A Survey of Wireless Sensor Network and its types

Manish Kumar Singh[1], Syed Intekhab Amin[2], Syed Akhtar Imam[2], Vibhav Kumar Sachan[1], Amit Choudhary[2],

Department of Electronics & Communication Engineering

[1]KIET Group of Institutions, Ghaziabad, India

[2]Jamia Millia Islamia, New Delhi, India

***Abstract*- In the past several years there is a fast development in the area of WSN. For cheap wireless communication, hundreds or thousands of sensor nodes and a base station (sink) have formed a new network that is called a wireless sensor network. Nodes and Base station are placed in large area. This paper describes a concise introduction to WSNs architecture, possible topologies and measurement of physical parameters through crossbow tool. Afterward, the paper highlights the types of WSN and its applications.**

Keywords: Sensor nodes, Wireless sensor network (WSN),sink node

I. INTRODUCTION

When many sensors monitor big physical areas, then they design a WSN. Wireless sensor nodes have sensing, processing, communication and storage capabilities. They can measure humidity, pressure, light intensity, temperature, etc. of Physical Environments. WSNs consist of one sink node and a large number of sensor nodes placed over a big area (sensing field) as shown in fig-1. Data are transmitted from nodes to base station through single hop or multi-hop communication and sink to user through internet [1, 2, 3].

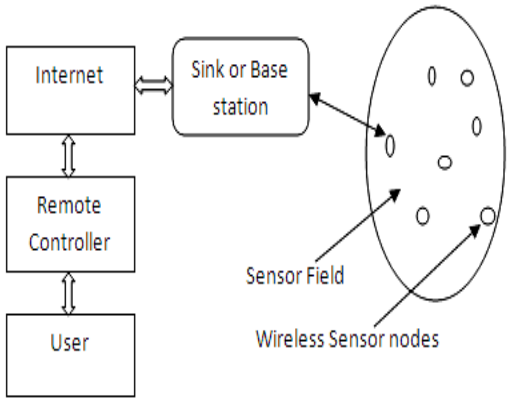

Fig 1. Architecture of WSN

Therefore, there are a vast number of applications of WSN like military related applications, Environment monitoring, medical and health, industries related applications, smart world, security and emergencies etc [4]. In many situations, the sensor nodes in WSNs are usually powered by tiny batteries with limited energy and recharging or replacement of them is difficult. Therefore, increasing energy efficiency of WSNs and improving lifetimes are great importance [5, 6, 7].

II. BLOCK DIAGRAM OF NODE

A wireless sensor node is fabricated with four basic parts: 1. Sensing unit [i] Sensors [ii] Analog-to-Digital Converter (ADC) 2. Processing unit 3. Transceiver unit 4. Power unit [1, 3]

The Sensor generates an analog signal and it is converted into a digital signal by ADC and then delivers into the processing unit. The processing unit is small storage units that handles the operation and make the node communicate with other nodes to accomplish the assigned sensing tasks [8]. The transceiver unit is to connect the node to the network and main work of sensor node is to detect the events, complete data processing and transmit the information [3].

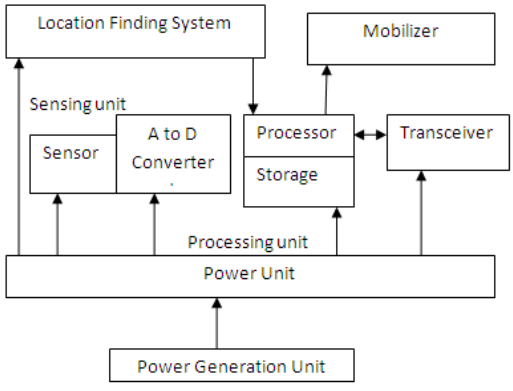

Fig 2. Block Diagram of node

ISBN: 978-1-5386-4119-4/18/$31.00 ©2018 IEEE

Hence Power consumption is split into three parts: - (i) Sensing (ii) Communication (iii) Data processing.

III. OBESRVATION OF PHYSICAL PARAMETERS THROUGH WSN

In figure -3 shows that there are four nodes and a Gateway (Base station). Sensor nodes sense physical parameters of an environment and a lot of applications. Sensor node senses physical parameters from the environment and send to PC through the Gateway (Base station).

Fig 3. Four sensor nodes and Gateway of Wireless Sensor Network

Id	voltage	humid	humtemp	prtemp	press	lightc
7092	3.02V	44.7%	29.78C	28.96C	975.51mbar	202.17Lux
7069	2.95V	44.29%	30.01C	29.42C	973.68mbar	235.29Lux
9	2.97V	43.88%	30.02C	29.42C	975.86mbar	161.42Lux
7123	2.95V	44.71%	29.26C	28.68C	974.84mbar	194.81Lux

Fig 4. Measurement of Physical Parameter humidity, pressure, temperature and light intensity from sensor nodes

In figure-4 shows that Sensor nodes sense physical parameters humidity, temperature, light intensity, pressure etc. from the environment and through Gateway display the measure value of humidity, temperature, light intensity, pressure etc. on PC.

In fig-5 shows that topology of WSN. In this topology all the nodes connect to Gateway through single hop communication.

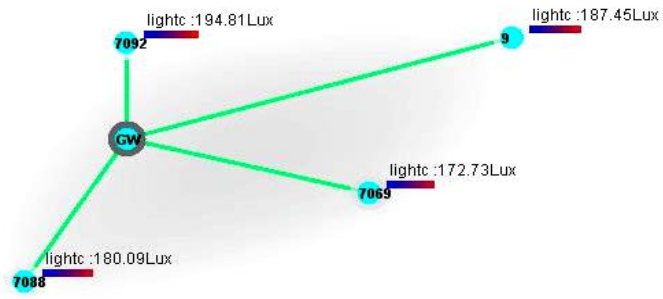

Fig 5. Topology of WSN having four nodes and a Gateway

IV. DESIGN CHALLENGES OF WSNs

A. Power Consumption

Power management is a major problem in sensor networks. Therefore, it is very necessary to design of power aware algorithms and protocols for WSN [8].

B. Production cost

In order to make WSN feasible the cost of a node should be less. Due to this the cost of node will be a very challenging issue [8].

C. Hardware design

Hardware of WSN should be energy-efficient. So micro-controller, power control and communication unit in sensor network should be designed to consume less energy [5].

D. Computational power and memory size

Every node stores the information separately and sometimes more than one node saved same information and transferred it to the sink that wastes the power and storing capacity of nodes [9]. So effective schemes are necessary to decrease the redundancy in the WSN.

E. Security

Security is a very essential issue in WSN. So it is difficult to identify whether the information is authenticated or not [10].

F. Operating environment

Sensor nodes may work very challenging environment. These nodes may work at the bottom of an ocean, in a home or large building, vehicle traffic management etc [10].

V. WIRELESS SENSOR NETWORKS TOPOLOGIES

A. POINT TO POINT TOPOLOGY

In this topology, a central hub is not required. A sensor node can directly communicate with other nodes. This is a very popular topology and has a single channel. Every device can be used as a client and a server [11].

B. STAR NETWROK TOPOLOGY

Unlike point to point topology, a centralized communication hub is required in a star network. In this topology, there is no direct communication between the nodes; every communication is accomplished through the centralized hub [8].

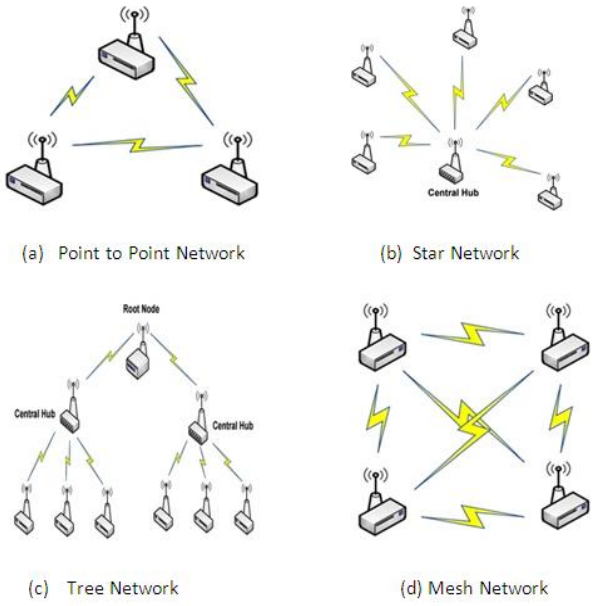

Fig 6. Topology of WSN

C. TREE TOPOLOGY

This topology is a combination of point to point network and star network topologies. The central hub is known as the parent node. 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 [11]

D. MESH TOPOLOGY

In the mesh topology, the data can transfer from one node to another. All the nodes can directly communicate with each other without using a central communication hub. Mesh topology is the most reliable network topology. But this topology is complex and consumes a lot of power [8].

VI. TYPES OF WSN

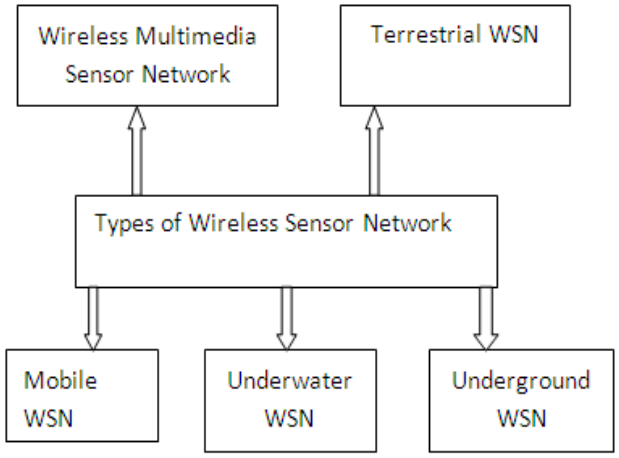

Fig 7. Types of WSN

A. *Mobile Wireless Sensor Networks (MWSNs)*

MWSNs have mobile sensor nodes, whereas generally used WSN have static sensor nodes. MWSNs have more adaptability than the static WSNs because Mobile WSNs can be set up for any situation and they can operate with sudden topology changes [12].

A static WSN can face the following issues

.

1. The Connectivity of the entire network and full coverage of the sensing field could not feasible in WSN like on account of aircrafts or robots for hostile region.
2. For tracking applications, the network requires larger nodes to cover the whole area that basically the cost of the network is expanded.
3. For a few applications, there is a requirement of few sophisticated sensor nodes for performing some particular military tasks that may require a camera with every node in picture collection that is not practical to equip every node with separate camera.

By Presenting MWSNs, all the listed issues can be solved and many other issues can be covered. We can upgrade the adaptability and capability of WSN by using mobile sensor nodes [12].

B. *Underwater Wireless Sensor Networks (UWSNs)*

Underwater wireless communication is one of the biggest challenges in building Underwater WSN. It has been seen that radio frequencies and acoustic waves (having small bandwidth) are attenuated and changed in water. Optical communication is the best solution for short distance communication in water. If optical communications in green/blue wavelengths are used as compared to acoustic communication for short distances then they provide high bandwidth and faster propagation in water. In the all types WSN, under water wireless sensor network is an emerging research area. Most of the UWSN can be used for Seismic, monitoring and security applications. UWSN applications also include for unmanned submarines and attack purposes. There are still so many challenges in UWSN like security, power consumption, installation and communication between UWSNs.

C. Underground wireless sensor networks(UWSNs)

UWSNs are used to monitor several underground conditions like soil composition and soil moisture etc, therefore whole network is underground, but transmit information to a base station that is above the ground.

D. Wireless Multimedia Sensor Networks(WMSNs)

Different applications of WMSNs include traffic management, weather monitoring etc involves effective communication in multimedia form i.e. audio, video and image. WMSNs require more resources like high bandwidth and high power consumption. In WMSNs needs advance techniques of data compression and transmission.

E. Terrestrial wireless sensor networks(TWSNs)

Terrestrial WSNs contains hundreds of nodes that are placed in a geographical area. Nodes are above the ground in the terrestrial sensor networks. Therefore, solar cells can be used in the terrestrial sensor network. The energy can be saved by reducing delays, operating low duty cycles etc. Free space optical (FSO) is used as a basic communication medium in FSO / RF systems, whereas radio frequency (RF) links are used as backup where LOS communication are not present for optical communication. FSO links give low communication energy in wireless sensor network

.

The main attribute of WSNs are self-healing, scalability, self-organization, energy efficiency, adequate degree of connectivity among nodes, low Cost, low-complexity. WSNs are not a particular case of wireless ad hoc networks. Wireless ad hoc networks are designed dynamically through an autonomous structure of nodes connected by wireless links without utilizing an existing network infrastructure. In ad hoc network, Sensor nodes are linked by ad hoc topologies, and cleared according to customer requirements and temporary situations.

Therefore, extreme care is used when using algorithms and protocols that are good for ad hoc networks, and applying them in the WSNs [13].

VII. COMPARISON STUDY OF DIFFERENT TYPES OF WSNs

Mobile WSNs	**Under Water WSNs**	**Underground WSNs**	**Multimedia WSNs**	**Terrestrial WSNs**
The advantages of MWSN as compared to the static sensor networks include better coverage, better energy efficiency, and better channel capacity and so on.	Under water WSNs can be used for security applications and seismic monitoring. Due to more than 70% of the world is occupied with water, thus Underwater WSNs is very necessary. The problem of energy saving for underwater WSNs involves the growth of underwater wireless communication and networking schemes.	The underground WSNs are more costly than the terrestrial WSNs in terms of maintenance, deployment, and equipment cost considerations. The underground environment forms wireless communication a challenge due to high level of signal loss and attenuation.	These sensor nodes are connected with each other through a wireless communication. The multimedia WSN include, high bandwidth requirements, high energy consumption, data compressing and processing techniques.	Terrestrial WSNs are able to communicating base stations effectively, and consist of hundreds of nodes deployed on earth. Due to limited power, the battery is outfitted with solar cells seeing that a secondary power source.

VIII. CONCLUSION

Communication networks are converted from wired to wireless rapidly. However in wireless networks, WSNs is emerging day by day and hot area of research. In this article we have seen there are several applications of WSN.The paper started with a concise survey of WSN architecture, applications and challenges. Afterward, the paper describes the various types and topology of wireless sensor network. This article enhances the base for this rising field and after it; we will choose a particular issue in WSN and work for an efficient approach.

REFERENCES

[1] Ian F. Akyildiz, Weilian Su, Yogesh Sankarasubramaniam, and Erdal Cayirci, “A Survey on Sensor Networks” 0163-6804/02/$17.00 © 2002 IEEE

[2] Mohd Fauzi Othman, Khairunnisa Shazali, “Wireless Sensor Network Applications: A Study in Environment Monitoring System” International S ymposium on Robotics and Intelligent Sensors 2012

[3] Vibhav Kumar Sachan, Syed Akhtar Imam & M. T. Beg, “Energy-efficient Communication Methods in Wireless Sensor Networks”

International Journal of Computer Applications (0975 – 8887) Volume 39– No.17, February 2012

[4] Halil Yetgin, Kent Tsz Kan Cheung, Mohammed El-Hajjar "A Survey of Network Lifetime Maximization Techniques in Wireless Sensor Networks" IEEE communication & tutorials ,vol. 19 ,no 2 second quarter 2017

[5] Krati Varshney, Manish Kumar Singh, Vibhav Kumar Sachan, Syed Akhtar Imam, "Energy Efficient Data Transmission Scheme for Wireless Sensor Network using DSC-MIMO" International Journal of Computer Applications (0975 – 8887) Volume 167 – No.6, June 2017

[6] Syed Akhtar Imam, Manish Kumar Singh and Vibhav kumar Sachan , "Energy efficient wireless sensor network using DSC-MIMO" Journal of Engineering Technology (ISSN: 0747-9964) Volume 6, Issue 2, July, 2017, PP.268-277

[7] Syed Akhtar Imam, Amit Choudhary, Aijaz Mehdi Zaidi, Manish Kumar Singh, Vibhav Kumar Sachan, "Cooperative Effort Based Wireless Sensor Network Clustering Algorithm for Smart Home Application" Integrated Circuits and Microsystems 2nd IEEE International Conference on, Nanjing, China , 2017

[8] Luís M. Borges, Fernando J. Velez and António S. Lebres, "Survey on the Characterization and Classification of Wireless Sensor Network Applications" IEEE Communication surveys & tutorial,Vol.16, No. 4,Fourth Quarter 2014

[9] Syed Akhtar Imam, Manish Kumar Singh, Vibhav Kumar Sachan, Amit Choudhary, Aijaz Mehdi Zaidi, "An energy-efficient data transmission scheme based on DSC-MIMO for wireless sensor network" Integrated Circuits and Microsystems 2nd IEEE International Conference on, Nanjing, China , 2017

[10] Ajay Jangra , swati,Richa & Priyanka "Wireless Sensor Network (WSN): Architectural Design issues and Challenges" IJCSE Vol. 02, No. 09, 2010, 3089-309

[11] Mr. Puneet Garg, Mr. Kuntal Saroha, Mrs. Ruchika Lochab, "Review of Wireless Sensor Networks- Architecture and Applications" International Journal of Computer Science & Management Studies, Vol. 11, Issue 01, May 2011"

[12] Muhammad Umar Aftab, Omair Ashraf, Muhammad Irfan, Muhammad Majid, Amna Nisar, Muhammad Asif Habib, "A Review Study of Wireless Sensor Networks and Its Security" Communications and Network, 2015, 7, 172-179

[13] Chiara Buratti , Andrea Conti , Davide Dardari and Roberto Verdone , "An Overview onWireless Sensor Networks Technology and Evolution" *Sensors* 2009, *9*, 6869-6896; doi:10.3390/s90906869