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Wireless Sensor Networks

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ABSTRACT:

Wireless Sensor Networks (WSN) are the topic of this study. Wireless Sensor Network (WSN) refers to a set of small electrical devices that communicate wirelessly. Sensors function similarly to electronic detectives. They can detect and exchange information such as temperature and pollution levels. In the electronic world, networks serve as secret agents for gadgets, facilitating collaboration and data collection. Wireless sensor networks (WSNs) enable smart devices, industries, and monitoring systems. WSNs, like superheroes, confront hurdles such as managing energy, handling large amounts of information, and protecting themselves from electronic threats. Wireless Sensor Networks (WSNs) revolutionise data collecting and monitoring by allowing for continuous communication between sensor nodes without physical connections. Wireless sensor networks (WSNs) are used in environmental monitoring, healthcare, and industrial automation to provide real-time data for better decision-making.

Keywords—Sensor nodes, Environment monitoring, Military applications, performance evaluation, Communication protocols.

I.INTRODUCTION

A wireless sensor network (WSN) is a network of autonomous devices that use sensors to monitor physical or environmental conditions such as temperature, sound, vibration, pressure, motion, or pollutants at multiple locations. A wireless sensor network (WSN) is an autonomous device network that uses sensors to keep an eye on various environmental or physical parameters, including motion, temperature, sound, vibration, pressure, and pollutants, at different locations. These devices communicate wirelessly. WSNs have gained popularity due to their capacity to provide real-time monitoring and data collecting in a variety of applications, including environmental monitoring, industrial automation, healthcare, smart cities, agricultural, and military surveillance. Additionally, their wireless nature permits easy deployment in dynamic or hazardous conditions, thereby expanding their value and influence in many fields. Compared to conventional wired sensor networks, they offer a number of benefits, including as easier setup, cost-effectiveness, scalability, and flexibility.

II.HISTORY

Wireless sensor networks were primarily developed in the 1980s and 1990s as a result of distributed sensor system research. (WSNs). The development of tiny sensors, improvements in wireless communication technologies, and projects like DARPA's Distributed Sensor Networks (DSN) programme have all been major turning points. The late 1990s saw the introduction of experimental efforts such as Smart Dust, which paved the way for WSNs. Approved in 2003, the IEEE 802.15.4 standard established a specified foundation for WSN communication. Since then, WSNs have multiplied across a wide range of applications and acquired widespread adoption in sectors like industrial automation, healthcare, and environmental monitoring thanks to advancements in energy efficiency, communication protocols, and sensor technology.

III.CLASSIFICATION

Wireless Sensor Networks (WSNs) are categorised based on mobility, supported applications, deployment environment, and other considerations. This taxonomy is based on the many types of WSNs.

Terrestrial WSN: The most common kind of WSN are those that are located on terrestrial surfaces. Smart cities, industrial automation, precision agriculture, and environmental monitoring all make use of terrestrial wireless sensor networks.

Subterranean WSN: underground WSNs, are used to keep an eye on geological phenomena, subsurface utilities, and soil conditions. They are employed in mining to guarantee safety and exploration, civil engineering to assess the structural integrity of subterranean structures, and agriculture to monitor soil moisture.

Underwater WSNs: In aquatic environments including lakes, rivers, and oceans, underwater wireless sensor networks are deployed for underwater

IV.ARCHITECTURE OF WSN

Energy Origin: This is the essential part that powers our network and keeps it running. Continuous functioning requires the maintenance of a constant power supply, whether it comes from batteries, solar panels, or some other source.

Microcontroller: The core of our WSN is the microcontroller, which serves as the brains of the system. It evaluates data collected from the environment and executes orders in accordance with preprogrammed rules.

Wireless receiver: Next is the transceiver, which acts as the communication centre of our network. Through the facilitation of wireless data sharing between sensors and external equipment, it makes communication seamless.

ADC, or analog-to-digital converter: Converting analogue signals from the environment into digital data that the microcontroller can process is one of the ADC's key roles. This conversion procedure is required for accurate interpretation and processing of the data.

External Information Retrieval: Lastly, the storage device on our network is external memory.It enables our sensors to store important data, ensuring that invaluable information is preserved for review and use at a later date.

V.ADVANTAGES & DISADVANTAGES

ADAVANTAGES:

Scalability: WSNs are very scalable due to their ability to add additional nodes or devices as needed. More sensor nodes can be added without affecting the functioning of the existing network.

Flexibility: WSNs are flexible enough to adjust to physical divisions. They are able to react to modifications in the network topology or environment.

Security: To protect client data and offer a consistent network connection, WSNs use a range of security measures.

DISADVANTAGES:

Vulnerability of hacking: Networks of wireless sensors (WSNs) are susceptible to cyberattacks. Taking security precautions is essential to avoiding unauthorised access.

Limited speed: WSNs are designed to operate at low speeds. Energy limitations prevent high-speed communication.

Cost**:** Not every entity or individual has the financial means to purchase the infrastructure.

V.APPLICATIONS

Environmental Monitoring: Environmental characteristics like temperature, humidity, air quality, soil moisture, and pollution levels are frequently monitored by WSNs. Applications include monitoring the weather, assessing the quality of the air in cities, detecting forest fires, monitoring the water quality in rivers and lakes, and conserving biodiversity.

Healthcare*:* WSNs provide telemedicine, remote patient monitoring, and healthcare administration. Vital sign tracking, chronic illness monitoring, fall detection, emergency scenarios in senior care, and medication adherence management are all done with WSNs. They also facilitate the use of wearable health monitoring equipment for maintaining general wellbeing and tracking exercise.

Military and surveillance: WSNs are crucial for battlefield monitoring, border security, and military surveillance. Applications include intrusion detection, perimeter security, target tracking, situational awareness, and reconnaissance are available for both ground-based and aerial scenarios.

VI.METHODOLOGIES

Data Collection*:*

1. Selecting the Right Location for Sensors: We give considerable thought to the location of our sensors. Our goal is to ensure that they address all of our concerns without abusing their authority.

2. Selecting the Frequency of Data Collection: We determine the frequency at which our sensors should record data. Ensuring that we obtain sufficient information while minimising power use is our goal.

3. Sending Only Vital Information: We only transmit data from our sensors in response to critical events. Because we don't always need to transport large amounts of data, this helps preserve power.

Data Processing:

1. Cleaning Up the Data: The data must be verified to be error-free and clean before it can be used. It's similar like cleaning up sloppy toys before using them.

2.Making the Data Easier to Handle: To reduce the size and facilitate manipulation of the data, we employ specialised procedures. It's similar to splitting up a large puzzle into smaller ones to make it easier to solve.

3. Sharing the Work: We distribute jobs across several sensors rather than having one sensor handle everything. This expedites tasks and conserves energy.

Experimental Setups:

1. In an industrial scenario, we deployed a WSN with thirty sensor nodes to track temperature and pressure levels in real time. Ad-hoc On-Demand Distance Vector (AODV), Low-Energy Adaptive Clustering Hierarchy (LEACH), and Shortest Path Routing (SPR) were the three routing protocols that were examined. The time it took for sensor data created by the nodes to reach the base station was referred to as the data delivery delay.

2.To keep an eye on building deformations and structural vibrations, we deployed a 50-sensor WSN in an urban setting. The configuration of the nodes was changed from 10 low density nodes to 30 medium density nodes and 50 high density nodes. The proportion of the area covered and the number of reachable nodes were used to measure network coverage and connectivity, respectively.

VII.RESULTS AND ANALYSIS

WSNs, which developed from research in the 1980s and 1990s, witnessed major breakthroughs in miniaturised sensors and wireless communication technology. In 2003, the IEEE 802.15.4 standard and initiatives like Smart Dust hastened the deployment of WSN in numerous applications. Terrestrial, underground, and underwater WSNs are dedicated to environmental monitoring, precision agriculture, and aquatic exploration, respectively. Scalability, versatility, and security are advantages, but disadvantages include hacker danger, restricted speed, and cost constraints. WSNs serve key roles in real-time data collecting and monitoring across several domains, including environmental monitoring, healthcare, and military surveillance. A thirty-node WSN was used in trials to monitor pressure and temperature in an industrial setting. AODV was mild, LEACH was slowest because to clustering, and Shortest Path Routing was the fastest. Increased node density led to a considerable improvement in coverage and connection in a metropolitan region with 50 nodes.

VII.CONCLUSION

To sum up, the development of wireless sensor networks (WSNs) has been greatly aided by advancements in wireless communication and sensor technology during the 1980s. They are used in military surveillance, healthcare, and environmental monitoring. Notwithstanding advantages like security and scalability, problems like speed limitations and hacking susceptibility still exist. Our experiments show how important it is to use the right routing protocols and node density in order to get the best possible network performance. All things considered, WSNs have a great deal of promise for real-time data monitoring and can be used to address a wide range of problems in numerous fields.

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