Role of Sensor Nodes in Wireless Sensor Network

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Abstract— **Wireless Sensor Networks consists of a wireless sensor network, all the nodes communicate with each other by means of wireless. Any given node collects information from environment by means of a sensor and forwards it to another node which in turn forwards the information to another node so that the information can reach at the gateway node. It is the gateway node which interfaces between the nodes and the server where all the collected information from all the nodes are stored and further processed [1]. Sensor nodes that are able to interact with their environment by sensing or controlling physical parameter; these nodes have to collaborate in order to fulfill their tasks as usually, a single node is incapable of doing so; and they use wireless communication to enable this collaboration.**

A sensor is a small device that has a micro-sensor technology, low power signal processing, low power computation and a short-range communications capability. Sensor nodes are conventionally made up of five basic components: Microcontroller, power supply, transceiver unit, memory unit and sensor unit.

IndexTerms— **Wireless Sensor Network, sensor node, microcontroller, Analog to Digital convertor**
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I. INTRODUCTION

Wireless Sensor Network

Wireless Sensor Networks consists of individual nodes that are able to interact with their environment by sensing or controlling physical parameter; these nodes have to collaborate in order to fulfill their tasks as usually, a single node is incapable of doing so; and they use wireless communication to enable this collaboration.

The definition of WSN, according to, Smart Dust program of DARPA is:

"A sensor network is a deployment of massive numbers of small, inexpensive, self powered devices that can sense, compute, and communicate with other devices for the purpose of gathering local information to make global decisions about a physical environment".
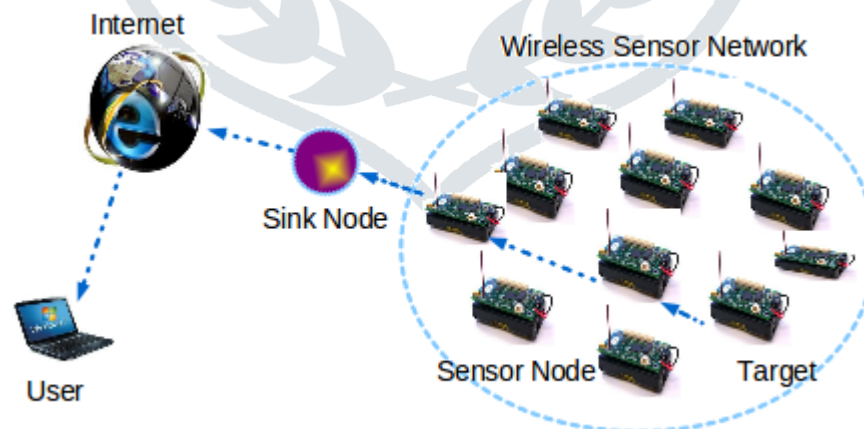

Fig. 1 Wireless Sensor Network

The Sensor Node

A Sensor is an electronic device used to detect or measure a physical quantity and convert it into an electronic signal. In other words, sensors are devices that translate aspects of physical reality into a representations understandable and processable by computers.[2]

II. COMPONENTS OF SENSOR NODE

Sensor nodes are conventionally made up of five basic components as shown in Figure 2 microcontroller, a power supply unit, a transceiver, memory unit, and sensor unit.
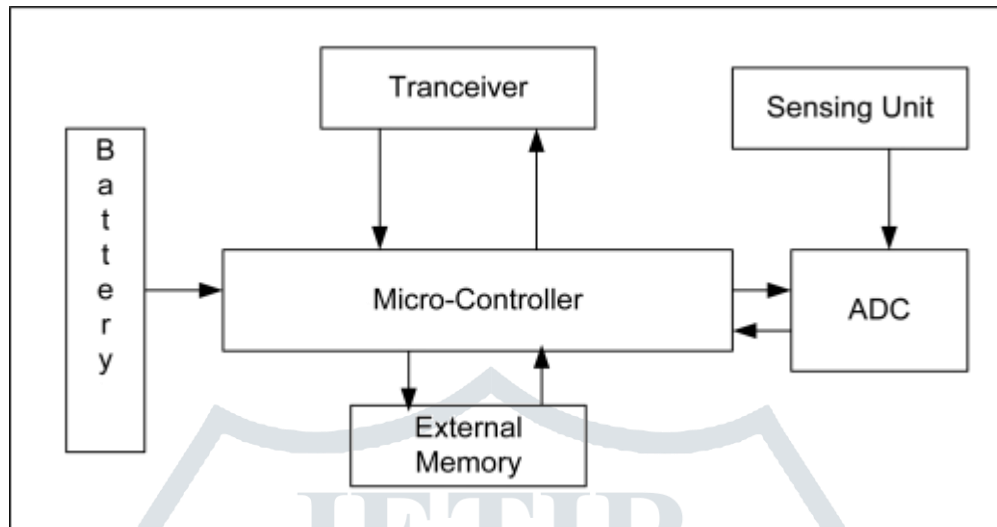

Fig. 2 Sensor Node Architecture

Microcontroller

The microcontroller is the central component in the WSN signal chain. It communicates with all of the sensors to read and process the data that the sensors are measuring. It communicates with the radio, to package the data in a manner that the radio can transmit wirelessly. It also houses the memory, containing all of the system parameters such as sleep modes, and the RF communications protocol. ADI has a family of microcontrollers that are designed specifically for this extremely low power application space such as the ADuCRF101 which is based on Cortex M3 processor technology.

Power Supply

Each component in the wireless sensor node is powered through the power supply unit and the limited capacity of the power supply unit requires energy efficient operations for the task performed by each component. The power in a WSN is mainly dissipated by sensors and Transceivers while either transmitting or receiving

Two options for power supply are:-
1. Primary batteries –not rechargeable
2. Secondary batteries –rechargeable, only makes sense in combination with some form of energy harvesting

Examples of primary batteries are Zinc-air, Lithium and Alkaline. Examples of secondary batteries are Lithium, NiMHd and NiCd[2].

Other power supply options are also available like solar energy.

Transceiver Unit

A transceiver unit acts as transmitter as well as receiver. It provides the communication between any two wireless sensor nodes. It also connects wireless sensor network to the network. Transceiver unit mostly uses Radio Frequency waves to as a transmission media. Transceiver can be in four operational states:- transmitting, receiving, sleep and idle.

Memory Unit

Memory in sensor nodes consists of: RAM (for fast data storage), internal flash (for code storage), EEPROM (for data storage), and external flash which is required for data persistence.[3]

Sensor

Sensor is a hardware device which gathers information from the physical world. Different kinds of sensors are used for gathering different kinds of information. Mainly sensor is composed of twp subunits: a sensor and an analog to digital convertor (ADC). Sensor receives analog signals from physical world and ADC converts these analog signals to digital signals and fed them to processing unit.

A sensor can be in one of two modes, i.e. active mode (AM) and power-save mode (PS). In active mode, a node is awake and may receive data at any time. In power-save mode, a node is sleeping most of the time and wakes up periodically to check for pending messages.[4] Transitions between power-save and active mode are triggered by packet arrivals and expiration of the keep alive timer.

III. EXAMPLES OF SENSOR NODES EMPLOYED IN WIRELESS SENSOR NETWORKS

Wireless sensor networks (WSN) consist of a great deal of sensor nodes with limited power, computation, storage, sensing and communication capabilities. WSN will have broad applications in either controlled environments (such as home, office, warehouse, etc) or uncontrolled environments (such as hostile or disaster areas, toxic regions, etc).

Wireless sensor networks have broadly utilized in a variety of industrial, medical, consumer and military applications. Some of the examples of sensor nodes are given in Table 1.[5]

Table 1 Sensor nodes employed in Wireless Networks

Sr. No.	Sensor	Application area	Sensed Events
1	Accelerometer	Transportation	2D and 3D acceleration of movements of people and objects
2	Electroencephalography	Health Care	Heart Rate
3	Magnetic Sensor	Transportation	Presence, intensity, direction, rotation and variation of magnetic field
4	Oximeter	Health Care	Blood oxygenation of patient's hemoglobin
5	Photo acoustic spectroscopy	Pipeline	Gas sensing
6	pH sensor	Pipeline(water)	Concentration of hydrogen ions

IV. CONCLUSION

A sensor node is an important part of the Wireless Sensor Network. Sensors nodes are the heart of the network. They are in charge of collecting data and routing this information back to a sink. Sensor nodes are conventionally made up of five basic components as shown in Figure 2 microcontroller, a power supply unit, a transceiver, memory unit, and sensor unit.

Additional components may include Analog-to-Digital Convertor (ADC), location finding systems, mobilizers that are required to move the node in specific applications and power generators. The analog signals are measured by the sensors are digitized via an ADC and in turn fed into the processor. The processor and its associated memory commonly RAM is used to manage the procedures that make the sensor node carry out its assigned sensing and collaboration tasks. The radio transceiver connects the node with the network and serves as the communication medium of the node. Memories like EEPROM or flash are used to store the program code. The power supply/battery is the most important component of the sensor node because it implicitly determines the lifetime of the entire network.

V. ACKNOWLEDGMENT

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