IJCSN - International Journal of Computer Science and Network, Volume 6, Issue 3, June 2017
ISSN (Online) : 2277-5420
www.IJCSN.org
Impact Factor: 1.5

Classification of Sensors used in WSNs

Parul Garg

CSE, MRSPTU, GZSCCET
Bathinda, 151001, India

Abstract - A wireless sensor network is used for the detection of some parameter like temperature change, fire detection, and many more applications. For the accomplishment of this task, the network uses a number of sensor nodes to sense the desired property. These nodes are deployed in area of interest. This paper firstly discuss a basic overview of a wireless sensor network and give brief description of a sensor node and its components. This paper also presents an overview of number of sensors that are used by wireless sensor networks. The classification of sensors is done on the basis of their area of application. A brief summarization is also presented in tabular form covering different types of sensors, their principle for the operation and application areas where they can be used. Since each requirement need different sensor to be used so we can use them accordingly.

Keywords – *Acoustic sensors, Biosensors, Thermal Sensors, Sensor Node.*

1. Introduction

The recent improvements in remote interchanges, and computerized hardware lead to the development of sensor nodes that are little in size and interconnect in short separations. These modest sensor nodes that comprises of sensing, information preparing, and conveying parts, impact the thought of sensor networks [1]. Wireless Sensor Network is a Deployment of several devices equipped with sensors that perform a combined measurement process. The improvements taken in sensing innovation, low-control microcontrollers and correspondence radio have energized the large scale manufacturing of generally economical sensor nodes [8]. The following diagram shows the overview of a sensor network:

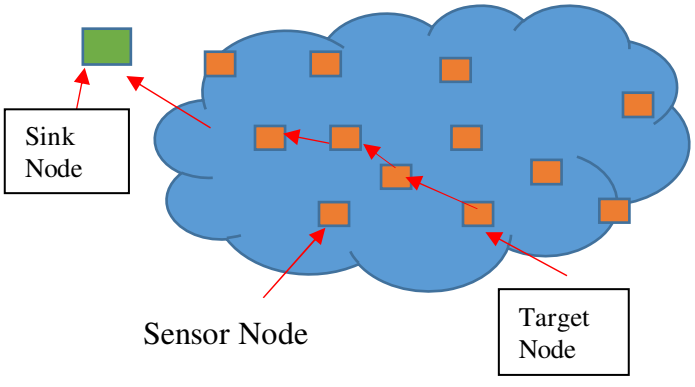


Figure 1: WSN Overview

1.1 Components of a node

The basic components of a sensor node are shown in figure 2: a sensing unit comprising of sensor unit and ADC (Analog to Digital Converter), CPU (Central processing unit), power unit and transceiver unit [3].

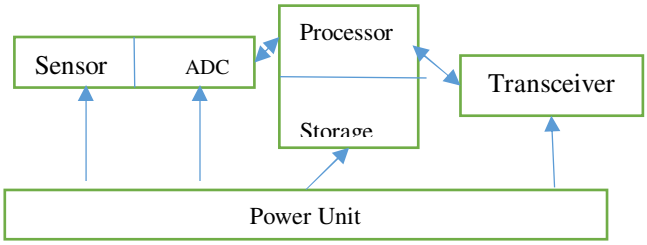


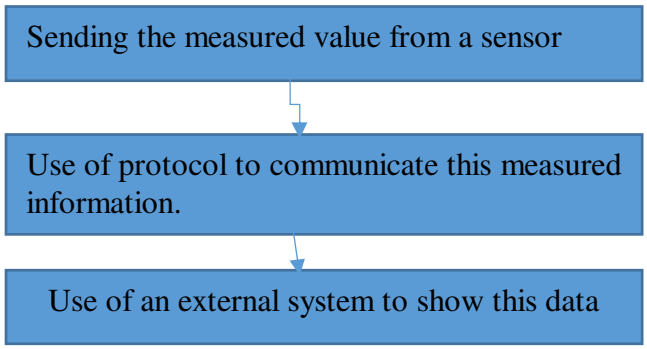
Figure 2. Major parts of a sensor node

The sensors deliver the analog signals and ADC convert them to digital signals, and served to the processing unit. A small storage unit is associated with processing unit and achieves the procedures that make the sensor node to cooperate with the other nodes to carry out the given sensing tasks. The transceiver unit associate the nodes to the network. The main part is the power unit. The sensed data must be conveyed to a control center called Base Station (BS). Just the highly energized nodes can impart data to the BS. The sink (Base Station) communicates with the client through web or satellite correspondence. It is spotted close to the sensor field or decently prepared hubs of the sensor system [2]. It is expected that all nodes of a system live on a plane in 2D WSN outline of physical systems. This supposition is not legitimate if a system is conveyed in space or sea, where nodes of a system are

disseminated over a 3D space. For instance, 2D configuration of submerged sensor system is not fitting; it obliges 3D outline [4].

1.2 Working process of a sensor network:-

Any wireless sensor networks work in three steps which are as follows:



The very first step is to measure some kind of information, measuring the information means to sense the environment in which the sensor network is deployed. After sensing the environment, the sensed information is sent to other nodes with the use of some protocol and at the end, the sensed information is sent to the user for further processing. The transmission is done either through radio signals or through acoustic signals. Radio signals are used by the terrestrial sensor networks whereas acoustic signals are used by underwater wireless sensor networks [9].

2. Literature Survey

In [1], Akyildiz, Ian F. et al (2002) has described the concept of the sensor networks and has explored the applications of the sensor networks and a list of factors are provided that affect the design of the wireless sensor networks. In [2], Al-Obaisat Yazeed and Robin Braun (2007) have presented the architecture and design features of the wireless sensor networks and also discussed the design goals and challenges for routing protocols. In [3], Pal S. et al. (2010) categorized the routing protocols on the basis of a number of factors and summarized them on the basis of their operation mode and a comparative analysis of the routing protocols is also presented. In [4], Roy S. et al. (2012) has proposed a framework for topology construction of 3D WSN using computational geometry for a given 3D space monitoring application. In [5], F. L. LEWIS discussed about the smart networks and described various types of sensors that are used in wireless sensor networks. In [6], author has described various displacement sensors along with their types and applications. In [7], authors have discussed about acoustic sensors. Acoustic sensors sense five types of acoustic waves that are also explained in their paper. In [8], Ramesh, Siddharth presented a protocol architecture of wireless sensor networks. In [9], Jaydip M. Kavar et al (2012) discussed the internal architecture of underwater sensor network. They also discussed the application area and issues of UWSNs.

3. Classification of Sensors

A sensor is also known as the transducer. A transducer can be defined as a device that converts one form of energy to another form. In case of wireless sensor networks, transducers can be defined as the device that senses some area of interest and convert that sensed information into some useful information that can be processed later on. The task of sensing an environment depends on physical principles. The Sensors can be classified on the basis of following criteria which is stated as below:

1. Primary Input quantity (Measurand)
2. Transduction principles (Using physical and chemical effects)
3. Material and Technology
4. Property
5. Application

In this paper, classification is done on the basis of application which is done as below [5]:

1. Thermal Sensors
2. Displacement Sensors
3. Optical Sensors
4. Biosensors
5. Acoustic Sensors

In the next section, the brief description of each sensor is given.

3.1 Thermal Sensors

Thermal Sensors are a family of sensors used to measure temperature or heat flux [5]. Thermal sensors are also known as temperature sensors. A temperature sensor is a device that gathers the information about temperature of a particular area of interest and converts it into an understandable form. There are two types of temperature sensors: contact sensors and non- contact sensors. The contact sensors require direct contact with the object for the measurement of the temperature. For eg. A thermometer. On the other hand, non- contact sensors do

not require direct contact with the object. They measure the temperature using Plank's Law. This law deals with amount of heat radiation released by the object.

3.2 Displacement Sensors

Displacement sensors are those that deal with the measurement of amount by which some object has been moved. These sensors are also known as positions sensors and proximity sensors. The position sensor deals in determining the position of some object with reference to some other object whereas the proximity sensors are those that deal with measurement of distance when some object is moved to within the range of the sensor. Displacement sensors are of two types: contact sensors and non- contact sensors. The contact sensors require physical contact of the object with the sensor whereas non- contact sensors do not require any physical contact of the object with the sensor. The contact sensor uses the movement of the sensor element's that cause a change in electrical voltage, resistance, capacitance or mutual inductance in order to measure the displacement whereas non- contact sensors use the locality of the measured object that cause change in air pressure or change in inductance or capacitance.

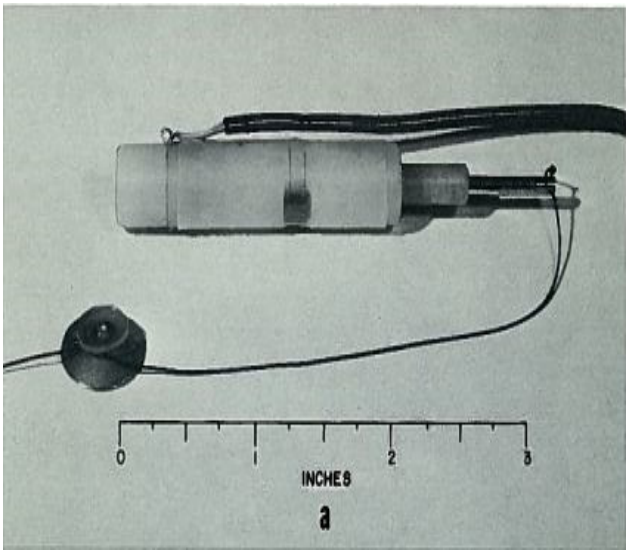


Figure 3. Displacement Sensor [6]

3.3 Optical Sensors

Optical sensors are those that sense some incidence of light and convert that sensed light into electrical signals. The transmission and reception of light is the basic principle of an optical sensor. The object to be detected reflects a light beam that is sent out by an emitting diode. The reflection of the light beam is evaluated on the basis of type of object. Due to this property optical sensor detect objects independently of the material they are constructed from (wood, metal, plastic or other). An optical sensor can operate in three mode of operations: through beam sensors, retro- reflection sensors and diffuse reflection sensors. In through beam sensors, transmitter and receiver are mounted on opposite side to each other. In retro-reflection sensor, transmitter and receiver are on the same side via a reflector that reflects back the light to the receiver. In diffuse reflection sensors, both transmitter and receiver are on same side and the transmitted light is reflected by the object to be detected.

3.4 Biosensors

Biosensor is a device that is used for the detection of some chemical in living organism.

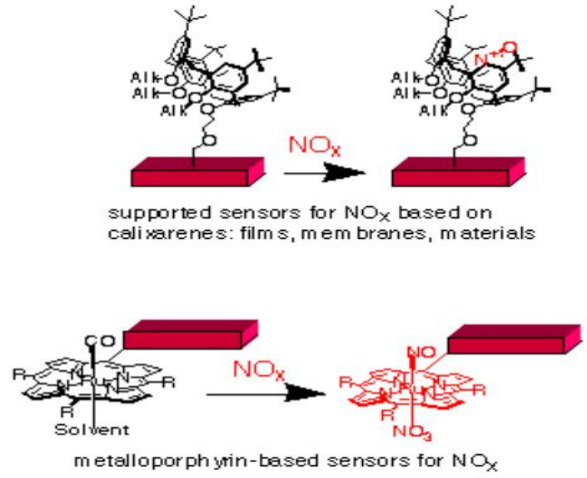


Figure 4. Biosensors based on molecular recognition [5]

The working of an optical sensor is explained as: The looked-for biological chemical is immobilized by conservative methods (physical or membrane set-up, non-covalent or covalent binding). This immobilized biological chemical is in near contact with the transducer. The analyte binds to the biological material to form a bound analyte which in turn produces the electronic response that can be measured.

3.5 Acoustic Sensors

Acoustic sensors are those which measure the sound waves and convert them into an understandable mode. Acoustic sensors sense acoustic waves that can be categorized in five forms: Rayleigh waves, lamb waves, love waves, acoustic plate mode waves and surface transverse waves [7].

Table 1: Classification of Sensors

S.No.	Sensor Name	Measurand	Principle used	Types of sensor	Applications
1.	Thermal sensor	Temperature	Piezoresistive effect	• Thermocouples • Resistor temperature detectors • Thermistors • Infrared sensors • Thermometers	To measure the temperature of solids, liquids and gases.
2.	Displacement sensor	Distance of an object	Wiedemann effect	• Linear Differential transformers • Strain Gauges • Potentiometers	Medical treatment in determining the movement of any tissue of the body
3.	Optical sensors	Incidence of light	Photoelectric effect	• Photodiode • Phototransistors	Breath analysis and heart rate analysis
4.	Biosensors	Presence of chemical	Signal Transduction	• Blood Glucose biosensor • Amperometric biosensor • Electrochemical Biosensor	• Food Analysis • Drug Development • Crime detection
5.	Acoustic sensors	Sound waves	Piezoelectric effect	• Geophone. • Hydrophone. • Lace Sensor. • Microphone. • Seismometer. • Surface acoustic wave sensor.	Underwater wireless sensor networks and detecting earthquake

4. Conclusions

Wireless Sensor Network is of great use now a days because of its wireless and data centric property. We do not need any wires for connecting devices. These networks are used to measure some physical property like pressure, humidity, fire, temperature and many more. The task of measuring is done with the help of a sensor. Sensor is nothing but a transducer that convert one form of energy into other form that is understandable. Sensors can be classified in a number of ways. On the basis of applications, sensor device can be divided as biosensors, thermal sensors, acoustic sensors etc. These different kinds of sensors can be used in different areas like

biosensors can be used in medical treatment for the detection of some chemical in human being whereas thermal sensor can be used to determine the room temperature. In this way sensors pay a vital role in wireless sensor networks.

References

[1] Akyildiz, Ian F., Weilian Su, Yogesh Sankarasubramaniam, and Erdal Cayirci. "Wireless sensor networks: a survey." *Computer networks* 38, no. 4 (2002): 393-422.

[2] Al-Obaisat, Yazeed, and Robin Braun. "On wireless sensor networks: architectures, protocols, applications, and management." (2007).

[3] Pal, Subhajit, Debnath Bhattacharyya, Geetam S. Tomar, and Tai-hoon Kim. "Wireless sensor networks and its routing protocols: a comparative study." In*Computational Intelligence and Communication Networks (CICN), 2010 International Conference on*, pp. 314-319. IEEE, 2010.

[4] Roy, Sarbani, and Nandini Mukherjee. "Topology Construction of 3D Wireless Sensor Network." In *Advances in Computing and Information Technology*, pp. 533-542. Springer Berlin Heidelberg, 2012.

[5] Lewis, Franck L. "Wireless sensor networks." *Smart environments: technologies, protocols, and applications* (2004): 11-46.

[6] Hoshall, C. Howard. "Displacement Sensors and Their Application to Control of Synthetically Powered Prostheses and Orthoses." *Bull. Prosthetics Res., BPR* (1973): 10-20.

[7] Vellekoop, Michael J. "Acoustic wave sensors and their technology." *Ultrasonics* 36, no. 1-5 (1998): 7-14.

[8] Ramesh, Siddharth. "A Protocol Architecture for Wireless Sensor Networks." In *Proc. of the 1st ACM International Workshop on Wireless Sensor Networks and Applications (WSNA)*. 2008.

[9] Kavar, Jaydip M., and K. H. Wandra. "Survey paper on Underwater Wireless Sensor Network." (2012).

Authors -

Parul Garg I am working as Assistant Professor in Giani Zail Singh Campus College of Engineering and Technology, Bathinda in the Department of Computer Science and Technology. I have done my Masters of Technology in Computer Science and Engineering from Guru Nanak Dev University, Amritsar, India in 2015. I have done my Bachelors of Technology in Computer Science and Engineering from DAV Institute of Engineering and Technology, Jalandhar, India. My current area of research is Information Security and Wireless Sensor Networks.