A Survey on Wireless Sensor Network: An Application Perspective

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Abstract

During the last decade, Wireless sensor networks have found their way into a wide variety of applications and systems with vastly varying requirements and characteristics. Tremendous use of wireless sensor networks which consist of small nodes with sensing, computation and wireless communications capabilities. Different types of architectures and node deployment strategies have been developed for wireless sensor network, depending upon the requirement of application. In this paper, the wireless sensor network is viewed in aspects of features, environment and application. The motivation of this paper is to give an overall coverage of applications that can be bridge for a new beginning.

Keywords: Wireless sensor Network; Ad hoc network; Survey

1. Introduction

Wireless sensor network (WSN) technologies have the potential to change our lifestyle with different applications in fields such as healthcare, entertainment, travel, retail, industry, dependent care and emergency management, in addition to many other areas.[2] Wireless sensor networks (WSNs), may be comprised by hundreds or maybe thousands of ad-hoc sensor node devices, working together to accomplish a common task. Self-organizing, self-optimizing and fault-tolerant are the main characteristics of this type of network. [1] Wireless sensors deployed in specific distributed manner to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications. [3]

According to the application and requirement, wireless sensor networks working on different specific protocols and architecture. Also performance criteria of WSN include: Quality of service, Scalability, Mobility, Radio Bandwidth, Heterogeneity etc. Choice of communication media is one of many factors that influence the design of WSN. [4] Like IEEE 802.15.1/Bluetooth, Wibree (Ultra Low Power Bluetooth), Ultra wide band, ZigBee, X-Bee etc.

2. General Architecture of Wireless sensor Network

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Sensor nodes are the elementary components of any WSN and they provide the following basic functionalities[1]: i) signal conditioning and data acquisition\n for different sensors; ii) temporary storage of the acquired data; iii) data processing; iv) analysis of the processed data for diagnosis and, potentially alert generation; v) self-monitoring (e.g., supply voltage); vii) scheduling and execution of the measurement tasks; viii) management of the sensor node configuration; viii) reception, transmission, and forwarding of data packets; and ix)) coordination and management of communications and networking.
Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors

and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in sizes and cost, depending on the complexity of the individual sensor nodes. [3]

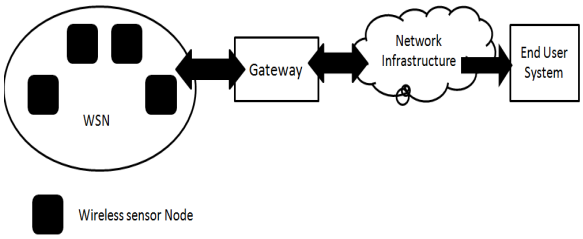

Fig1. General Architecture of Wireless sensor network

Sensors are communicated with the base node through the protocols using some communication media. The basic issue in communication networks is the transmission of messages to achieve a prescribed message Quality of Service (QoS). QoS can be specified in terms of message delay, message due dates, bit error rates, packet loss, economic cost of transmission, transmission power, etc. Depending on QoS, the installation environment, economic considerations, and the application, one of several basic network topologies may be used. A communication network is composed of nodes, each of which has computing power and can transmit and receive messages over communication links, wireless or cabled. The basic network topologies are fully connected, mesh, star, ring, tree, bus. A single network may consist of several interconnected subnets of different topologies. Networks are further classified as Local Area Networks (LAN), e.g. inside one building, or Wide Area Networks (WAN), e.g. between buildings.

3. Wireless Sensor and Ad Hoc Network

The wireless sensor devices can automatically organize themselves to form an ad-hoc multi hop network. Although many protocols and algorithms have been proposed for traditional wireless ad hoc networks, they are not well suited for the unique features and application requirements of sensor networks. In this subsection we briefly compare sensor and ad hoc networks to emphasize the important role of wireless sensor networks, especially in monitoring of the human body. To illustrate this point, the differences between sensor networks and ad hoc networks can be summarized as follows: [2]

- Numbers of Sensor Nodes: the number of sensor nodes in a sensor network can be many orders of magnitude higher than the nodes in an ad hoc network.
- Efficiency: sensor nodes are densely deployed.
- Failure: sensor nodes are prone to failures.
- Network Topology: the topology of a sensor network changes very frequently.
- Communication Ability: sensor nodes mainly use broadcast communication paradigm whereas most ad hoc networks are based on point-to-point communications.
- Computing: sensor nodes are limited in power, computational capacities, and memory.
- Cost: Sensor nodes may not have global identification because of the large amount of overhead and large number of sensors.

4. Wireless Sensor Network applications

Now a days the use of wireless sensor networks broadly in our routine life. You can find different sensors usage around your places may be your home, work place, mall, hospital etc. Here categorized the applications into military, environment, health, home and other commercial areas. It is possible to extend this classification with more categories such as space exploration, chemical processing, disaster relief, and so on.

4.1 Military Applications

Wireless sensor networks can be a part of military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting systems. The rapid deployment, self-organization and fault tolerance characteristics of sensor networks make them a very promising sensing technique for military applications.[2-3] Some of the military applications of sensor networks are monitoring friendly forces, equipment and ammunition; battlefield surveillance; reconnaissance

of opposing forces and terrain; targeting; battle damage assessment; and nuclear, biological and chemical attack detection (recently is considered as one of the critical types of attacks) and reconnaissance.

4.2 Environmental Applications

Another important area of wireless sensor networks are environmental applications which includes large-scale earth monitoring and planetary exploration; chemical/biological detection; precision agriculture; biological, earth, and environmental monitoring in marine, soil, and atmospheric contexts; forest fire detection; meteorological or geophysical research; flood detection; bio-complexity mapping of the environment; and pollution study.[2]

4.2.1 Air quality monitoring

The degree of pollution in the air has to be measured frequently in order to safeguard people and the environment from any kind of damages due to air pollution.[3] Different parameters of air quality are measured to check specific volume of different gases. Also uses for observing the gas levels at vulnerable areas. In deferent cities also WSN deployed for air pollution monitoring as well.

4.2.2 Forest fire detection

A network of Sensor Nodes can be installed in a forest to detect when a fire has started. The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation. The early detection is crucial for a successful action of the firefighters.

4.2.3 Landslide detection

A landslide detection system makes use of a wireless sensor network to detect the slight movements of soil and changes in various parameters that may occur before or during a landslide. Through the data gathered it may be possible to know the occurrence of landslides long before it actually happens.[5]

4.2.4 Water quality monitoring

Water quality monitoring involves analyzing water properties in dams, rivers, lakes & oceans, as well as underground water reserves. [3] The use of many wireless distributed sensors enables the creation of a more accurate map of the water status, and allows the permanent deployment of monitoring stations in locations of difficult access, without the need of manual data retrieval.

4.2.5 Natural disaster prevention

Wireless sensor networks can effectively act to prevent the consequences of natural disasters, like floods. Wireless nodes have successfully been deployed in rivers where changes of the water levels have to be monitored in real time.

4.3 Healthcare Applications

Some of the health applications of sensor networks involve providing interfaces for the disabled, integrated patient monitoring, diagnostics, drug administration in hospitals, telemonitoring of human physiological data, and tracking and monitoring doctors and/or patients inside a hospital. Combination of wireless sensors for health care application called wireless body area network (WBAN). In which the sensors have been wearable and implantable on/in body.

4.3.1 Tele monitoring of Human Physiological Data

The physiological data collected by sensor networks may be stored for a long period of time, and can be used for medical investigations when needed. In addition, the installed sensors can also monitor and detect the behavior of elderly people. Integration of wireless sensor network with medical service provides ubiquitous e-Healthcare feature.

4.3.2 Tracking and Monitoring Doctors and Patients inside a Hospital

Each patient has a small sensor node attached to them. Sensors vary based on their functions and each sensor node has its own specific task to perform. For example, one sensor node may be detecting the heart rate while another is detecting the blood pressure. Doctors can also carry a sensor node, which allows other doctors to locate them within the hospital.[2]

Major projects working on the e-healthcare monitoring system using WSN like, Code blue, MiThril, Medicon, Alarm-Net .[6]

4.4 Home Applications

As technology advances, smart sensor nodes and actuators can be incorporated into appliances and day life, such as vacuum cleaners, micro-wave ovens, and refrigerators. These sensor nodes inside the devices can communicate with each other and with the external network via the Internet or satellite. They allow end users to control home devices locally and remotely more easily and can be used as alarms for disasters at homes.

Monitoring the activities performed in a smart home is achieved using wireless sensors embedded within everyday objects forming a WSN.[7] State changes to objects based on human manipulation is captured by the wireless sensors network enabling activity-support services .

4.5 Commercial Applications

Some of the commercial applications are monitoring material fatigue; building virtual keyboards; managing inventory; monitoring product quality; constructing smart office spaces; environmental control in office buildings; robot control and guidance in automatic manufacturing environments such as interactive toys; interactive museums; factory process control and automation; monitoring disaster area; smart structures with sensor nodes embedded inside; machine diagnosis; transportation; factory instrumentation; local control of actuators; detecting and monitoring car thefts; vehicle tracking and detection; as well as instrumentation of semiconductor processing chambers, rotating machinery, and wind tunnels. Also includes machine health, data logging, waste/water monitoring in industries.

4.6 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.

When real time data is delivered, farmers are able to achieve intelligent irrigation. Data regarding the fields such as temperature level and soil moisture are delivered to farmers through wireless sensor networks.

Wireless sensor networks are also used to control the temperature and humidity levels inside commercial greenhouses. When the temperature and humidity drops below specific levels, the greenhouse manager must be notified via e-mail or cell phone text message, or host systems can trigger misting systems, open vents, turn on fans, or control a wide variety of system responses.[3]

5. Conclusion

This paper shows that wireless sensor network is broadly used in different application. Features and characteristics of wireless sensor network make it more popular for user as well for researcher. Utilization of commercial off-the-shelf technology in WBNs in healthcare opens up the possibility of using inexpensive, unobtrusive and unsupervised monitoring for patients.WSN for monitoring of environment and industries parameters make more secure and accurate for the forecast.

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