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A Review on Wireless Sensor Networks and its applications

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ABSTRACT- Around the globe, wireless sensor nodes are utilized in a variety of real-time applications. Significant research in the field of wireless sensor networks (WSNs) has been done in the last decade due to an increase in demand in various applications all over the world. WSNs are a new field of research that is being investigated to provide solutions to existing issues such as energy consumption, sensor location, routing algorithms, robustness, efficiency, and many more. Various scholars have grappled with a variety of network design and computational complexity issues during the last decade. Because of its uses in a number of areas, including as healthcare, espionage, environmental monitoring, industrial monitoring, forest fire detection, and natural disaster prevention, WSNs are gaining popularity throughout the world. This article discusses the use of WSN infrastructure and its applicability in many sectors to solve current problems.

KEYWORDS- Communication Systems, Energy Consumption, Sensor Nodes, Wireless Sensor Networks.

I. INTRODUCTION

The development of low-cost WSNs across the world has resulted in many advancements in the wireless communication industry during the past decade. Sensor networks may be utilized for a variety of applications in a variety of industries, depending on their applicability and demand. The researchers are using different methods to detect current difficulties and solve problems connected to network infrastructure [1]. Every industry has its own set of issues that need greater attention in today's communication systems. A WSN has a variety of important applications in a variety of fields, such atmosphere monitoring and target tracking. The wireless interfaces are used to arm the smart sensors, which allow each sensor to establish a communication connection with other sensors in order to form a network [2][3][4][5][6].
The purpose of a wireless sensor network is to work collaboratively detection, processing, as well as transmitting object monitoring information in areas where the internet backbone coverages. It is made up of a large amount of static as well as mobile detector nodes that form the wireless network using self-organization and multi-hop method. Sensor networks are made up of three elements: sensor nodes, sink nodes, and user nodes. Sensor nodes are the basis of the whole network; they are in charge of data perception, interpretation, storage, and transmission [7][8][9]. The sensor notes work together; they don't directly upload the original data, instead using their own processing capability to ensure correct functioning and integration, and only transmit the data that the lower-level note requires Temperature and light condition, humidity, pressure, vehicle movement, mechanical pressure strength, airflow direction speed, and other environmental variables may all be sensed by the sensor node. Because of these qualities, sensor networks have been extensively used in a variety of fields, including medical health, environment including agriculture, intelligent home furnishing and construction, military, space, and marine exploration[10]. Self-organization, multi-hop routes, dynamic network architecture, node resource limitations, data-centricity, as well as security issues are the primary characteristics of wireless sensor networks[11][12].
WSNs have become critical components in a wide range of applications and are used in a variety of sectors across the world. The network infrastructure is a critical component of any communication network, and it necessitates a simpler structure with low computing complexity in order to save energy. However, since WSNs have many applications in a number of computer industries, the creation and improvement of WSN infrastructure is a crucial issue in today's world. WSNs are a collection of distributed appliances that can detect or monitor a variety of environmental variables. There are many significant difficulties in the WSN infrastructure that are caused by loss of communication connections, computing complexity, including power supply, among other things. The wireless sensor network system design is shown in Figure 1.

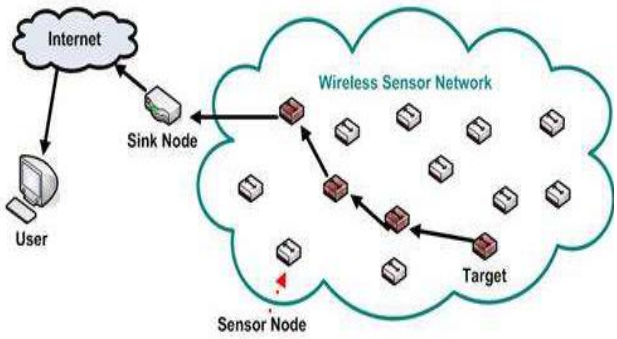

Figure 1: Illustrates the system architecture of the

wireless sensor networks (WSNs)[13]

A. Kinds of Wireless Sensor Networks

WSNs use a variety of sensors to meet the needs and applications of different industries, including submersible WSNs, multimedia WSNs, as well as many more. The WSN categorization is shown in Figure 2 below.

The purpose of a wireless sensor network is to work collaboratively detection, processing, as well as transmitting object monitoring information in areas where the internet backbone coverages[14,15][16][17][18]. It is made up of a large amount of static as well as mobile detector nodes that form the wireless network using self-organization and multi-hop method. Sensor networks are made up of three elements: sensor nodes, sink nodes, and user nodes.

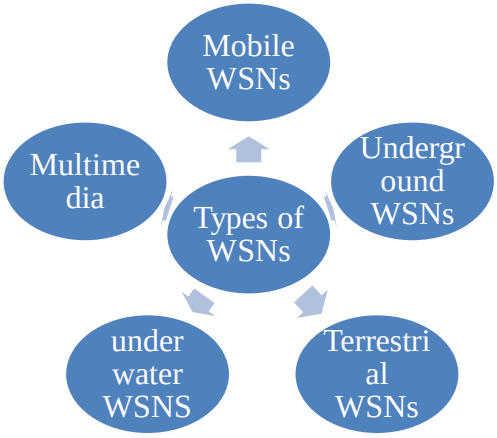

Figure 2: Illustrates the classification of the wireless sensor networks (WSNs)

B. Hardware Infrastructure of the Wireless Sensor Node

Figure 3 depicts the fundamental hardware architecture of wireless sensor nodes. The wireless sensor nodes architecture consists of interface circuitry, a sensor unit, a processing unit, a transmitter and receiver, and a power supply. Wireless sensor nodes come in a variety of shapes and sizes to suit the requirements of a wide range of applications, including water quality monitoring. These wireless sensor nodes may be used for a wide range of applications, from on-the-spot water quality monitoring to long-term monitoring and analysis.

C. Energy Management Schemes for Wireless Sensor Networks (WSNs)

Wireless sensor use a lot of energy during communication. One of the main issues during the construction of network infrastructure is energy management. During communication, network nodes are believed to use a considerable amount of energy. Certain energy-saving strategies have been investigated, but they have a number of drawbacks and have an effect on routing protocol, data collection, and scheduling, among other things. depicts the energy management techniques used in wireless sensor networks. The three major kinds of energy management system are energy conservation, energy transfer/charging, and energy harvesting. These three classes may be further subdivided into a number of other categories[19].

D. Networking Methodologies

As illustrated in Figures 5 and 6, there are two kinds of network methods: centralized and self-configuration. Centralized creation methods are appropriate for networks when the processing energy is reliant on a single extraordinary device. In this approach, the devices are in charge of processing, administration, and synchronization. Self-organization methods have been considered as one of the most reliable and fast processing methods over the last decade. This technique is more convenient or reliable than conventional methods due to a variety of reasons, including a reduced computational complexity.

E. Wireless Sensor Node Energy Consumption

One of the major challenges with wireless sensor nodes is energy consumption, which requires more attention. The overall energy consumption of wireless sensor nodes is depicted in Figure 7. This graph is separated into segments that show that sensing, CPU, transmitter, receiver, IDLE, & SLEEP consume 27 percent, 7 percent, 33 percent, 27 percent, 4 percent, and 4 percent of total energy.

Each sensor detects its surroundings and transmits the information to a remote base station, where an end-user may access it. A typical wireless sensor network, consists of a number of wirelessly linked sensors. Currently, research is focusing on the implementation of wireless sensor nodes, primarily in the automotive industry.

In region coverage, predictable and random deployments are used, as is the random deployment of target coverage. Random deployment, in which nodes are thrown at random initially, and subsequently deployed using a variety of optimization algorithms. Virtual force algorithm, virtual force oriented particles method, simulated annealing algorithm, particle swarm optimization algorithm, and simulated annealing genetic algorithm are only a few examples. The study's main focus was on deployed nodes.

The objective of this algorithm is to expand the coverage area, improve network connection, extend the network lifespan, and improve data transmission accuracy. Second, the goal of the node's deployed algorithm is to improve the node's tolerance and load balancing. Obviously, if you simply use node random deployment to fully fulfill those design objectives, it's going to be tough. At same time, even if it can satisfy the requirements of major or minor deployment goals of managing deployments in principle, it still has to be addressed to the maximum limit decreased deployment cost issues. As a result, the sensor node deployment goal optimization is split into three categories: coverage area, network connection, as well as network lifespan [20].

F. Major Application of Wireless Sensor

There are many real time applications of wireless sensor networks in various domains. The WSNs have been implemented magnificently in different sectors such as environment monitoring, military, agriculture and many

more. Fig. 8 depicts the typical applications of wireless sensor networks in divers sectors.

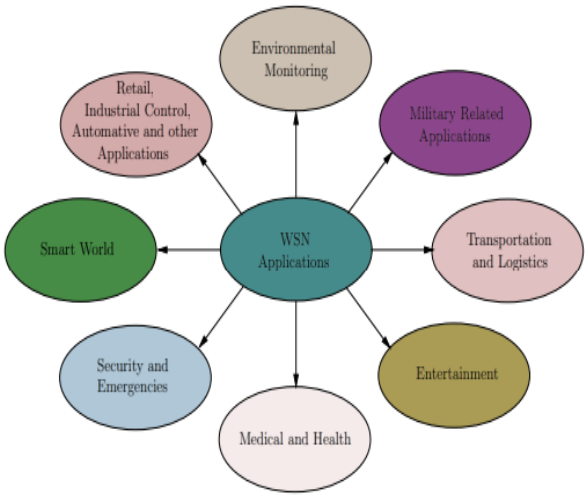

Figure 8: Illustrates the typical applications of wireless sensor networks [11]

1.7 Ecosystem Protection: Over the past decade, WSNs have been used in a variety of industries to solve a variety of issues. The image shows a wireless sensor network-based environmental monitoring system. Environment monitoring is in high demand all around the world in order to safeguard the environment from pollution, fire, and other hazards. Because of their autonomy, dependability, and robustness, WSNs are the ideal choice for adequately monitoring the environment.

G. Emergencies & Security

WSNs are the most efficient and appropriate choice for providing pragmatic security in a variety of areas. These sensors are used in a variety of locations to keep the secret of various items. These sensor networks have the ability to identify emergency situations quickly. Military Applications

Over the past decade, WSNs have been used in military surveillance applications. A user can operate these sensor networks in an effective way. WSNs can efficiently track an enemy's position, which is greatly desired in today's environment.

H. Transportation Use Cases

Because modern cars need surveillance from the viewpoint of secrecy, the transportation industry is an area of interest where WSNs may be used most effectively. These kinds of demands may be met by integrating transportation vehicles with wireless sensor networks in order to keep track of the vehicle's position from a security standpoint. The use of wireless sensor networks in the transportation industry [21].

II. LITERATURE REVIEW

Slobodan N. Simic et al studied about We present a distributed algorithm for environmental monitoring of a scalar field (such as temperature, intensity of light, atmospheric pressure, etc.) using a random sensor network. We derive an error estimate, discuss the average complexity of the algorithm, and present some simulation results [22].

Huang et al. explored the applications of wireless sensor networks in his paper titled wireless sensor networks and its applications. The WSNs are the combination of the highly scattered, trivial, and the low weight wireless nodes which are utilized to track the environment or any system via physical quantity. This paper provides the existing research in the sector of wireless sensor networks during last decade. The networks infrastructure, topologies, routing mechanism, the data integration and the applicability has been explored in a well-organized manner. The WSNs have wide range of applications in various sectors and some of them includes the military and the civilian watching in both the sectors such as rural and the urban. In this paper, authors found that WSNs have extensive range of applicability in various sectors [23].

Buratti et al. discussed the wireless sensor networks (WSNs) techniques and the evolution. In this paper authors, investigated the novel applications as well as the demands for non-conventional paradigms for the protocols designing due to the certain constraints. The network infrastructure play a vital role in order to minimize the power consumption and to make the network more efficient in order to establish a proper communication link between the various nodes. This paper provides the comprehensive survey about the existing research in the arena of wireless sensor networks particularly in certain peculiar applications which are rooted on the environment monitoring. There has also been discussed various network design protocol as well as the networks standard and their functions in order to provide the complete information about the network structure and the designs [24].

III. DISCUSSION

During the last decade, the availability of small WSNs across the globe has led in many advances in the wireless communication sector. Depending on their applicability and demand, sensor networks may be used for a number of applications in a variety of sectors. The researchers are using a variety of techniques to identify and resolve existing network infrastructure issues. Around the globe, wireless sensor nodes are utilized in a variety of real-time applications. Significant research in the field of wireless sensor networks (WSNs) has been done in the last decade due to an increase in demand in various applications all over the world. WSNs are a new field of research that is being investigated to provide solutions to existing issues such as energy usage, sensor location, routing algorithms, robustness, efficiency, and many more. WSNs are in high demand because to their low computational complexity, robust privacy and security, simplicity of installation, and resilience and reliability. Although much research has been done in the subject of WSNs, there is still much more to be done, and more research is needed to fully explore the WSNs' potential.

IV. CONCLUSION

Over the past several decades, WSNs have been used in a variety of areas to offer wonderful answers to current issues faced by people all over the world. Sensor networks have been used in a variety of industries, including healthcare, agriculture, military, intelligence, and many more. Because of the constant technical advancements, there is a significant need for further study in the field of WSNs. The major goal of this review article is to provide an up-to-date overview of WSNs and their applications in many domains. Furthermore, the paper offers in-depth information on the key problems and obstacles that must be addressed in order for WSNs to be properly implemented in different sectors in today's world. WSNs are in great demand for a variety of reasons, including their low computational complexity, strong privacy and security, ease of installation, and resilience and dependability. Although considerable study has been done in the field of WSNs, this area is not restricted, and further research is required to fully explore the WSNs' potential.

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