International Journal of Engineering, Science and Mathematics
Vol. 7 Issue 2, February 2018,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: **http://www.ijesm.co.in, Email: ijesmj@gmail.com**
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Introduction To Wireless Sensor Network and its Applications

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Abstract

Sensor networks are expected to play an essential role in the upcoming age of pervasive computing.WSN stands for Wireless Sensor Network. Wireless Sensor Network consists of thousands of self organizing, low-power, low cost wireless nodes and is used in variety of fields which includes military, healthcare, environmental, biological, home and other commercial applications. In this paper, different types of wireless sensor network topologies described in details. The characteristic of this is to divide WSN into network based on Topologies i.e. Bus, Tree, Star, Ring, Mesh. Information of the position of nodes, and those nodes are organized within the network by the Topological way.

Wireless Sensor Networks (WSN), which is composed of several thousands of sensor nodes which are capable of sensing, actuating, and relaying the collected information. This paper presents an overview of the various wireless sensor network types and their applications, operations, topologies and advantages etc.

Keywords: wireless sensor network, applications, topologies, types

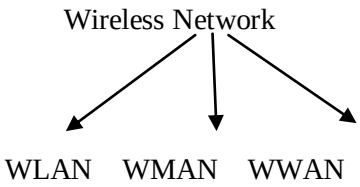
Introduction

Wireless sensor network refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data. Recently, this technology becomes more popular because of its application and cost. The wireless sensor networks are built of several hundred or thousands of nodes, where each node is connected to one or several sensor. It measures the environmental conditions like temperature, pollution, wind, sound and etc. The development of wireless sensor networks was motivated by military applications like battlefield surveillance, today this type of network also used in industrial applications like this industrial process monitoring and controlling, machine monitoring etc.

Wireless sensor network is dynamic which can consist of various types of sensor nodes. The environment is heterogeneous or dissimilar type in terms of both hardware as well as software. The sensor node construction focuses to reduce cost, increase flexibility, Improve conserve energy. The structure of sensor node consists of sensing unit (sensor and analog to digital converter), processing unit (processor and storage), communication unit (transceiver), and power supply unit.

Wireless Network

Wireless networks are not connected to cable. Wireless telecommunications networks are generally implemented and using a transmission system called radio waves. AM radio, FM radio, satellite radio, satellite TV, satellite Internet access and broadcast TV are wireless networks. Wireless technology is very convenient. Wireless networks have many uses. A common is the portable office. People on the road want to use their portable electronic equipment to send and receive telephone calls, faxes, and electronic mail, read remote files, login on remote machines. Computers there can send messages, keep records, and so on. It is a kind of computer network. Wireless communication is the transfer of information between two or more devices that are not connected through cable. The most common wireless technology is use radio communication. There are various types of wireless networks:-

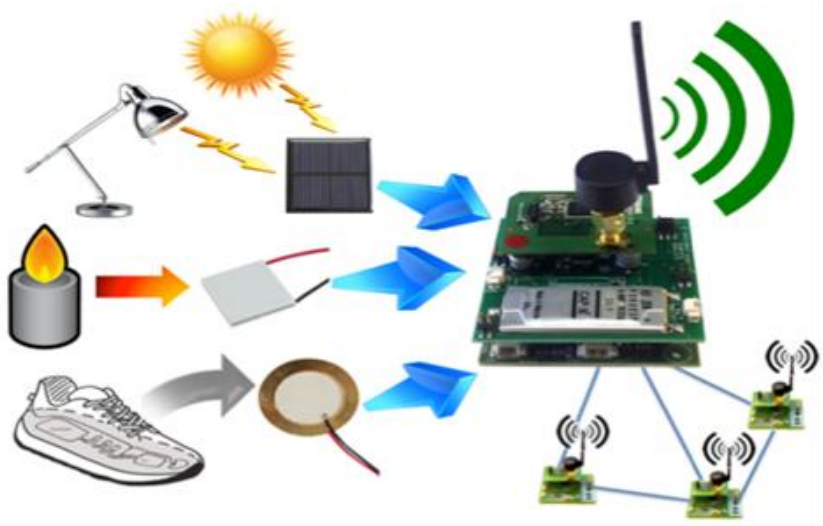


Wireless local area network (WLAN), it covers a very little area to communicate the networks with each others. Wireless metropolitan area network (WMAN), communicates with the device over a city, town etc. Wireless wide area networks (WWAN), information are shared over all the world.

Wireless Sensor Network:

A sensor network is a group of tiny, generally battery powered device and wireless infrastructure that monitor and record conditions in any number of environment.

WSN monitors are parameters which are temperature, direction of wind and speed, pressure, intensity of vibrations, pollution, humidity etc.



A wireless sensor network is a kind of wireless network. These networks covers a large number of distributed, battery operated, embedded devices that are network to collect, process and transfer data to the operators. The sensor node is a multi-functional, efficient wireless device. A collection of sensor nodes collects the data from the surrounding to achieve specific application.

Types of WSNs

There are various types of sensor networks which are given below:

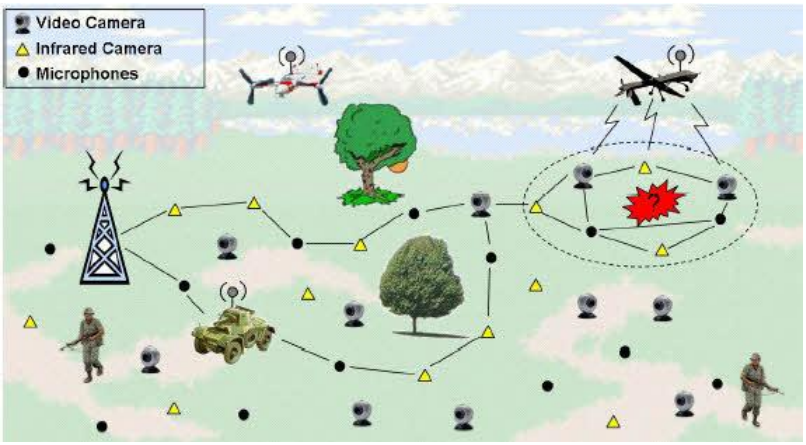
1. Terrestrial WSNs
2. Multimedia WSNs
3. Underground WSNs
4. Underwater WSNs
5. Mobile WSNs

1. Terrestrial WSNs

Terrestrial WSNs are capable of communicating base stations, and consist of hundreds to thousands of wireless sensor nodes deployed either in unstructured or structured manner. In an unstructured mode, the sensor nodes are randomly distributed within the target area that is dropped from a fixed plane. The structured mode considers optimal placement, 2D, 3D placement models. In this wireless sensor network limited battery power.

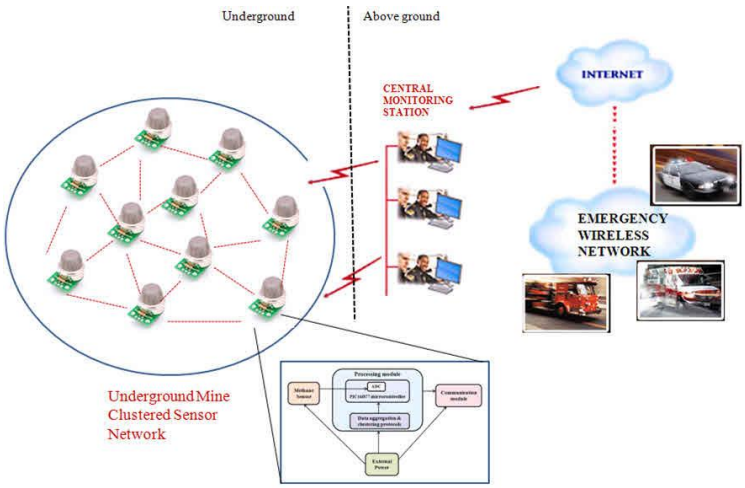
2. Multimedia WSNs

Multimedia wireless sensor networks to enable monitoring and tracking in the form of multimedia: images, audio and video. These networks consists of low cost sensor nodes equipped with cameras and microphones. The challenges with the multimedia wireless sensor networks include high energy consumption, data processing techniques and high bandwidth requirements



3. Underground WSNs

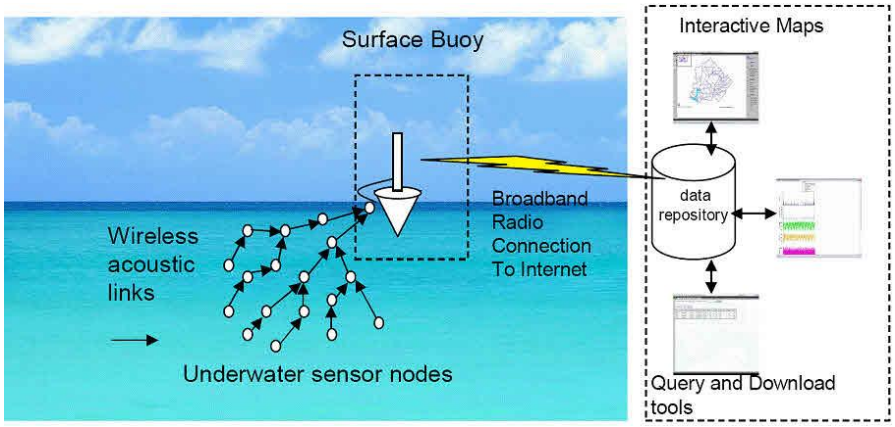
The underground wireless sensor networks are more expensive than the terrestrial wireless sensor networks in terms of deploy, maintenance, cost considerations and planning etc. The WSNs networks consist of a number of sensor nodes that are hidden in the ground to monitor underground conditions. To relay information from the sensor nodes to the base station, additional sink nodes are located above the ground.



The underground wireless sensor networks deployed into the ground are difficult to recharge. The sensor battery nodes equipped with a limited battery power.

4. Under Water WSNs

More than 70% of the earth is occupied with water. These networks consist of a number of sensor nodes and vehicles deployed under water. Autonomous underwater vehicles are used for gathering data from these sensor nodes. A challenge of underwater communication is a long propagation delay, bandwidth and sensor failures.



Under water WSNs are equipped with a limited battery that cannot be recharged or replaced. The issue of energy conservation for under water WSNs involves the development of underwater communication and networking techniques.

5. Mobile WSNs

These networks consists of a collection of sensor nodes that can be moved on their own and can be interacted with the physical environment. The mobile nodes have the ability to sense and communicate. It is more versatile than the static sensor networks. The advantage of this WSNs are better energy, channel capacity good and improved coverage etc.

Operation of wireless sensor network

In wireless sensor network, wireless transmission consists of three major operations:

1. Convert data into radio wave.

2. Amplifying radio waves until reaching the receiving sensor.

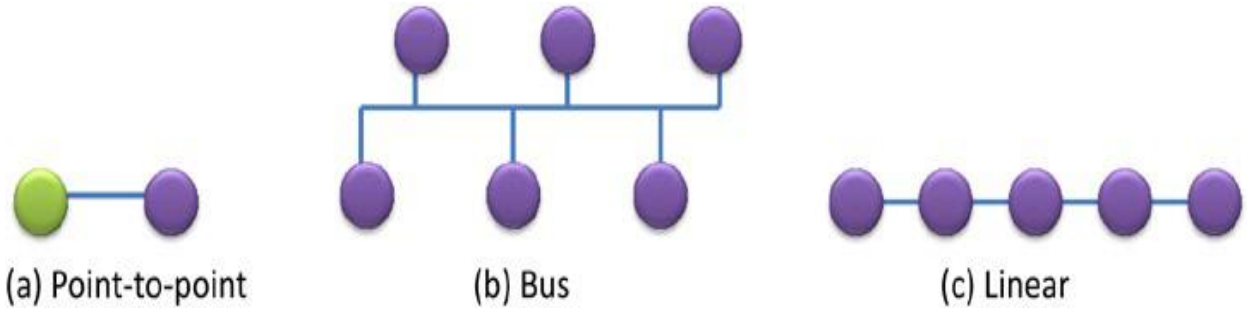
3. Receiving sensor receives the data.

WSN Topology

For radio communication networks, the structure of a WSN includes different types of topologies like: star, mesh, tree, ring.

Bus Topology

In this topology, there is a node send message to another node on the network sends a broadcast message onto the network but only the intended recipient actually accepts and processes the message. Bus topology is easy to install. However, bus networks work best with a limited number of nodes. If more than a few dozen nodes are added to a network bus, performance problems will likely result.
In this paper presents a framework for real-time bus priority control system. The proposed system architecture integrated active and passive strategies and adding a priority classification level, can provide efficient bus priority control and minimize overall effects to motor vehicle movements under different traffic condition.



Star Topologies

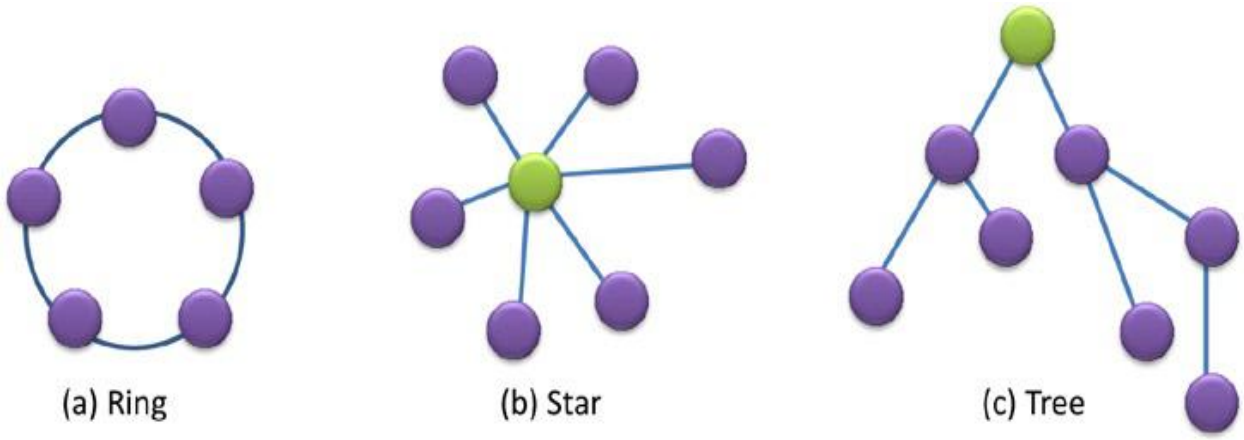
Star topology consists of a single "central node," such as a hub or a switch that every node in the network connects to it. This topology is easy to design, implement, and extend. All data traffic flows through the central node. Failure of this node will result in failure of the entire network. The star network topology is one of the most common sensor network topologies. A wireless personal area network (WPAN), consists of a smart phone connected to several wireless sensors, is a common example of this topology.

Due to its dependency on a single node to manage the network, the gateway must be within the radio transmission range of all the individual nodes. The advantage includes the ability to keep the remote nodes' power consumption to a minimum and simply under control. The size of the network depends on the number of connections made to the hub.

Tree Topologies

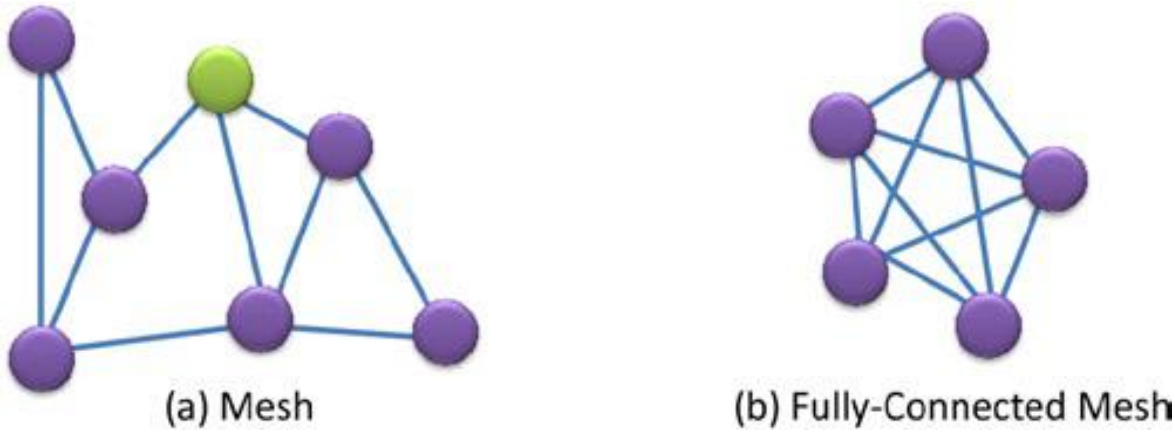
Tree topology is a hierarchy of nodes in which the highest level of the hierarchy is a "root node," and this node is connected to one or many nodes in the level. A tree topology can contain many levels of nodes. The processing and power in nodes increase as the data moves from the branches of the tree toward the root node, allowing data to be processed close to where it is generated. This topology is scalable and the simple structure makes it easy to identify and isolate faults. Tree networks become increasingly difficult to manage as they get larger.

Tree topology is also called as cascaded star topology. The main advantage of the tree topology is that the expansion of a network can be easily possible, and also error detection becomes easy. The disadvantage with this network is that it relies heavily on the bus cable; if it breaks, all the network will collapse.

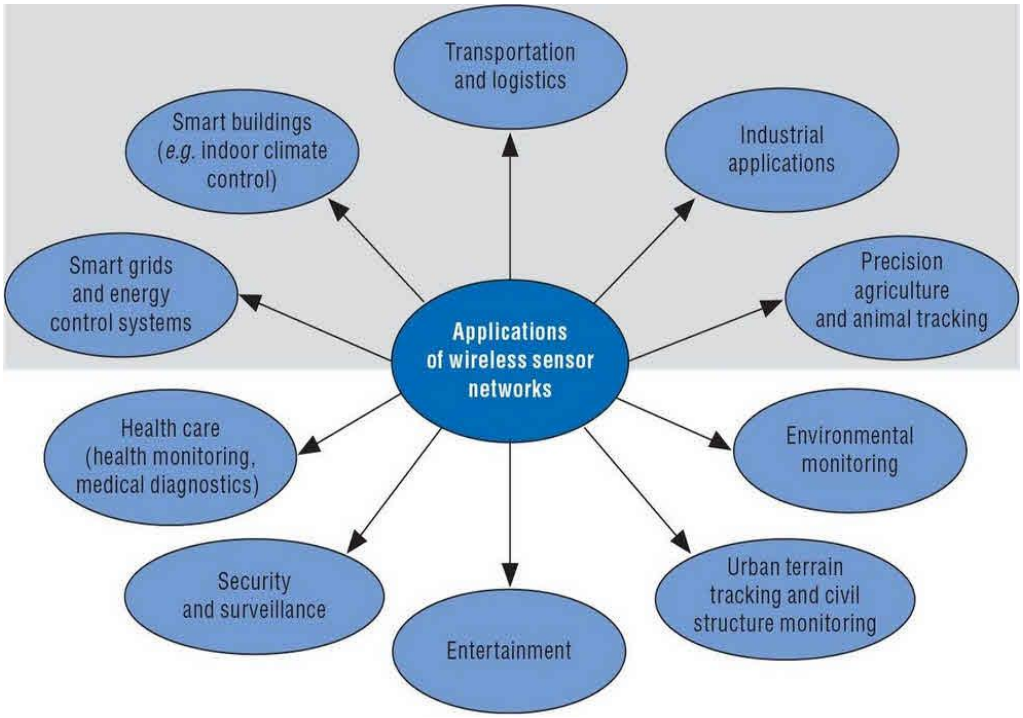


Mesh Topologies

The Mesh topologies allow transmission of data from one node to another, which is within its radio transmission range. There are two forms of mesh topology: a partially connected mesh, in which some nodes are connected to more than one other node; and a fully connected mesh, in which every node is connected to every other node in the mesh. Mesh networks are self-healing, as data can be routed along a different path if a node fails. Mesh topologies are most commonly found in wireless networking Sensor networks can also be described by their logical topology—the method they use to move data around the network. This logical topology is used in bus, star, or hybrid physical topology networks, due to their shared data bus or shared node.
The advantage with this mesh topology includes easy isolation and detection of faults in the network. The disadvantage is that the network is large and requires huge investment.



Wireless Sensor Networks applications



- These sensor networks are used in environments applications such as:animal tracking, flood detection, weather prediction and also in commercial applications activities prediction and monitoring.
- Health applications are also used this type of network such as: tracking and monitoring of doctors and patients.
- Wireless sensor networks can be an integral part of military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting systems.
- Area monitoring is a common application of WSNs. In area monitoring, the WSN is deployed over a region where some phenomenon is to be monitored. A civilian example is the geo-fencing of gas or oil pipelines.
- The most of the applications used in the field of transport systems such as monitoring of traffic etc.

Advantages of sensor network

1. Sensor nodes can be added or removed easily.

2. Execution pricing is inexpensive.

3. It can be opened by using a centralized monitoring.

4. Can be configured into different network technologies: star, tree, mesh etc.

5. Node location can be changed without rewiring.

Limitations of Wireless Sensor Network

1. It consumes a lot of power because it works in short communication range.
2. Very little storage capacity.
3. It has a limited life time of batteries
4. This network is not secure as compared to wired networks. Hackers can easily hack the network.
5. Communication speed is low as compared to wired network.
6. Wireless sensor network keep distraction by other wireless devices.

Conclusion

The wireless sensor network (WSN) technology is one such a new technology and has been attracting significant attention. In this paper, we have presented the introduction, topologies and characteristics of the wireless sensor network which will help the researchers and industry to design a functional WSN with maximum throughput using minimum resources with a low cost. There are different types of topologies of wireless sensor networks each topologies have different performance. The application of wireless sensor network in the area of healthcare, military, environmental, industrial etc. These applications are possible flexibility, fault tolerance, low cost. Though wireless sensor networks are constrained by scalability, cost, topology change and power consumption, new technologies are being devised to overcome these and to make sensor networks an integral part of our lives. The future prospects of wireless sensor network applications are highly promising to revolutionize our everyday lives.

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