**STUDY ON WIRELESS SENSOR NETWORK & CHALLENGES & ITS APPLICATIONS**

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**ABSTRACT**

Sensing technology used in wireless sensor networks (WSNs) plays a major role in revolutionizing the world. In recent years, wireless sensor networks have emerged as a powerful technology with numerous uses, such as in military operations, surveillance systems, and intelligent transportation systems (ITS). Sensor nodes in WSNs collect data from their surroundings and monitor the external environment as well. Sensor networks are being researched to make them operate with minimal energy consumption so that they can last for longer periods. It has been primarily the discharging of batteries on which sensor nodes operate that has caused the primary concern in the direction of energy saving. WSNs are also exploited for their security aspects, so that they can be used in some confidential areas such as military battlefields. A brief overview of WSNs is presented here, including applications, routing and data collection, security aspects, and a brief description of the simulation platforms available for WSNs. A contribution to this chapter focuses on introducing and reflecting the significance of WSNs in different sectors of their operation.

* 1. **INTRODUCTION**

Sensor nodes are devices that make up wireless sensor networks thanks to advances in wireless communication. Low-power, small-size, cheap sensor nodes are capable of sensing, wireless communication, and computation. Upon deployment, the sensors configure themselves and connect with each other to collect data and forward the data to the base station.



**Figure 1.1 WSN Architecture & Network**

It can also be defined as a network made up of devices that are relatively small and low-complexity, known as nodes that can sense the environment and communicate the information it gathers. Through gateway nodes, data can be transmitted directly or via multi-hops to sinks, which can then use the data locally or connect it to other networks (e.g. Internet).

Sensor nodes are composed of four main components: a sensing unit, a processing unit, a transceiver, and a power source. In the sensor unit, physical quantities are sensing and then converted to digital ones through the ADC, or A/D converter. Afterwards, the processor is used to process data and the transceiver is used to transmit and receive it from the other nodes or the base station. A sensor node's power unit is its most prominent component. An unattended application cannot operate without a battery once it has been exhausted. Other units are application dependent unit like Mobilizer, Power Generator and Location Finding System.



**Figure 1.2 Component of Sensor Role**

**1.2 MOTIVATION FOR WSN**

•The recent developments in engineering, communication and networking led to new sensor designs, information technologies and wireless systems.

•Such advanced sensors can be used as a bridge between the physical world and the digital world.

•Sensors are used in numerous devices, industries, machines and help in avoiding infrastructure failures, accidents, conserving natural resources, preserving wildlife, increase productivity, provide security etc.

•TheuseofdistributedsensornetworkcontributedbythetechnologicaladvancesinVLSI, MEMS and Wireless Communication.

•With the help of modern semi conductor technology, powerful microprocessor scan be developed, smaller in size when compared to the previous generation products. This miniaturization of processing, computing and sensing technologies led to tiny, low-power and cheap sensors, controllers and actuators.

* 1. **WORLDWIDE SENSOR NETWORK CHALLENGES**

One of the main design goals of WSNs is to communicate data while prolonging the lifetime of the network. This is done by employing aggressive energy management techniques. The topology control in WSNs is influenced by many challenging factors. These factors must be overcome before efficient communication can be achieved in WSNs. In the following, we summarize some of the challenges and design issues that affect the topology of construction and maintenance in WSNs [2].

**A. Node deployment:** Node deployment in WSNs is application dependent and affects topology control algorithms. The deployment can be deterministic or random. In deterministic deployment, sensors are manually placed and data is routed through pre-determined paths. However, in random node deployment, sensor nodes are scattered randomly, creating an ad hoc infrastructure.

**B. Energy consumption without losing accuracy:** Sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment. As such, energy-conserving communication and computation are essential. There is a strong correlation between the battery lifetime and the sensor node lifetime.

**C. Data Reporting Model:** Data sensing and reporting in WSNs depends on the application and time criticality. Data reporting can be categorized as time-driven (continuous), event-based, query-based, or hybrid. The time-driven delivery model is suitable for applications that require regular data monitoring. As such, sensor nodes will periodically switch on their sensors and transmitters, sense the environment and transmit the data of interest. This is done at constant intervals of time.

**D. Node/Link Heterogeneity**: In many studies, all sensor nodes were assumed to be homogeneous, i.e., having equal capacity in terms of computation, communication, and power. However, depending on the application a sensor node can have a different role or capability.

**E. Fault Tolerance:** Some sensor nodes may break or be blocked due to lack of power, physical damage, or environmental interference. Sensor nodes should not fail the overall sensor network task. If many nodes fail, MAC and topology control algorithms must accommodate the formation of new links and routes to the data collection base stations.

**F. Scalability:** The number of sensor nodes deployed in the sensing area may be on the order of tens of thousands, or more. Any topology control scheme must work with this huge number of sensor nodes. In addition, sensor network routing and control algorithms should be scalable enough to respond to environmental events. Until an event occurs, most sensors can remain in sleep state, with data from the few remaining sensors providing coarse quality.

**G. Security:** In some applications, communication among nodes must be secured enough to maintain confidentiality. In military applications, such as battlefield surveillance or military operations, it is mostly required.

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**Figure 3.1 Challenges of WSN’s**

**1.4 APPLICATIONS OF WIRELESS SENSOR NETWOR**K

1. Military applications
* Military Command
* Control
* Communications
* Computing
* Intelligence
* Battlefield Surveillance
* Reconnaissance
* Targeting Systems
1. Area monitoring
* In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored.
* When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action will be taken.
1. Transportation
* Real-time traffic information is being collected to feed transportation models and alert drivers of congestion and traffic problems
1. Health applications
* Some Of The Health Applications For Sensor Networks Are
* Supporting Interfaces For The Disabled Patients
* Integrated Patient Monitoring
* Diagnostics,
* Drug Administration In Hospitals
* Tele-Monitoring Of Human Physiological Data
* Tracking & Monitoring Doctors Or Patients Inside A Hospital.
1. Environmental sensing
* Oceans
* Glaciers
* Forests Etc.
* Air Pollution Monitoring
* Forest Fires Detection
* Greenhouse Monitoring
* Landslide Detection
1. Structural monitoring
* Wireless Sensors Can Be Utilized To Monitor The Movement Within Buildings
* To Monitor Infrastructure Such As Bridges, Flyovers, Embankments, Tunnels Etc
* Enabling Engineering Practices To Monitor Assets Remotely
1. Industrial monitoring
* Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionalities.
1. Agricultural sector
* Using a wireless network frees the farmer from the maintenance of wiring in a difficult environment.
* Irrigation automation enables more efficient water use and reduces waste
	1. **CONCLUSION**

Many aspects of human life have benefited from WSNs. Sensor nodes are able to communicate and react too many attributes because of sensing technology. The purpose of this Chapter is to provide an overview of several WSN-related topics. The WSN has been briefly introduced, and special issues covered. Applications and security concerns in WSN have both been identified. Following that, a table comparison of the various simulation software was provided. The research conducted for this paper concludes that WSN has revolutionised practically every industry in the modern period. It offers tremendous potential for investigation into many facets of human life.

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