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Exploring Applications and Implementation Challenges of Wireless Sensor Networks

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ABSTRACT: ***Important uses for a wireless sensor network (WSN) include target tracking and remote environmental monitoring. This has been made possible by the accessibility of sensors that are more compact, affordable, and sophisticated, especially in recent years. These sensors have wireless interfaces built into them so they can communicate to one another to establish a network. The application has a considerable impact on the WSN's design and must take into account elements including the environment, the application's design goals, cost, and hardware and organizational restrictions. This survey's objective is to provide a review on applications and implementation challenges of WSNs. The WSNs are essential to a wide range of real-time applications worldwide. Due to the increased demand for WSNs in numerous applications around the world, there has been a lot of research done in this area during the past ten years. The study of WSNs is a new area of study for researchers looking for answers to problems with energy consumption, sensor placement, routing algorithms, resilience, efficiency, and other concerns. Over the past ten years, numerous researchers have run across several problems linked to computational complexity and network architecture. As a result of their applicability in a variety of fields, including healthcare, surveillance, and environmental monitoring, WSNs are growing in popularity worldwide.***

KEYWORDS: ***Wireless Sensor Networks, Implementation Challenges, Application, Wireless, Technology.***

1. INTRODUCTION

Recent years have seen an increase in interest in wireless sensor networks (WSNs) due in large part to the widespread use of micro-electro-mechanical systems (MEMS) technology, which has eased the creation of smart sensors. These sensors are tiny and have just basic processing compared to conventional sensors, they are less expensive and require less computational power. This sensor network can detect, Measure the environment and collect data from it and they can send the detected data to the user depending on a local judgment procedure. Due to the global spread of low-cost WSNs over the past ten years, the wireless communication industry has seen various improvements. Depending on their suitability and need, sensor networks can be applied in a wide range of ways across numerous industries. By using a variety of methodologies, the researchers are identifying current concerns and resolving issues with the network architecture [1].

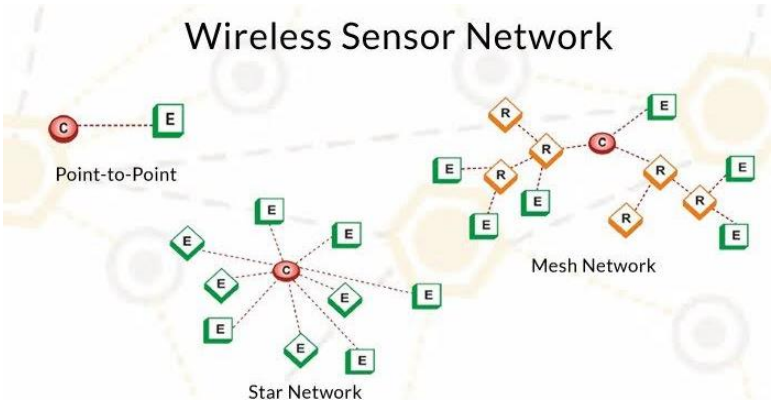

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Figure 1: Illustrates the architecture of wireless sensor network [Google].

Every industry faces unique issues that call for increased attention in contemporary communication systems. Environmental monitoring and target tracking are only two of the vital uses for a WSN in a variety of fields. The wireless interfaces are used to arm the sensor networks so that each sensor can connect to the others via communication in order. Since the sensor nodes often deploy in difficult-to-access locations and have limited memory, a radio is implemented for wireless communication to relay the data to a base station (such as a laptop, or a desktop computer). Personal portable device or a fixed infrastructure access point). A sensor's primary power source is a battery node. The supplementary power source that draws energy from solar panels, for example, might be added to the surroundings depending on how suitable the surroundings are, a node where will the sensor be placed? Actuators may be built within the sensors, depending on the application and the kind of sensors utilized [2]–[5].

The network is unattended while monitoring and reporting tasks are carried out. Because there are so many nodes in an unstructured WSN, it is challenging to manage connectivity and detect faults. A structured WSN pre-plans the deployment of all or some of the sensor nodes. Fewer nodes can be installed in a structured network, which is an advantage. Lower costs for network management and maintenance. Fewer Nodes can now be deployed since they are positioned at predetermined areas to give coverage, as opposed to ad hoc deployment. WSNs have enormous potential for use in a wide range of contexts, including military target tracking and surveillance, disaster relief, biomedical health monitoring, and seismic sensing. A WSN can help with intrusion detection and prevention in military target tracking and surveillance. Identification. Movements of troops and tanks that are geographically correlated and coordinated are specific examples. Sensor, nodes may notice and recognize the natural calamities a setting to predict calamities before they happen. The surgical implantation of sensors can be helpful in biological applications. Observing the patient's condition by placing sensors near the volcanic area can identify the progression of eruptions and earthquakes [6]–[8].

During communication, wireless sensor networks need a lot of energy. One of the main issues during the construction of the network infrastructure is energy management. The network nodes are thought to consume a lot of energy while communicating. Energy-saving approaches have been researched; however, they have several downsides and have an impact on scheduling, data gathering, and routing algorithms, among other things. The energy management plans used in wireless sensor networks. Energy conservation, energy transmission and charging, and energy harvesting are the three basic categories into which energy management schemes can be divided. These three classes can be further divided into several categories.

2. DISCUSSION

To illustrate the situation in real-time, the WSNs have been used extensively. Additionally, these kinds of WSNs are built for real-world applications and operate under extreme energy constraints. To lower the computational complexity, which is a big challenge that requires greater attention, network design is a very difficult and time-consuming task. Numerous network design strategies and methodologies have been studied. However, the existing networks of this kind suffer from several shortcomings and are incompatible with the communication systems of the day. The authors of this study examined both the research frontiers in the field of WSNs as well as the commercially available WSNs nodes founded on the parameters. The WSNs are a collection of wireless nodes that are lightweight, inexpensive, and widely dispersed and are used to track the environment or any system using physical quantities. This report summarises the recent research in the field of wireless sensor networks.

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A well-organized investigation has been made into the topologies, routing mechanisms, data integration, and applicability of networks. The WSNs have a wide range of applications in numerous industries, some of which include military and civilian watch operations in both rural and urban areas [9].

The authors of this paper discovered that WSNs had broad industry applicability. Due to particular restrictions, fresh applications as well as the necessity for unconventional paradigms for protocol design were investigated. To reduce power consumption and increase network efficiency and create a reliable communication link between the various nodes, network infrastructure is crucial. This paper presents a thorough overview of the research that is currently being done in the field of wireless sensor networks, especially with regard to some unusual applications that are based on environmental monitoring. In order to provide comprehensive knowledge on the network structure and designs, many network design protocol as well as the networks standard and their functions have also been described [10].

A WSN differs from conventional networks in that it has its own design and resource limitations. Limited energy, a constrained communication range, and other resources are among the restrictions reduced processing and storing capacity due to poor bandwidth node. Application-specific design restrictions are dependent on the surroundings under observation. Surroundings plays a crucial part in defining the network's size, the deployment strategy and the topology of the network. The network's size changes depending on the environment being watched. Fewer nodes are needed for indoor settings can create a network in a constrained area, while outdoor settings could need more nodes to cover a bigger region. Pre-planned deployments are preferred to ad-hoc one's deployment when there is no human access to the environment or when the network is made.

Due to technological improvements, wireless sensors are being used in numerous fields for a variety of purposes. To manage network power consumption, which is a major problem in contemporary communication systems, several network protocols have been developed from energy efficiency viewpoints. The authors of this research noted that security has been a key challenge for wireless sensor networks during the past 10 years and that it needs greater attention to be fixed. Over the past ten years, the WSNs have been used in a variety of industries to solve a variety of challenges. The use of wireless sensor networks to monitor the surroundings. To safeguard the environment from pollution, fire, etc., there is a great need for environmental monitoring all over the world. Due to their independence, dependability, and robustness, WSNs are the greatest alternative for accurate environmental monitoring.

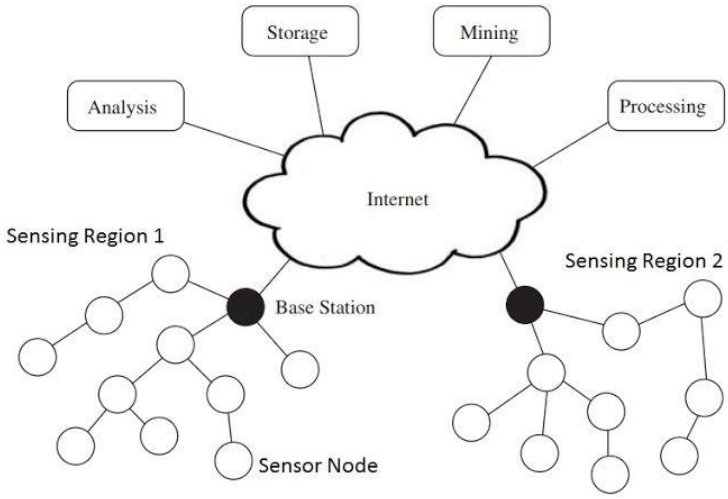

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Figure 2: Illustrates the sensor networks connections [Google].

3. CONCLUSION

WSNs applications include tracking military targets, industrial machine monitoring, surveillance systems, and environmental monitoring, among others specifications vary depending on the type of application. To accommodate this variety of applications, new communication protocols, and algorithms, there is a need for designs and services internal platform and underpinning operation system, a stack of communication protocols, a network, and difficulties with services, provisioning, and deployment. To date, analysed and evaluated various suggested designs, services, protocols, and algorithms. Additionally, highlighted areas for each that could want improvement and research area. There are still many problems to be overcome in this area application areas for WSN include communication architectures, security, and administration. By addressing these problems. Over the past few decades, the WSNs have been used in a variety of fields to offer outstanding solutions to problems that people all over the world are currently facing. These sensor networks have been used in a variety of fields, including but not limited to the military, intelligence, agriculture, and healthcare. A lot more research is needed in the area of WSNs due to ongoing technological advancements. This review paper's major goal is to give an up-to-date analysis of WSNs and their applicability across many fields. The paper also goes into great length regarding the primary problems and difficulties that must be overcome to properly implement WSNs across a variety of modern domains. Therefore, the need for WSNs has been growing daily.

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