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A Survey On Wireless Sensor Network Challenges

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Abstract
The importance of wireless sensor networks is increasing from few years as wireless sensor networks (WSN) is becoming progressively attractive for various application areassuch as military,health monitoring,threat detection,environmental monitoring,Industrial automation,Agriculture etc.Sensor nodes are involved in almost every field.WSN has become one of the vital technologies for the future.The significance of this technology has been emphasized due to the development of related fields where it can be applied.The wide availability of sensors and introduction of internet of things (IOT) is providing huge growth to WSN market in smart automation.The purpose of this paper is to provide a concise information about WSN architecture,types,recent applications and insight of innovative applications of WSN.
Keywords: ***Sensor nodes, Wireless sensor network (WSN), Internet of things (IOT)***

1. Introduction
Wireless Sensor Networks technology appeared more than 20 years ago [1].Wireless sensor networks are expected to alter the way communication takes place in the physical world. Organizations need real-time visibility and intelligence service for their organizational and operational data.Wireless Sensor Networks is a group of specialized sensors nodes embedded with communications infrastructure intended to monitor and record conditions at diverse locations.As seen in Figure 1, a sensor node is an electronic device which consists of a processor along with a storage unit, a transceiver,one or more sensors, analog-to-digital converter (ADC), and a power source.The main job of each node is to
As illustrated in Figure 2, the Base Station, by using the data transmitted to itself, is able to both perform supervisory control over the WSN it belongs to and transmit the related information to human users or/and other networks [2]. monitor the environment using on-board sensors. Each node can be used as a router to forward data from neighbors to the sink or Base Station (BS).

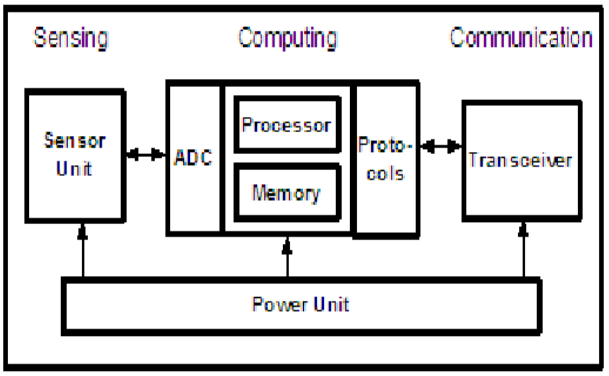

Figure 1. Architecture of sensor node.

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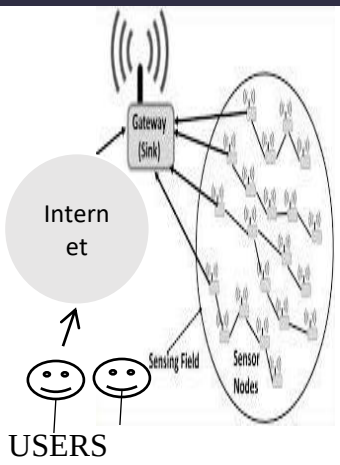

Figure 2. Architecture of WSN.

2. Wireless Sensor Network Topologies

Wireless sensors networks are often built using star, tree, or mesh topology configurations:

i. Star topology

Star topology consists of a "central node," such as a hub or a switch to which all nodes in the network are connected. Data flows through the central node, hub.Therefore, an intelligent central node is required. Failure of this node will result in failure of the entire network[3]. Wireless personal area network (WPAN) consisting of a smartphone connected to several wireless sensors, is an example of star topology.

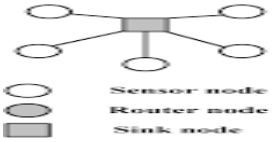

Figure 3

ii. Tree topology

A tree topology contains many levels of nodes. The nodes are connected to hub known as secondary hub.The main hub is known as primary/parent hub to which all the secondary hubs are connected. Data is transferred from leaf sensor node to parent sensor node .The main benefit of this topology is consuming less power as compared to other network topologies [4].Tree topology is suitable for large sensor networks.

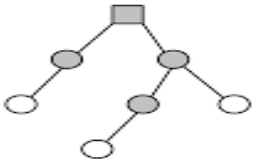

Figure 4

iii. Mesh topology

In the mesh topology, the nodes can directly communicate with each other without using a central communication hub.Mesh networks are self-healing, as data can be routed along a different path if a node fails.Mesh topology is the most reliable network topology. The major drawbacks of mesh topology are: it is complex and consumes a lot of power [5]. Mesh networks are not suitable for large sensor networks as the number of connections required become unmanageable.

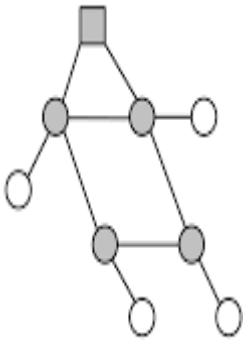

Figure 5

3. Categories of Wireless Sensor Network

I. Wireless Personal Area Network (wireless PAN)

A wireless personal area network (Wireless PAN) is a type of personal network that uses wireless communication technologies to communicate and transfer data between the user's connected devices. Wireless PAN is also known as a short wireless distance network.Wireless PAN is carried over a low-powered, short-distance wireless network technology such as Bluetooth network,wireless USB or ZigBee[6]. WPAN provides a network range of 10 meters.

II. Wireless Local Area Network (wireless LAN)

Wireless LAN is formed within a restricted location such as office or workplace.Wireless LAN use high-frequency radio waves and often include an access point to the Internet[7]. A Wireless LAN allows users to move around the coverage area, often a home or small office, while maintaining a network connection.Wireless LAN s have become common for use in the several households, as a result of their ease of installation and use. They are also became widespread in commercial areas that offer wireless access to their work forces and clients.

III. Wireless Metropolitan Area Network (wireless MAN)

Wireless MAN is a fixed wireless installation that interconnects buildings or locations. A Wireless MAN is mostly governed by a single entity such as an Internet Service Provider (ISP), government entity, or any other large corporation.Wireless MAN is also used in describing the interconnection of several LAN s in an urban region via the use of "point-to-point connections" between them.

IV. Wireless Wide Area Network (wireless WAN)

Wireless WAN is a network that covers a huge geographic location.Wireless WAN is network traffic encapsulated in mobile communications technology such as Worldwide Interoperability for Microwave Access (WIMAX), Universal Mobile Telecom System (UMTS), code division multiple access (CDMA) 2000, Global System for Mobile (GSM) etc[8].Wireless WAN connectivity permits a user with a network and a wireless WAN card to surf the network, check electronic mail, or connect to a virtual private network (VPN) from somewhere within the boundaries of wireless networks.

V. Wireless global area network (wireless GAN)

Wireless GAN is composed of diverse interconnected computer networks(WAN s) and covers an unrestricted geographical location. Since GAN s are used for supporting mobile telecommunication cellular networks (MTCN) across a number of wireless LAN s, one of the main challenges for any wireless GAN is in transferring of the user communications from one LAN to another. Wireless GAN use the fiber optic infrastructure from wide area networks and combine these with international undersea cables or satellite transmissions.One of the utmost popular wireless GAN

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categories is a broadband (BB) wireless GAN.

4. Types Of WSN

i. Multimedia WSN

network are detecting images of enemies,weapons etc. These networks consist of low-cost sensor nodes equipped with microphones and cameras[9]. These nodes are interconnected with each other over a wireless connection for data compression, data retrieval, and correlation.Thechallenges with the multimedia WSN include high energy consumption, high bandwidth requirements, data processing, and compressing techniques.

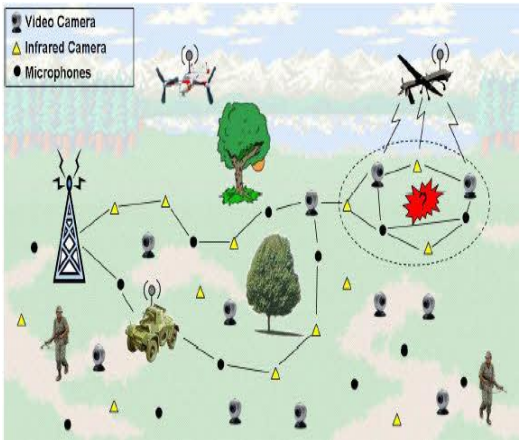

Figure 6

ii. Body Area Network

In Body Area Network, tiny sensors are implanted on or inside human body or embedded in an external clothing or else worn on human body like ornaments.These sensors collect important health parameters like Blood Pressure,Blood Sugar,heart rate etc [10].Examples of implanted sensor is pacemaker.Example of surface sensor is BP machine.Example of external sensor is alcohol sensor.

Multimedia wireless sensor networks enable tracking and monitoring of events in the form of multimedia, such as imaging, video, and audio.Examples of this

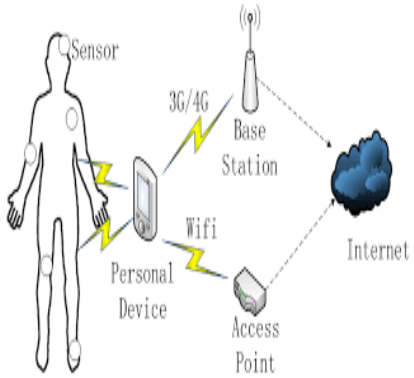

Figure 7

iii. Under-ground WSN

Under-ground WSN consist of various sensor nodes that are concealed in the ground to monitor underground conditions.Examples of this network are earthquake monitoring,field monitoring,soil condition monitoring etc. The underground environment makes wireless communication a challenge due to the high level of attenuation and signal loss.The sensor battery nodes equipped with limited battery power are difficult to recharge.

iv. Under-water WSN

Under-water networks consist of multiple sensor nodes that are deployed underwater. Example of this network is tsunami detection.Autonomous underwater vehicles are used for gathering data from these sensor nodes. Most of the UWSN can be used for Seismic monitoring and security applications. The major challenges of underwater communication are long propagation delay,power consumption, installation and communication between sensor nodes,bandwidth and sensor failures.

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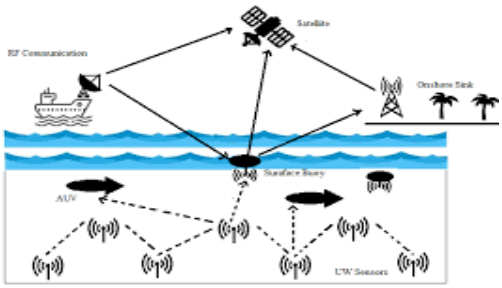

Figure 8

5. Applications Of WSN

The utilization of wireless sensor network is rising at good speed, due to its application in various fields.WSN applications are classified according to their use.

i. Military Applications

The introduction of sensors in military for various applications is boosting the WSN market.Military is the first field that used WSN[11]. It motivated the initiation of sensor network research. Smart Dust is an example of the initial research efforts, which were performed in the late 90 s . The technological advances achieved made WSN capable of supporting various operations.The main subcategories of the military applications of WSN are battlefield surveillance, combat monitoring, andintruder detection.

ii. Health Applications

Medical applications benefit from wireless sensor networks in many ways.Wireless sensor networks are used in healthcare to enhance the quality of healthcare services [12]. Patients equipped with a wireless body area network need not be physically present at the physician for their diagnostic. A body sensor network proves to be adequate for emergency cases, where it autonomously sends data about patient health so that physician can prepare for the treatment immediately.

iii. Environment Monitoring System Applications

The development of environmental monitoring system has been applied in many applications in order to assist people in their job and reduce cost and time. The applications of environmental monitoring have grown rapidly in agricultural monitoring,air monitoring,seismic activity monitoring,volcanic activity monitoring,
habitat monitoring, indoor monitoring, greenhouse monitoring, climate monitoring and forest monitoring and tsunami Detection.Environmental applications that demand continuous monitoring of close conditions at incompatible and remote areas can be improved with the utilization of WSNs.

iv. Industrial Applications

In industrial environments, sensors are typically used to monitor the operation of an equipment, an asset, or environmental conditions. Sensors are often used in locations that are inaccessible or unsafe to workers.Any potential problems are notified to the plant personnel as an advanced warning system[13]. This enables plant personnel to repair or replace equipment before their efficiency drops or they fail entirely. In this way, catastrophic equipment failure and the associated repair and replacement costs can be prevented.WSN is applied in industrial applications such as manufacturing, condition-based maintenance, automated metering, remote monitoring, inventory, vehicle and personnel management, and many other areas of operations management.

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6.Challenges Of WSN

Wireless Sensor Networks had a comprehensive range of challenges**.** In this paper we have pointed a list of issues associated with Wireless Sensor Networks.

i. **High Power consumption**: Power is always been a challenge for WSN design.The sensors used in wireless sensor network requires power to operate and process various operations.Most of the energy stored in the attached battery is consumed during data transmission.One way to prolong the network lifetime is to implement the energy efficient algorithms.

ii. **Hardware Cost:** One of the main challenges is to produce low cost and tiny sensor nodes. Low cost of sensor nodes can be achieved by recent and future progress in the fields of MEMS(MicroElectroMechanicalSystem).

iii. **Security:** Security is one of the major challenge in WSN. Most of the attacks that are performed on WSN are insertion of false information by compromised nodes within the networks. Development of security schemes for WSN also faces challenges related to constrained environment.

iv. **System Architecture:** Researches in the field of WSN is going on around the world but still there is no unified system and network architecture, on the top of that different application can be built.

v. **Realtime Applications :**Protocols need to be developed for real-time applications considering the theoretical concepts and summarizing novel solutions.

vi. **Analytical and Practical Results:** Till date very few analytical results exists for WSN. New applications get assurance when it is tested and analyzed practically by comparing results with existing schemes.

vii. **Environment Conditions :** Sensor nodes are the core element of WSN. Sensors are exposed to harmful environment, radiation of radio frequency energy, vibration,high humidity, dust that degrades their performance [14]. Due to these uneven conditions, sensors can malfunction and give inaccurate information to other nodes.

viii. **Adaptation :** WSN consists of large number of sensor nodes. But due to failure of nodes WSN topology changes frequently. Sometimes additional sensor nodes need to be placed which leads to a reorganization of network.. During the network operations, the network topology is constantly changing. WSN once deployed should be able to adaptable to changing connectivity.

ix. **Diversity :** WSN s consist of nodes with different sensing and processing capabilities. Heterogeneity arises when two different WSN communicate with each other. It creates obstacles in communication and network configuration. New routing protocols should be designed and implemented, with the purpose of using sensor node heterogeneity to increase the lifetime of WSN.

x. **Data novelty :** In WSN, accurate data plays an important role.Data freshness should be maintained in WSN applications. To achieve this, accurate data should reach to sink within the time limit. Data from previous round should not get mixed with the current round data. Sometimes due to poor network, data is not refreshed and incorrect data is transferred to destination.

xi. **Quality of Service (QOS) :**The growing usage of wireless sensors in different scenarios makes the quality-of-service animportant issue in wireless sensor applications.Due to unreliable characteristics of the wireless medium and the hardware limitations of devices, providing QOS in WSN applications is a challenging task.Managing QOS parameters for sensor network is difficult as network topology changes continuously and routing information is imprecise.

xii. **Sensor Deployment :** Node deployment is a fundamental issue to be solved in Wireless Sensor Networks.WSN nodes will be deployed in varied ways under different application scenarios. Deployment methods are closely related to specific applications[15]. For some applications senor nodes are placed at predetermined positions to meet all requirements, such as coverage, connectivity, expected lifetime.Examples of such application are office buildings, hospitals, factories. In harsh or hostile environments, e.g. forests, deserts, battlefields, sensor nodes may be air-dropped from an aircraft or be distributed in other ways, which can result in a random placement.These applications usually deploy more nodes and need more complicated sensor scheduling mechanisms.The deployment problem of WSN is a critical issue because it affects both the overall performance and the energy consumed by the sensors in the whole system

xiii. **Operating System (OS) :** The OS of sensor node should be capable of working in constraint environment, hardware independent and application specific. It should be energy efficient and capable of taking priority based decisions. Some Operating system designed for sensor node includes Tiny OS, Contiki ,Mantis and Nano-Q plus.

xiv. **Redundant Data :** In Wireless Sensor Network (WSN s), nodes are densely deployed in a region to collect information. Sensors sense the similar data and forwards to sink.This similar data leads to data redundancy.The collection and transmission of huge amounts of redundant data by sensor nodes will lead to a faster consumption of their limited battery power, which is sometimes difficult to replace or recharge, reducing the overall lifetime of the network.

7. Conclusion

The future of WSN is expected to be more innovative.WSN field will give us a tremendous chance to alter the way we perceive the world today. In this paperwe presented a survey on different topologies ,types,categories,applications and challenges of WSN.This paper will be usefulto work on various challenges of WSN and find methods to overcome the problems.We will evaluate a specific

issue in WSN and work for an effective technique.

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