Research on Technology Used in Wireless Sensor Networks

Ratnesh Yadav[1], Namit Gupta[2]

[1]*MCA, Teerthanker Mahaveer University, Moradabad*

[2]*Assistant Professor, Teerthanker Mahaveer University, Moradabad*

[1]ratneshy37 @gmail.com

[2]namit.k.gupta@gmail.com

Abstract - **A wireless sensor network (WSN) becomes an emerging research area in wireless and distributed networks. Wireless sensor network (WSN) is combination of large number of small and cheap devices known as sensor nodes. The sensor nodes are capable of sensing, actuating, and controlling the collected information. The sensor nodes intract together by many wireless strategies and these communication strategies are administered by routing protocols. Performance of sensor networks largely depends on the some factors. It has important applications such as remote environmental monitoring and target tracking. This has been enabled by the availability, particularly in recent years, of sensors that are smaller, cheaper, and intelligent. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network. The design of a WSN depends significantly on the application, and it must consider factors such as the environment, the application's design objectives, cost, hardware, and system constraints. The goal of survey is to present a comprehensive review of the recent literature in wireless sensor network. This paper reviews the major development and new research challenges in this area.**

Keywords— **WSN, Sensor networks, Sensor Nodes, Distributed Networks**

I. INTRODUCTION

Wireless sensor networks are getting more attention now a days because they are low cost solutions to various real-world challenges.

WSANs provide an efficient, economic approach for the deployment of distributed monitor and control devices, avoiding the expensive sub devices in wired systems.
A wireless sensor and actuator network is a combination of small devices which provides three necessary functions; the ability to monitor physical and environmental conditions, often in real time, such as temperature, pressure, light and humidity; the ability to operate devices such as switches, motors or actuators that control those conditions; and the ability to provide efficient, reliable communications via a wireless network.

II. WIRELESS SENSOR NETWORKS

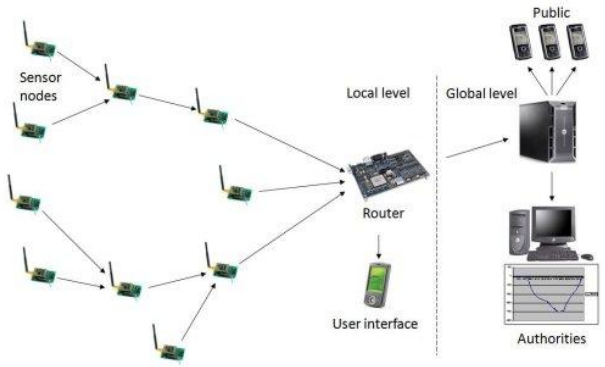
A WSN can be defined as a network of devices, denoted as nodes, which can sense the environment and communicate the information gathered from the monitored field through wireless links .

WSANs are basically self-healing and self-organizing. Self-healing networks allow nodes to reconfigure their link associations and find alternative pathways around failed or powered-down nodes. Self-organizing networks allow a new node to automatically join the network without the need for manual intervention.

WSNs has good functions of data collection, transmission, and processing. It has more benefits over a advantages over a traditional wired network, eg. low cost, , low power dissipation, convenient organizing network, small influence to environment, etc.

Now a days wireless communication technology has been used widely, especially Bluetooth, wireless local area network (WLAN), infrared, etc.

WSNs also have some drawbacks, eg: large power dissipation, complexity, short distance, networking in small scale. A new type of wireless net technology-Zigbee emerges as the times require, in order to satisfy the demand of low power dissipation and low speed among wireless communication devices.



III. WIRELESS SENSOR NETWORK ARCHITECTURE

WSN architecture follows the OSI architecture Model. The architecture of the WSN includes five layers and three cross layers. Generally in sensor networks we require five layers, namely application, transport, network, data link & physical layer. These layers of the WSN are used to establish the network and make the sensors work together in order to raise the complete efficiency of the network.

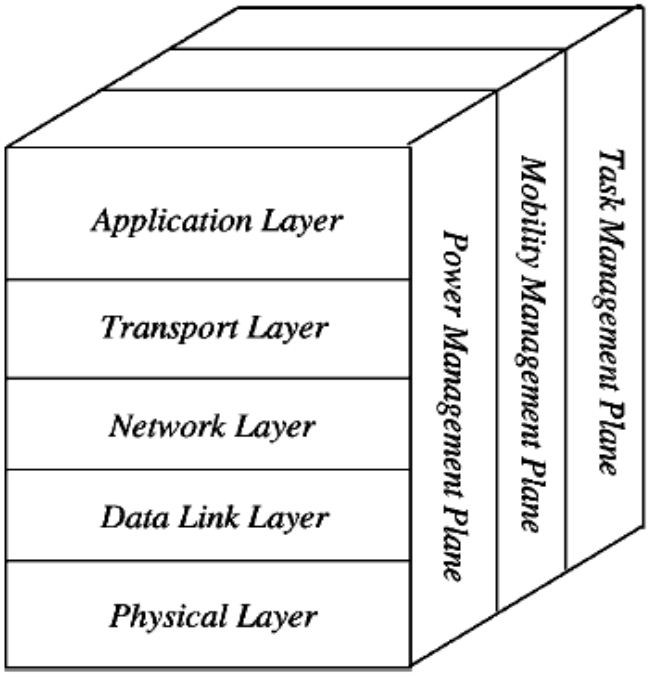


FIG: Wireless Sensor Network Architecture

A. Application Layer

The application layer is responcible for traffic management and offers software for numerous applications that convert the data in a clear form to find positive information. Sensor networks arranged in numerous applications in different fields such as agricultural, military, environment, medical, etc.

B. Transport Layer

The transport layer is exactly needed when a system is planned to contact other networks.

Transport layer is used to deliver congestion avoidance and reliability where a lot of protocols intended to offer this function are either practical on the upstream. These protocols use dissimilar mechanisms for loss recognition and loss recovery.

TCP is not fit for WSN because Providing a reliable loss recovery is more energy efficient.

C. Network Layer

Network layer is used for routing, it has a lot of tasks based on the application, but actually, the main tasks are in the power conserving, partial memory, buffers, and sensor don't have a universal ID and have to be self-organized.

D. Data Link Layer

The data link layer is responsible for multiplexing data frame detection, data streams, MAC, & error control, confirm the reliability of point–point (or) point– multipoint.

E. Physical Layer

The physical layer provides an edge for transferring a stream of bits above physical medium. This layer is responsible for the selection of frequency, generation of a carrier frequency, signal detection, Modulation & data encryption.

IV. CHARACTERISTICS OF WIRELESS SENSOR NETWORK

The characteristics of WSN include the following.

- The consumption of Power limits for nodes with batteries
- Capacity to handle with node failures
- Some of the mobility of nodes and Heterogeneity of nodes

- Scalability to large scale of distribution
- Capability to ensure strict environmental conditions

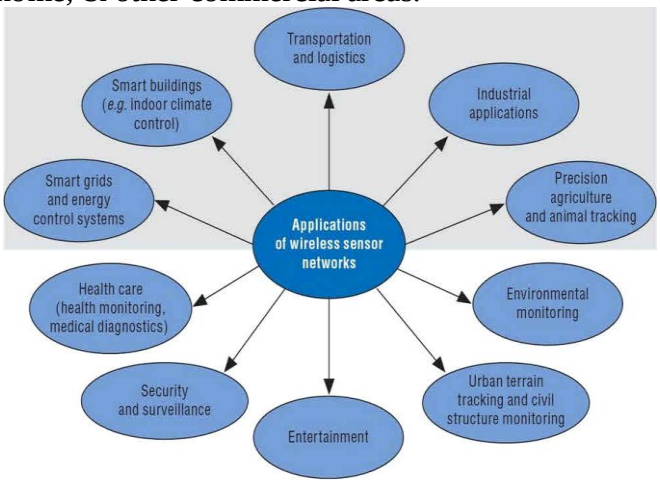
V. ADVANTAGES OF WIRELESS SENSOR NETWORKS

The WSN include the following advantages;

- Network arrangements can be carried out without immovable infrastructure.
- Apt for the non-reachable places like mountains, over the sea, rural areas and deep forests.
- Flexible if there is a casual situation when an additional workstation is required.
- Execution pricing is inexpensive.
- It avoids plenty of wiring.
- It might provide accommodations for the new devices at any time.
- It can be opened by using a centralized monitoring.

VI. WIRELESS SENSOR NETWORK APPLICATIONS

The applications of wireless sensor network mainly include health, military, environmental, home, & other commercial areas.



WSN Application

- Environmental/Earth sensings
- Air pollution monitoring
- Industrial monitoring
- Environmental Applications
- Home Applications
- Commercial Applications
- Military Applications
- Health Applications
- Area monitoring
- Health care monitoring
- Forest fire detection
- Landslide detection
- Water quality monitoring

VII. ZIGBEE TECHNOLOGY

ZigBee is the product from Zigbee alliance.Zigbee communication is specially built for control and sensor networks on IEEE 802.15.4 standard for wireless personal area networks (WPANs). It defines physical and Media Access Control (MAC) layers to handle many devices at low-data rates.

Zigbee is low-cost and low-powered mesh network widely deployed for controlling and monitoring applications where it covers 10-100 meters within the range. This communication system is in-expensive and simpler than the other proprietary short-range wireless sensor network as Bluetooth and Wi-Fi.

Zigbee supports different network configurations for master to master or master to slave communications. And also, it can be operated in different modes as a result the battery power is conserved. Zigbee networks are extendable with the use of routers and allow many nodes to interconnect with each other for building a wider area network.

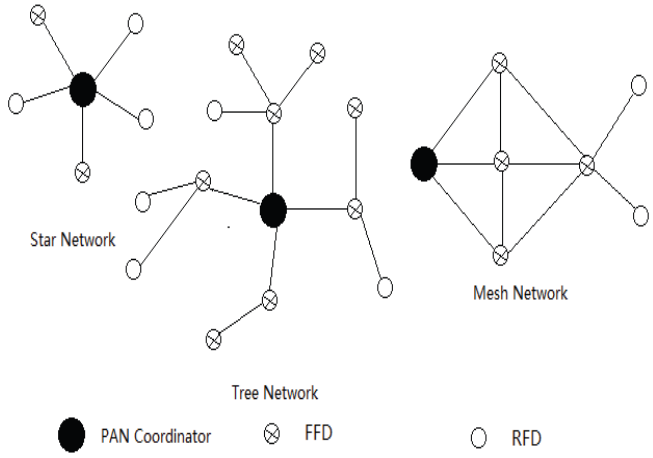
ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. It is Open standard protocol with no or negligible licensing fees, chipsets available from multiple sources, remotely upgraded firmware, fully wireless and low power, mesh networking to operate on batteries, low maintenance and larger network size with standard based high security

VIII. ZIGBEE ARCHITECTURE

Zigbee system structure consists of three different types of devices such as Zigbee coordinator, Router and End device. Every Zigbee network must consist of at least one coordinator which acts as a root and bridge of the network. The coordinator is responsible for handling and storing

the information while performing receiving and transmitting data operations.

Zigbee routers act as intermediary devices that permit data to pass to and fro through them to other devices. End devices have limited functionality to communicate with the parent nodes such that the battery power is saved as shown in the figure. The number of routers, coordinators and end devices depends on the type of network such as star, tree and mesh networks.



The architecture of Zigbee network.

ZigBee techonology is used in the wireless sensor networks. It is a typical wireless communication technology.ZigBee uses low rate, low-power digital radios based on an IEEE 802 standard for personal area networks. The technology defined by the ZigBee specification is intended to be simpler and low cost as compare to other WPANs (Wireless personal area network), such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

IX. Applications of Zigbee Technology

Industrial Automation*:* In manufacturing and production industries, a communication link continually monitors various parameters and critical equipments. Hence Zigbee considerably reduce this communication cost as well as optimizes the control process for greater reliability.

Home Automation: Zigbee is perfectly suited for controlling home appliances remotely as a lighting system control, appliance control, heating and cooling system control, safety equipment operations and control, surveillance, and so on.

***Smart Metering*:** Zigbee remote operations in smart metering include energy consumption response, pricing support, security over power theft, etc.

Smart Grid monitoring*:* Zigbee operations in this smart grid involve remote temperature monitoring, fault locating, reactive power management, and so on.

This is all about a brief description of Zigbee technology's architecture, operations modes, configurations and applications. We hope that we have given you enough content on this title, for you to understand it better. We are pioneers in developing Zigbee based projects. For further help and technical assistance, you can contact us by commenting below.

X. Characteristic of ZigBee

Some Characteristics of ZigBee are given as:

- ZigBee is created by ZigBee alliance
- ZigBee offers full Wireless mesh networking
- ZigBee absorbs low power for all classes of devices
- ZigBee supports approximately 65,000 devices on one network
- Designed to connect the very large range of devices in an industry into a single network.
- ZigBee adds network layer, security layers and an application framework to enhance the IEEE 802.15.4 standard.
- ZigBee operates globally in 2.4 GHz band of frequency as per IEEE 802.15.4.
- It has regional operation in 915MHz (Americans) & 868 MHz (Europe) bands.
- ZigBee has various transmission options like broadcast.
- It has security key generation mechanism and it uses the AES-128 security scheme.
- It supports alliance standards like public application profiles or manufacturer application profiles.

XI. Research Challenges

1) ***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.

2) ***Hardware Cost:*** One of the main challenges is to produce low cost and tiny sensor nodes. Current sensor nodes are mainly prototypes with respect to these objectives. Low cost of sensor nodes can be achieved by recent and future progress in the fields of MEMS.

3) ***Security*****:** Security is one of the major challenges in WSNs. 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.

4) ***Power:*** Power is always been a challenge for WSNs designs. One of the ways to prolong the network lifetime is to design the energy efficient algorithms and hardware that uses power intelligently.

5) ***Real World Protocols:*** protocols need to be developed for real world problems considering the theoretical concepts and synthesizing novel solutions into a complete system wide protocol for real world application.

6) ***Analytical and Practical Results:*** Till date very few analytical results exists for WSNs. All new applications only get confidence when it is tested & analyzed practically and results are compared with existing schemes.

XII. CONCLUSION

This paper surveys the application areas where WSNs have been deployed such as military sensing, traffic surveillance, target tracking, environment monitoring, and healthcare monitoring. These application areas are being researched by various people across the industry and academic institutions.

The main focus of this paper presentation is to discuss some of the relevant issues of WSNs, from the application, design and technology viewpoints. For designing a WSN, we need to define the most reliable technology to be used and the communication protocols to be implemented (signal, topology, processing strategies, etc.). These choices depend on different factors, above all the application requirement.

REFERENCES

[1] Akyildiz, I.; Su, W.; Sankarasubramaniam, Y.; Cayirci, E. A survey on sensor networks. *IEEE Commun. Mag.* 2002, *40*, 102–114.
[2] Tubaishat, M.; Madria, S. Sensor networks: an overview. *IEEE Potentials* 2003, *22*, 20–30.
[3] Hac, A. *Wireless Sensor Network Designs*. John Wiley & Sons Ltd: Etobicoke, Ontario, Canada, 2003.*Sensors* 2009, *9* 6894
[4] Raghavendra, C.; Sivalingam, K.; Znati, T. *Wireless Sensor Networks*. Springer: New York, NY,USA, 2004.
[5] 5. Sohrabi, K.; Gao, J.; Ailawadhi, V.; Pottie, G. Protocols for self-organization of a wireless sensor
[6] network. *IEEE Personal Commun.* 2000, *7*, 16–27.
[7] Culler, D.; Estrin, D.; Srivastava, M. Overview of sensor networks. *IEEE Comput.* 2004, *37*, 41–49.
[8] Rajaravivarma, V.; Yang, Y.; Yang, T. An Overview of Wireless Sensor Network and Applications.
[9] In *Proceedings of 35th Southeastern Symposium on System Theory*, Morgantown, WV, USA, 2003;pp. 432–436.
[10] Verdone, R.; Dardari, D.; Mazzini, G.; Conti, A. *Wireless Sensor and Actuator Networks*; Elsevier:London, UK, 2008.
[11] Verdone, R. Wireless Sensor Networks. In *Proceedings of the 5th European Conference*, Bologna,Italy, 2008.
[12] Culler, D.; Estrin, D.; Srivastava, M. Overview of sensor networks. *IEEE Comput. Mag.* 2004,*37*, 41–49.