routing the data supplied by the transport layer. Since the environment is noisy and sensor nodes can be mobile, the MAC protocol must be power aware and able to minimize collision with neighbors broadcast. The physical layer addresses the needs of the simple but robust modulation, transmission and receiving techniques. In addition, the power, mobility and task management planes monitor the power, movement and task distribution among the sensor nodes. These planes help the sensor nodes coordinate the sensing task and lower the overall power consumption.

2. RELATED WORK

The nodes of the wireless sensor network have the automatic networking function and the nodes can communicate with each other. In the application of wireless sensor network, typically the sensor nodes are placed somewhere with no base network facility. Such as a vast area of virgin forest, or the danger area where people cannot reach, this requires the sensor node has the self-organization ability to configure and manage automatically. When a node cannot directly communicate with the gateway, it requires other nodes to transmit data, so the network data transmission is a multi-hop routing. In some special applications, wireless sensor network is mobile, sensor nodes may stop work because of the energy consumed or other failure, these factors will make the network topology changes. There are a large number of sensor nodes in wireless sensor network and often need to arrange in a specific monitoring area. The hardware resources of sensor node are limited because of the size and cost constraints. So its computing power, storage capacity is relatively weak. Mobile communication network or Ad hoc network mainly considers how to improve the network transmission capacity under current conditions, that is to provide users with a bandwidth sufficient, safe and reliable transmission channel. However, wireless sensor network is used to monitor the various measured data. In the network design process, we mainly consider how to deal with perception data efficiently and transmit the obtained data to the user node. Therefore, one characteristic of the wireless sensor network is data-centric. As wireless sensor networks uses wireless transmission, so the monitoring data is easy to be intercepted, or even confuse users after tampering. After a large number of sensor nodes are captured, the enemy may use them to destroy the existing network. Therefore, in the design of wireless sensor networks, security problem is the focus of the study.

The key technologies of wireless sensor networks are network protocol, time-synchronization, localization, data aggregation, power management and security administration. In the wireless sensor network protocol study, medium access control protocol and routing protocol is the key point. Medium access control protocol is a set of rules and processes to effectively, orderly and equitably use shared media. Routing protocol is responsible for the data packets from source node forwarding to destination node through the network, mainly to complete the search for optimal path and transmit the data according to the optimal path. Wireless sensor network nodes are generally battery-powered; a deployment of lifetime use, the battery charging and replacement is difficult. Therefore, in the design of wireless sensor networks, we should work for the efficient use of energy node in the completion of the requirements under the premise, as far as possible to extend the life of the entire network. In wireless sensor networks, security administration is mainly reflected in two aspects: communication and information security. Communication security mainly considers the security node, passive defense intrusion attack and active against invasion. And the information security mainly considers data confidentiality, data integrity and effectiveness.

3. APPLICATION OF WIRELESS SENSOR NETWORK

A. Military or Border Surveillance Applications

WSNs are becoming an integral part of military command, control, communication and intelligence systems. Sensors can be deployed in a battle field to monitor the presence of forces and vehicles, and track their movements, enabling close surveillance of opposing forces.

B. Environmental Applications

Environmental applications include tracking the movements and patterns of insects, birds or small animals.

C. Health Care Applications

Wireless sensor networks can be used to monitor and track elders and patients for health care purposes, which can significantly relieve the severe shortage of health care personnel and reduce the health care expenditures in the current health care systems. For example sensors can be deployed in a patient's home to monitor the behaviors of the patient. It can alert doctors when the patient falls and requires immediate medical attention.

D. Environmental Conditions Monitoring

WSN applications in this area include monitoring the environmental conditions affecting crops or livestock, monitoring temperature, humidity and lighting in office buildings, and so on. These monitoring modules could even be combined with

actuator modules which can control, for example, the amount of fertilizer in the soil, or the amount of cooling or heating in a building, based on distributed sensor measurements.

E. Home Intelligence

Wireless sensor networks can be used to provide more convenient and intelligent living environments for human beings. For example, wireless sensors can be used to remotely read utility meters in a home like water, gas, electricity and then send the readings to a remote centre through wireless communication.

F. Industrial Process Control

In industry, WSNs can be used to monitor manufacturing process or the condition of manufacturing equipment. For example, chemical plants or oil refiners can use sensors to monitor the condition of their miles of pipelines. These sensors are used to alert in case of any failures occurred.

G. Agriculture

Using wireless sensor networks within the agricultural industry is increasingly common; using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Gravity feed water systems can be monitored using pressure transmitters to monitor water tank levels, pumps can be controlled using wireless I/O devices and water use can be measured and wirelessly transmitted back to a central control center for billing. Irrigation automation enables more efficient water use and reduces waste.

H. Structural Monitoring

Wireless sensors can be used to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc... enabling Engineering practices to monitor assets remotely without the need for costly site visits, as well as having the advantage of daily data, whereas traditionally this data was collected weekly or monthly, using physical site visits, involving either road or rail closure in some cases. It is also far more accurate than any visual inspection that would be carried out.

4. CHALLENGES

4.1 Target Coverage and Connectivity:

Target coverage is one of the fundamental problems for wireless sensor networks (WSNs). Target coverage is needed to select sensors in a given area that can monitor a set of interesting points. With the limited energy of sensor nodes organizing these nodes into a maximal number of subgroups (or called set cover) capable of monitoring all discrete points of interest and then alternately activating them is a prevalent way to provide better quality of surveillance. In addition to maximizing the number of subgroups, how to guarantee the connectivity of sensor nodes (i.e., there exist links between the base station (BS) and sensor nodes) is also critically important while achieving full coverage.

4.2 Data Collection:

Data collection is also a primary objective in WSN. Data collection is needed to transmit the sensed data from sensors to a sink. Since, in many applications, sensors are battery powered, it is expected that a WSN can work Wireless Sensor Networks (WSNs) play a vital role in today's real world applications. The effectiveness of WSNs purely depends untended for a long period.[11] Numerous data collection schemes such as multipath, chain, tree, cluster and hybrid topologies are available in literature for collecting data in WSNs. However, the existing data collection schemes fail to provide a guaranteed reliable network in terms of mobility, traffic, and end-to-end connection.

4.3 Network Lifetime:

One of the key challenges facing wireless sensor networks (WSNs) is extending network lifetime due to sensor nodes having limited power supplies and non-replenish able energy resources. Extending WSN lifetime is complicated because nodes often experience differential power consumption. For example, nodes closer to the sink in a given routing topology transmit more data and thus consume power more rapidly than nodes farther from the sink [10]. Also energy consumption is severely disproportional to the uniform energy deployment for the given network topology, which greatly reduces the lifetime of the sensor networks. In order to improve the lifespan of the network, load balancing techniques using efficient routing mechanisms must be employed such that traffic is distributed between sensor nodes and gateway(s).

4.4 Data Compression:

Wireless sensor networks are resource constraint: limited power supply, bandwidth for communication, processing speed, and memory space. One possible way of achieve maximum utilization of those resource is applying data compression on sensor data. Usually, processing data consumes much less power than transmitting data in wireless medium, so it is effective to apply data compression before transmitting data for reducing total power consumption by a sensor node.

5. ACKNOWLEDGMENTS

6. CONCLUSION

Wireless Sensor Network (WSN) is an emerging technology that shows great promise for various futuristic applications both for mass public and military. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in abundance in future. Many applications of WSNs include military, health, environmental, water, industries, home, agriculture and so on. Besides these applications, security is the main issue in WSNs.

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