STUDY ON WIRELESS SENSOR NETWORK & CHALLENGES & ITS APPLICATIONS

Abstract

Sensing technology used in the world is undergoing a huge upheaval thanks in large part to wireless sensor networks (WSNs). In recent years, wireless sensor networks have emerged as a powerful technology with numerous uses, the use of intelligent transportation systems (ITS), surveillance technologies, and military operations. WSN's sensor nodes 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 basically the fundamental concern toward energy preservation has been the depleting of batteries on which sensor hubs capability. WSNs are likewise taken advantage of for their security viewpoints, so they can be utilized in a few private regions like military front lines. A brief overview of WSNs is presented here, counting applications, directing and information assortment, security perspectives, and a concise portrayal of the recreation stages accessible for WSNs. A contribution to this chapter focuses on introducing and reflecting the significance of WSNs in different sectors of their operation.

Keywords: Wireless Sensor Networks, ITS, VLSI, sensing technologies

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I. INTRODUCTION

Sensor nodes are devices that make up wireless sensor networks thanks to advances in wireless communication. Small, inexpensive, low-power sensor nodes can do computation, wireless communication, and sensing. When deployed, the sensors set themselves up and establish connections with one another to start gathering data and transmitting it to the base station.
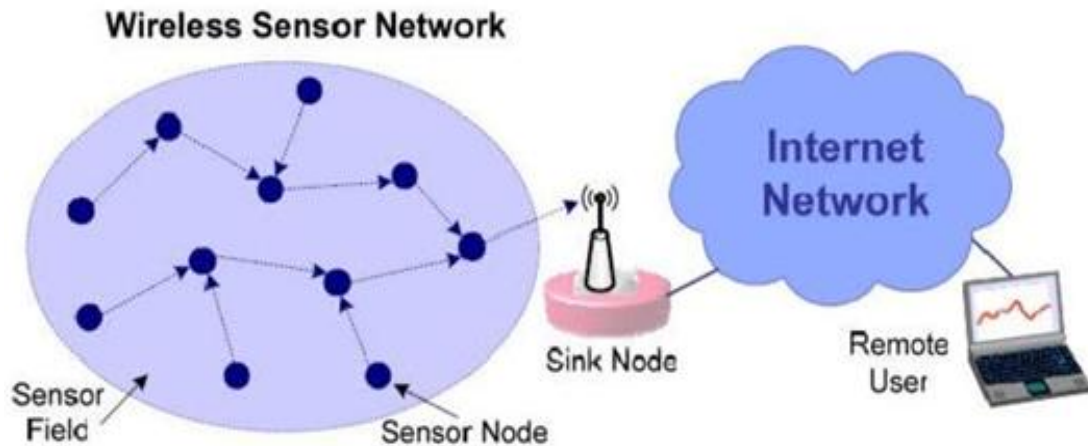
Figure 1: WSN Architecture & Network

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, Information can be sent straightforwardly or through different jumps to sinks, which can utilize it locally or interface it to different organizations (like the Web) for additional use.
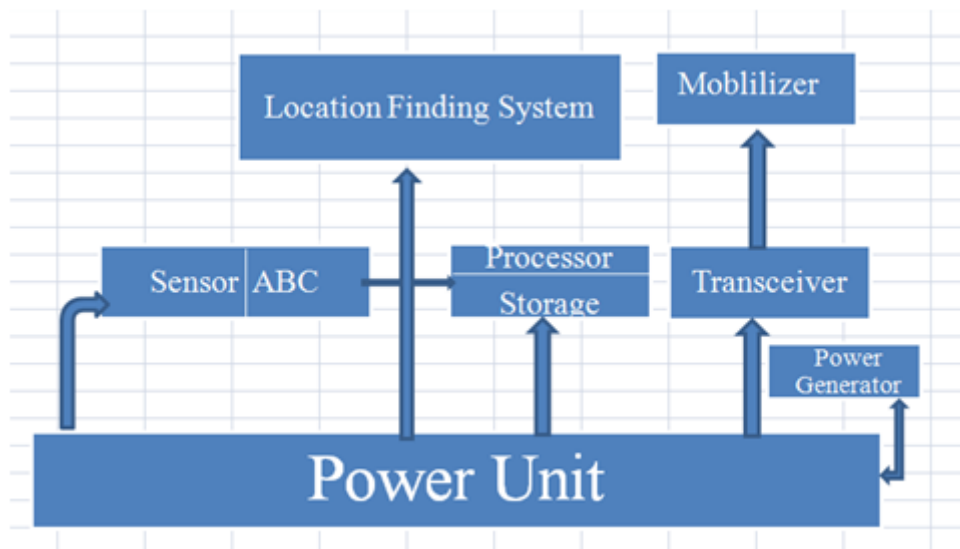
Figure 2: Component of Sensor Role

Four major parts make up a sensor node: a transceiver, a processing unit, a sensing unit, and a power source. Physical quantities are sensed in the sensor unit and then transformed to digital values using an ADC, or an A/D converter. Data is then processed by the processor and transmitted to and received from other nodes or the base station using the transceiver. The most noticeable part of a sensor node is its power unit. Once a battery is depleted, an unattended application cannot function without one. Other units, such Mobilise, Power Generator, and Location Finding System, are application-dependent units.

II. MOTIVATION FOR WSN

- New sensor designs, information technologies, and wireless systems have been made possible by recent advancements in engineering, communication, and networking.
- Such sophisticated sensors can act as a link between the physical and digital worlds.
- The development of VLSI, MEMS, and wireless communication technologies allowed for the usage of distributed sensor networks. Sensors are employed in a wide range of products, businesses, and machinery and help, among other things, prevent infrastructure failures, accidents, the depletion of natural resources, the extinction of species, boost productivity, and provide security. Modern semi conducting technology has enabled the development of powerful microprocessors that are more compact than those of earlier generations.
- Tiny, low-cost, and low-power sensors, controllers, and actuators have been produced as a result of the miniaturisation of processing, computing, and sensing technologies.

III. 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 aggressive energy management strategies are used. There are several difficult issues that affect how topology control in WSNs is managed. Before In order for WSNs to communicate effectively, a number of barriers must be addressed. The issues and design factors that affect the development and maintenance of the WSNs' topology are outlined in the section below [2].

1. **Node Deployment:** In WSNs, the placement of node depends on the application and has an impact on topology control algorithms. The deployment can be deterministic or arbitrary. In deterministic arrangement, sensors are physically positioned and information is directed through pre-decided ways. Notwithstanding, in irregular hub arrangement, sensor hubs are dissipated haphazardly, making an impromptu framework.

2. **Energy Utilization without Losing Exactness:** Sensor hubs can go through their restricted stockpile of energy performing calculations and sending data in a remote climate. Accordingly, energy-rationing correspondence and calculation are fundamental. There is a strong correlation between the battery lifetime and the sensor node lifetime.

3. **Data Reporting Model:** The application and the degree of time criticality determine the data sensing and reporting in WSNs. There are several types of data reporting, including time-driven (continuous), event-based, query-based, and hybrid. The time-driven delivery model is appropriate for applications that need to check data on a regular basis. As a result, sensor nodes will regularly turn on their transmitters and sensors, sense the

surrounding environment, and send the relevant data. This occurs at regular intervals of time.

4. **Node/Link Heterogeneity:** In several research, it was believed that all sensor nodes were homogeneous, i.e., that they had equivalent computing, communication, and power capacities. However, a sensor node may have a distinct function or role depending on the application.

5. **Fault Tolerance:** Due to a lack of power, physical harm, or interference from the environment, some sensor nodes may break or become blocked. The overall task of the sensor network shouldn't be failed by sensor nodes. The development of new links and routes to the data collection base stations must be accommodated by MAC and topology control algorithms if several nodes fail.

6. **Scalability:** In the sensing region, there may be tens of thousands or more sensor nodes placed. This enormous number of sensor nodes requires compatibility with any topology control mechanism. Algorithms for routing and controlling sensor networks must also be scalable enough to react to environmental changes. Most sensors can remain in a sleep state until an event happens, with data from the few remaining sensors having coarse quality.

7. **Security:** For some applications, communication between nodes needs to be sufficiently protected to preserve confidentiality. It is mostly needed in military applications, such as battlefield monitoring or military operations.
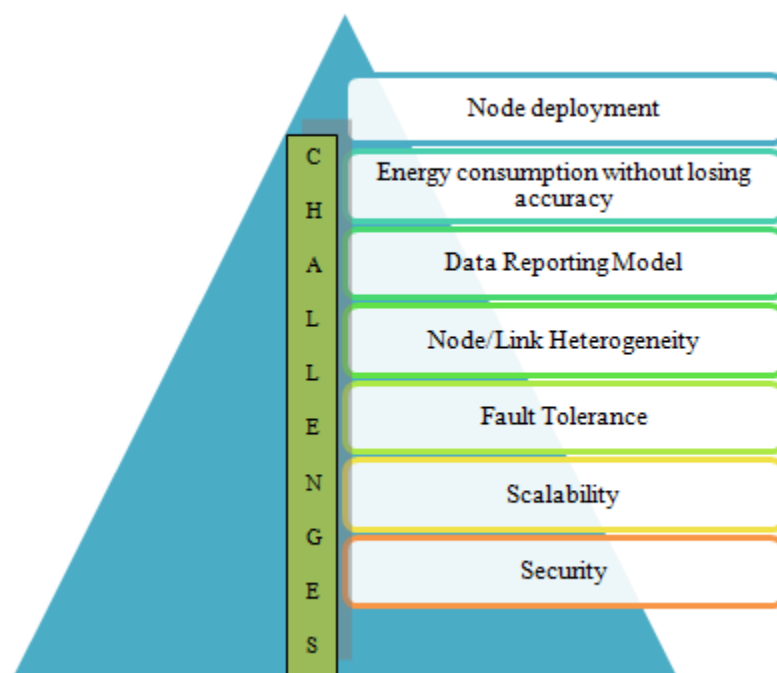
Figure 3: Challenges of WSN's

IV. APPLICATIONS OF WIRELESS SENSOR NETWORK

1. **Military applications**

   - Military Command
   - Control
   - Communications
   - Computing
   - Intelligence
   - Battlefield Surveillance
   - Reconnaissance
   - Targeting Systems

2. **Area monitoring**

   - In area monitoring, sensor nodes are placed over an area that needs to have a certain occurrence observed.
   - When the sensors pick up the monitored event (heat, pressure, etc.), one of the base stations reports it and subsequently performs the necessary action.

3. **Transportation**

   - In order to feed transport models and warn drivers of congestion and traffic issues, real-time traffic information is being gathered.

4. **Health Applications**

   - Integrated patient monitoring, diagnostics, drug administration in hospitals, tele-monitoring of human physiological data, and tracking and monitoring of doctors or patients inside a hospital are a few of the health applications for sensor networks.

5. **Environmental sensing**

   - Oceans
   - Glaciers
   - Forests Etc.
   - Air Pollution Monitoring
   - Forest Fires Detection
   - Greenhouse Monitoring
   - Landslide Detection

6. **Structural monitoring**

   - Wireless sensors are useful for monitoring infrastructure like bridges, flyovers, embankments, tunnels, and more. They also make it possible for engineering practises to remotely monitor assets.

7. Industrial Monitoring

- For machine condition-based maintenance (CBM), wireless sensor networks have been created because they provide significant cost reductions and allow for additional functionality.

8. Agricultural Sector

- Irrigation automation provides more efficient water use and decreases waste, freeing the farmer from the maintenance of wiring in a challenging setting.

V. 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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