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WIRELESS SENSOR NETWORK- A REVIEW ON NODE ARCHITECTURE AND VARIOUS ISSUES

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ABSTRACT

Nowadays, Wireless sensor networks (WSN) are receiving significant attention due to their unlimited potential. WSNs are used in variety of fields which includes military, healthcare, environmental, biological, home and other commercial applications. A wireless sensor network is a collection of sensor nodes which are equipped with wireless interfaces with which they communicate each other to form a cooperative network. Sensing, computing and communicating are the major functions of wireless sensor networks which consume much power of these low powered sensor nodes. In this review paper we discussed the hardware components of the sensor node in the wireless sensor network, applications of sensor network in various fields and various issues involved in WSN.

INDEX TERMS: Wireless sensor network, sensor nodes, WSN applications, issues.

1. INTRODUCTION

In the wireless network all the computers are connected and communicate with each other not by the visible medium, but by emission of electromagnetic energy in the air. The most widely used transmission support is radio waves. Wireless Sensor Network (WSN) has come forth as an important new field in the wireless communication. These networks have gained worldwide attention in recent years, particularly with the rapid increase in Micro-Electro-Mechanical Systems (MEMS) technology which has facilitated the development of smart sensors. A sensor network is composed of a large number of small, low-cost, low-power multi-functional devices

called sensor nodes that are densely deployed either inside the phenomenon or very close to it. These sensor nodes which are very small in size consist of sensing, data processing and communicating components.

A WSN is a computer network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical environmental conditions such as temperature, motion, pressure, sound, vibrations, or pollutants at different locations. This network can be deployed in any type of environment such as geographic regions, office buildings, interior of planes and urban toxic environment.

In general, there are two types of WSNs: Structured and Unstructured. An unstructured WSN is one in which sensor nodes are deployed in an ad hoc manner into the field. In structured wireless sensor network, the all sensor nodes are deployed in planned manner. The benefit of structured wireless sensor network is that some nodes can be deployed with lower network maintenance and management cost. The aim of wireless sensor network is to provide efficient connection among the physical environmental condition and internet worlds.

Figure 1 show the basic architecture of the wireless sensor network in which sensor node are deployed in the sensor fields and they communicate with one another for collecting the information from the environment, or directly send to the base station or sink, basically base station act as a gateway. With the help of gateway data is transmitted to the internet. Because users are directly connect to the internet. In a typical scenario, users can retrieve information of their interest from a WSN by injecting queries and gathering results from the base stations, which behave as an interface between users and the network. In this way, WSNs can be considered as a distributed database.

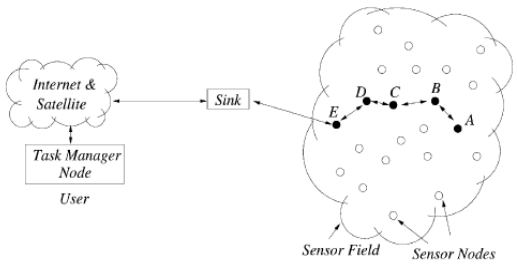

Figure 1: WSN Communication Architecture [1]

2. ARCHITECTURE OF SENSOR NODE

A natural architecture for such collaborative distributed sensors is a

network with wireless links that can be formed among the sensors in an ad hoc manner. The wireless sensor nodes are the essential building blocks in a sensor network. A general sensor node is composed of four basic components as shown in Figure 2: a sensing unit, a processing unit, a transceiver unit and a power unit. They may also have application dependent additional components such as location finding system to determine their position, a mobilizer to change their location or configuration (i.e. antenna's orientation) and a power generator.

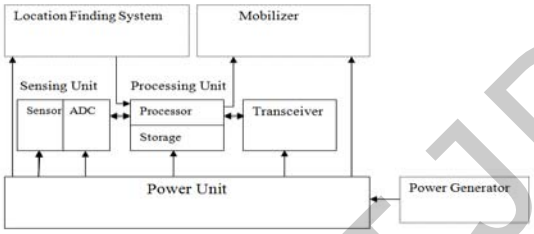

Figure 2: Architecture of Sensor Node

2.1 SENSING UNIT

This is the part of sensor node which physically reads and collects data from the environment. These are usually composed of two subunits: Sensors and Analog to Digital Converters (ADCs).

- **Sensors:** Sensors are the small tiny, self-contained, battery-powered, low cost devices which can sense, store and gather information. These hardware devices produce a measurable response to a change in a physical condition like temperature, humidity or pressure. The analog signal produced by the sensors is passed to an analog-to-digital conversion stage for digitization and further processed. There are two types of sensors: active and passive. Active sensor gathers data by examining the environment, while passive sensors collect data without actually disturbing the environment.

- **ADC:** The analog signals produced by the sensors by the observed phenomenon are converted into digital signals by the ADC, and then fed into the processing unit.

2.2 PROCESSING UNIT

The processing unit is generally associated with small storage unit, which manages the procedures that make the sensor node collaborate with other nodes to carry out the assigned sensing tasks.

- **Microprocessor:** It performs tasks after that it processes information and then controls the functionality of other components.
- **External memory:** The processor also stores the gathered data in the memory until it is forwarded to

the next node. Two kinds of memory are used on the basis of type of storage: User memory for storing application related or personal data and Programming memory for program the device.

2.3 TRANSCEIVER UNIT

The Transceiver connects the node to the network. The transceiver provides the functionality of both transmitter and receiver. Most transceivers operating in idle mode have power consumption almost equal to the power consumed in receiving mode. Thus, it is better to completely switch off the transceiver rather than leave it in the idle mode when it is not transmitting or receiving due to the more power consumed in this mode. A significant amount of power is consumed when switching from sleep mode to transmit mode in order to transmit a packet.

2.4 POWER UNIT

One of the most important components of sensor node is the power unit. Power source supplies power to sensors and to the other components of the sensor node. Power unit may be supported by power scavenging unit such as solar cells. Sensors can sense, store and gather information. For all this they consume power. Power is stored either in batteries or capacitors. Batteries are the main source of power supply for sensor nodes.

3. APPLICATIONS OF WSN

A wireless sensor network (WSN) has important applications such as remote environmental monitoring and target tracking. The design of a WSN depends significantly on the application, and it must consider factors such as the environment, the applications design objectives, cost, hardware, and system constraints. A short list of applications is as follows:

- **Military Applications:** Wireless sensor networks can be an integral part of military command, control, communication, computing, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) systems [1]. The rapid deployment, fault tolerance and self organization characteristics of sensor networks make them a very promising sensing technique for military (C4ISRT).
- **Environmental Applications:** Sensor network provides some environmental applications like tracking the movement of birds , small animals and insects; monitoring environmental

conditions that affect crops and livestock ; irrigation; chemical/biological detection; biological, earth and environmental monitoring in marine, soil and atmospheric contexts ; forest fire detection ; flood detection; bio complexity mapping of the environment and pollution study.

- **Health Applications:** These applications are providing interfaces for the disabled; integrated patient monitoring; diagnostics; drug administration in hospital; monitoring the movements and internal process of insects or other small animals; telemonitoring of human physiological data; and tracking and monitoring doctors and patients inside a hospital.
- **Other Commercial Applications:** The commercial applications include monitoring material fatigue; building virtual keyboards ; managing inventory; monitoring product quality; environmental control in office buildings ; 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 detection and tracking; and instrumentation of semiconductor processing chambers , rotating machinery, wind tunnels and anechoic chambers .

4. ISSUES IN WSN

The main design goal of a WSN is to carry out data communication while trying to prolong the lifetime of the network. The design of the wireless sensor network is affected by many challenging issues which must be overcome before an efficient network can be achieved in WSN. These are:

- **Storage:** The sensor nodes have limited storage. So, conventional approaches in WSNs require that data is to be transferred from sensor nodes to a centralized base station. Techniques such as aggregation and compression reduce the amount of data transferred, thus reducing communication and energy costs.
- **Power Resource:** The most important issue in sensor network is the limited battery power of sensor nodes. The effective lifetime of a sensor node is directly determined by its power supply. Since sensor nodes are densely deployed in the sensing fields with limited battery power. And it is not also

possible to replace the battery so the available energy must be utilized in the best possible way so that network lifetime is also enhanced. It has to perform various controlling and communication operations regularly which will result in the more energy consumption of battery.

- **Fault Tolerance:** Some sensor nodes may fail or block due to lack of power, physical damage or environmental interferences. One damaged sensor node can affect the overall performance of the sensor network. It may require actively adjusting transmission powers and signaling rates on the existing links to reduce energy consumption, or rerouting packets through regions of the network where more energy is available.

- **Scalability:** The number of sensor nodes deployed into the sensing area may be on the order of hundreds or thousands or more. Any routing protocol must be able to work with this huge number of sensor nodes. In addition, sensor network routing protocols should be scalable enough to respond to events in the environment.

- **Node Capabilities:** In a sensor network, the sensor nodes have to perform different functionalities. Depending on the application, a node can be dedicated to a particular special function such as relaying, sensing and aggregation since engaging the three functionalities at the same time on a node might quickly drain the energy of that node.

- **Security:** A WSN is vulnerable to threats and risks. An adversary can compromise a sensor node, alter the integrity of the data, eavesdrop on messages, inject fake messages, and waste network resource [2]. Unlike wired networks, wireless nodes broadcast their messages to the medium. Hence, the issue of security must be addressed in WSN.

- **Transmission Media:** Generally, Transmission Media is wireless (RF or Infrared), which is affected by fading and high error rate and affect the operation of WSNs.

5. CONCLUSION

The emerging field of wireless sensor networks combine sensing, computation, and communication into a single tiny device. Unlike other networks, WSNs are designed for

specific applications. Applications include environmental monitoring, industrial machine monitoring, surveillance systems, and military target tracking. Each application differs in features and requirements. In this paper, we have studied the architecture of node in wireless sensor network and its various applications. Also we have presented various issues involved in WSN. Out of these, energy efficiency is the main concern.

In the future work, techniques for reducing energy consumption in a network will be studied, thus increasing network lifetime.

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