

WIRELESS SENSORS IN INDUSTRIAL AUTOMATION

Varshitha Prakash

Research Scholar, Instrument Technology, Andhra University, Visakhapatnam, India

E-mail ID: varshitha13j@gmail.com

Dr.M.Ramesh Patnaik

Assistant Professor, Instrument Technology, Andhra University, Visakhapatnam, India

E-mail ID:ramesh_patnaik@yahoo.com

Abstract- The advancement in technology led to the development of wireless sensors which are available now in smaller size, smarter, cheaper and lighter. Industrialists identified that wireless sensors exhibit different advantages like low cost, convenience, safer and more importantly they see it as an enabler of completely new improvement in communication purpose as reliable transmission can take place which increases their present production and manufacturing process. However, in industrial environment, while transmitting the data many challenges occur because of numerous noise sources so, the channel conditions may vary. In this paper an overview of wireless sensors and the problem faced with respect to channel is presented.

Keywords - Wireless Sensors, Wireless Communication, Industrial Automation, Wireless Channel, Coding Technique.

1. INTRODUCTION

This document is a template. Instruments [1] in industries play significant role in controlling and measuring the parameters and the medium of communication between them is wired either with optical fibers [2] or co-axial cables [3]. However, due to this wired communication many drawbacks have emerged such as high maintenance, high cost of cables, mobility etc. Hence, to overcome these limitations the evolution of wireless sensors [4] took place. Wireless sensors are standard tools used for measurement purposes as it consists of both transmitter and receiver implanted in it and it can convert control signal into radio transmission signal or vice-versa. In any type of environment, various parameters like strain, pressure and temperature etc. can be measured and transmitted to operator who constantly monitor and supervise the process by using wireless sensors as they have many advantages like safety, energy efficiency, convenience etc. In industries, wireless sensors are used in many areas like control and production, material handling, transportation, warehouses, maintenance and security system operation etc.

Wireless communication in a device is a conglomeration of different new technologies infused into instruments thereby resulting in the development of modern instruments or sensors. Modern sensors [12] are made wireless by following methods:

- a. By implanting wireless communication system into the sensor.
- b. Different wireless modems such as wireless RS-422 [5], RS-232 [5] and wireless USB etc. are connected to the sensor.
- c. By connecting wireless modules to the sensor.
- d. By joining data loggers, repeaters and bridges etc. to the sensor.

In this paper different types of wireless sensors are explored along with its applications and advantages. The problem faced with respect to channel in transmission process is also discussed.

2. TYPES OF WIRELESS SENSORS

The different modern sensors are categorized based on their respective field of application such as: web sensors, integrated circuit sensors, intelligent sensors, MEMS, wireless sensors etc. Web sensor [4] is used in remote places and it is very popular since it can provide web connection without any other assistance. The other type of sensor is integrated circuit sensor in which a signal processor, sensor, logic circuit is incorporated into a single chip and to support wireless operation a radio transceiver is implanted in it.

Wireless sensors are made up of silicon since it has excellent physical properties and this material is mostly used in MEMS [6] because of its crystalline structure, tensile strength and flexibility; as these properties aid in fabrication of products like sensors with very small foot-print area. These sensors are used in different applications as it has many benefits like low cost, small in size and high efficiency because of its precise fabrication.

The most widely used sensor in industry is intelligent wireless sensor [7] as it is manufactured with smart methods like neural networks and fuzzy logic. The block diagram of intelligent wireless sensor is shown in the Fig. 1. It mainly consists of a sensor, control unit, RF transmitter and an antenna and it can be used in any type of hazardous environment as they can easily sense the data and transmit through RF transmitter via antenna.

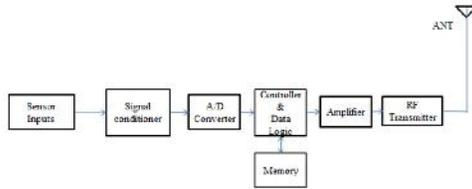


Fig.1.1 Intelligent Wireless Sensor

3. BENEFITS OF WIRELESS SENSORS

In industries, the necessity of wireless sensors has increased tremendously due to its benefits such as:

a. Reliability:

The wireless sensors provide high speed reliable data transmission to any place.

b. Low cost:

The wireless sensors can eliminate the usage of wires so due to this reason the cost is reduced.

c. Safety

The wireless sensors can be used in extreme environments like high temperature or pressure etc. as they can easily sense the data. Thus the operators from a safe distance can control the process.

d. Convenience

In an industry different processes can be easily monitored from centralized control by using wireless sensors.

4. USES OF WIRELESS SENSORS

Wireless sensors offer wide range of applications in various fields as these help to eliminate installation and maintenance of the cumbersome cables and also they overcome other limitations. The usage of wireless sensors can be applied to:-

a. Space Probe:

In space technology, wireless sensors are used to sense various parameters like vibration, temperature, strain, pressure etc. of any rocket [9] or satellite and this data can be effortlessly directed to controller through wireless linkage. The wireless sensors help in reduction of cost so that it can improve the number of probable benefits in design of spacecraft.

b. Industrial Supervisory Control:

In industries [15] wireless sensors will enable the personnel to collect the data from a remote location in any environment and can easily transmit to a control unit. These sensors are also used to monitor and control any complex processes. Hence, the wireless sensors can be applied to like chemical, oil and gas, power generation industries etc.

c. Environmental Sensing Systems:

The changes in an environment [14] can be easily detected by using wireless sensors as these help in sensing the quality of air, flood, landslide etc. and also play key role in measuring concentration of gases in mining.

d. Wireless Health Monitoring System:

The wireless sensors can be inserted into the body to sense the changes in the health through continuous monitoring by transmitting the measured data to the external devices. The different functions of wireless sensors are telemetric nurse to observe vital signs of a patient, mobile health monitoring [10] to observe the health of a patient in emergency situations, wireless home care systems for old aged people etc.

e. Structural Health Monitoring:

The Wireless sensors can be easily attached or built inside the structures [8] of buildings or bridges as they can easily monitor damages like deformations, delamination's and cracks etc. and this crucial data is transmitted to external devices which determine the health of the structure. The wireless sensors can be used in large structures like ships, aircrafts, spacecraft etc. as they offer many advantages like better accuracy, low maintenance and deployment cost, distributed monitoring and high resolution.

5. PROBLEM FACED WITH RESPECT TO CHANNEL

Wireless communication [11] is the process of transmitting the information from one point to another through wireless channel. However in the recent times, controlling and monitoring the process using this technology has attracted a lot of interest. Hence, wireless sensors are used in industrial automation as they assist to communicate with other external devices. Presently, for long distance data transmission, RF communication is suitable as it can be done by using different technologies like Wi-Fi [17], Ethernet and Bluetooth [16].

Wireless Fidelity (Wi-Fi) is one of the most popular networking technology because it can simply transmit the data to any place. However, to communicate with the other device wirelessly, a channel is required as a transmission pathway. When a signal is transmitted from source to destination many disturbances affect the wireless channel like interference, noise [13], fading etc. which is indicated in Fig. 2. Hence, due to this reason the corruption of data takes place and there will be possibility of system malfunction, safety problems and economic loss in industries.

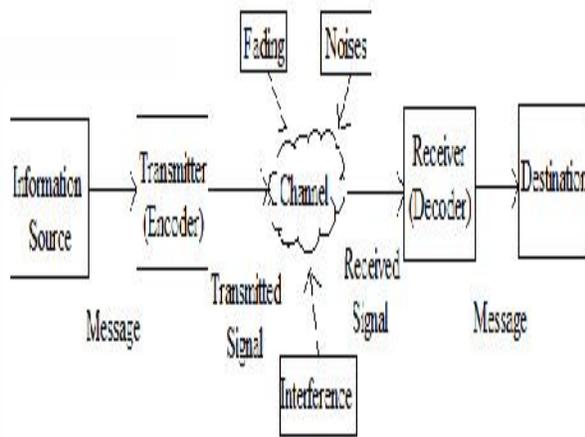


Fig.1.2 Wireless Channel

Consequently, the introduced disturbances can be mitigated by utilizing channel coding techniques. Therefore, when a signal is transmitted from source redundant bits are added and while decoding that received signal, these bits help to detect the errors. Hence, coding technique is used for error detection and correction in a noisy channel to attain reliable communication.

6. CONCLUSION

In this paper the complete overview of wireless sensors has been presented. The wireless sensors are obtained through modular or embedded designs and these are futuristic as they can be used conveniently in any application. In industrial environment, wireless sensors are used to provide flexibility, safety, monitoring, control etc. and they offer many benefits like low cost, easy maintenance, easy installation and convenience. Thus, in industries when the data is transmitted by wireless sensors through wireless channel, noises gets added to the data due to multipath phenomenon and therefore in order to reduce these errors coding techniques are used. The most popular amongst all techniques is the convolution coding.

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