Wireless Sensor Networks and its Applications in Real Life

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Abstract— Currently, Wireless Sensor Network is the most standard services employed in commercial and industrial applications, because of its technical development in a processor, communication, and low-power usage of embedded computing devices. With the advancements in wireless technology and digital electronics, some tiny devices have started to be used in numerous areas in daily life. The WSN is built with nodes that are used to observe the surroundings like temperature, humidity, pressure, position, vibration, sound etc. These nodes can be used in various real-time applications to perform various tasks like smart detecting, a discovery of neighbor node, data processing and storage, data collection, target tracking, monitor and controlling etc. This paper presents detailed overview of WSNs and also assesses the technology and characteristics of WSNs and its applications.

Key words: Wireless Sensor Networks, WSNs Design, Network Topologies, OSI Model Layers, Sensor Nodes

I. INTRODUCTION

Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analysed.

A Wireless Sensor Network is one kind of wireless network includes a large number of circulating, self-directed, minute, low powered devices named sensor nodes called motes.

These networks certainly cover a huge number of spatially distributed, little, battery-operated, embedded devices that are networked to caringly collect, process, and transfer data to the operators, and it has controlled the capabilities of computing & processing. Nodes are the tiny computers, which work jointly to form the networks.

A WSNs can be defined as a network of devices that can communicate the information gathered from a monitored field through wireless links. The data is forwarded through multiple nodes, and with a gateway, the data is connected to other networks like wireless Ethernet (see fig. 1).

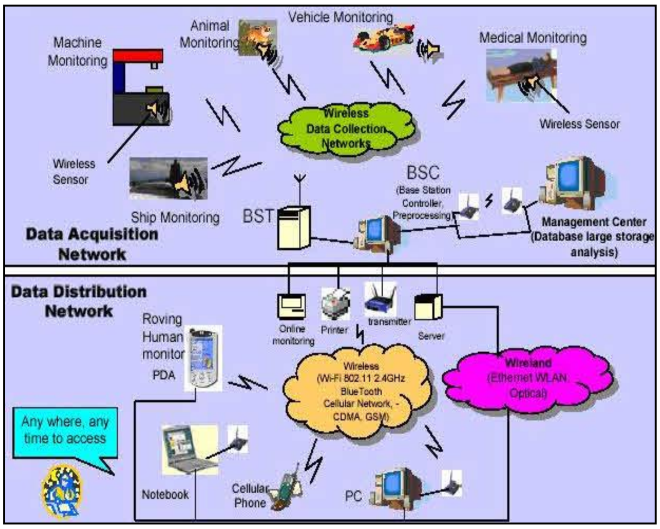

Fig. 1: Wireless Sensor Network Architecture

II. HOW IT WORKS?

There are many ways to implement a WSN. Typically they consist of small nodes with a low-power microprocessor, like an MSP430, and an on-board low-power wireless 802.15.4 radio -- such as a CC2430. The microprocessor is typically imaged with some kind of OS that is either Zigbee, TinyOS, or Contiki based. The last two are academic, open-source OS's that you could use on your wireless node.

WSN consist of several sensor nodes deployed at an area of concern. These sensor nodes are capable of sensing essential parameters such as temperature, pressure, humidity in the environment, soil quality, luminosity and various other essential data. Along with sensing the parameters these sensor nodes can also communicate with other sensor nodes thus forming a network.

Sensor nodes which are specially designed in such a typical way that they have a microcontroller which controls the monitoring, a radio transceiver for generating radio waves, different type of wireless communicating devices and also equipped with an energy source such as battery.

The sensor nodes are placed in a connected network according to a certain topology such as linear, star and mesh topology.

III. WIRELESS SENSOR NETWORK ARCHITECTURE

The most common WSN architecture follows the OSI architecture Model. The architecture of the WSN includes five layers and three cross layers. Mostly in sensor n/w we require five layers, namely application, transport, n/w, data link & physical layer.

These layers of the WSN are used to accomplish the n/w and make the sensors work together in order to raise the complete efficiency of the network (see fig. 2).

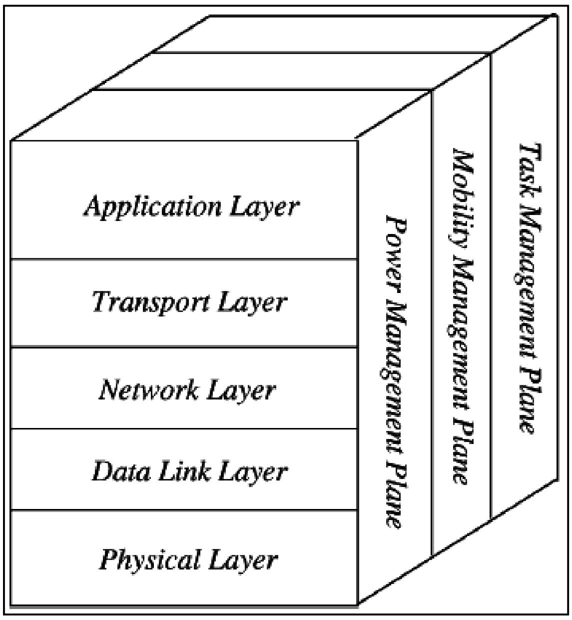

Fig. 2: Wireless Sensor Network protocol stack[3]

A. *Application Layer:*

The application layer is liable 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 function of the transport layer is to deliver congestion avoidance and reliability where a lot of protocols intended to offer this function are either practical on the upstream.

Providing a reliable loss recovery is more energy efficient and that is one of the main reasons why TCP is not fit for WSN. In general, Transport layers can be separated into Packet driven, Event driven.

C. *Network Layer:*

The main function of the network layer is routing. 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 liable 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.

In addition, the power, mobility, and task management planes monitor the power, movement, and task distribution among the sensor nodes (see fig. 2).

These planes help the sensor nodes coordinate the sensing task and lower the overall energy consumption.

IV. WIRELESS SENSOR NETWORK DESIGN

A. *Reliability:*

The ability or a sensor node to maintain the sensor network functionalities without any interruption caused due to sensor node failures can be considered as a measure of its reliability [3].

B. *Density in WSN:*

The density of the wireless sensor nodes affects the level of reliability, accuracy and data processing algorithms.

C. *Sensor Network Topology:*

The network topology has a tendency to affect the latency and capacity as well as robustness of the network.

D. *Energy Consumption:*

The wireless sensor that is remotely deployed is usually battery operated.Thus the life time of the sensor node is highly dependent on the battery life time.

E. *Hardware Constraints:*

The wireless sensor node consists of four main components.This includes a sensing unit, processing unit, transmission unit and a power unit.

F. *Security:*

There are several threats to a wireless sensor network. They include passive information gathering, node outage, supervision of a node, false node, node malfunction, message corruption, denial of service, etc.

G. *Quality of Services:*

The requirements of each wireless sensor varies depending up on the reason it has been implemented. There are subtle differences between quality of service and energy consumption in each implantation.

V. APPLICATIONS

WSNs were initially designed to facilitate military operations but its application has since been extended to health, traffic, and many other consumer and industrial areas.

A. *Military Applicants:*

Wireless sensor networks be likely an integral part of military command, control, communications, computing, intelligence, battlefield surveillance, reconnaissance and targeting systems [2].

B. *Area Monitoring:*

In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored. When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action [2].

C. *Transportation:*

Real-time traffic information is being collected by WSNs to later feed transportation models and alert drivers of congestion and traffic problems [2].

D. Health Applications:

Some of the health applications for sensor networks are supporting interfaces for the disabled, integrated patient monitoring, diagnostics, and drug administration in hospitals, tele-monitoring of human physiological data, and tracking & monitoring doctors or patients inside a hospital [2].

E. Environmental Sensing:

The term Environmental Sensor Networks has developed to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc[4].

F. Structural Monitoring:

Wireless sensors can be utilized to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc enabling Engineering practices to monitor assets remotely without the need for costly site visits[2].

G. Agriculture Sector:

Using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Irrigation automation enables more efficient water use and reduces waste[4].

VI. FUTURE SCOPE

The advances of wireless networking and sensor technology open up an interesting opportunity to manage human activities in a smart home environment [2].

Future work will focus on the fundamental problem of recognizing activities of multiple users using a wireless body sensor network.We believe that in near future, WSN research will put a great impact on our daily life. For example, it will create a system for continual observation of physiological signals while the patients are at their homes.

It will lower the cost involved with monitoring patients and increase the efficient exploitation of physiological data and the patients will have access to the highest quality medical care in their own homes.

VII. CONCLUSION

The aim of this paper is to discuss few important issues of WSNs, from the application, design and technology points of view. For designing a WSN, we need to consider different factors such as the flexibility, energy efficiency, fault tolerance, high sensing fidelity, low-cost and rapid deployment, above all the application requirements[2]. We hope the wide range of application areas will make sensor networks an integral part of our lives in the future.

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