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Improving the Quality of Life with WBAN/WBSN's in this Pandemic – A Survey

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Abstract: *Wireless Body Area Networks (WBANs) have gained immense popularity among researchers and this field has also touched the health sector. In this paper we have analyzed the various methods that are used to ensure the QoS in body nodes in WBANs. Wireless Body Area Network (WBAN) is a replacement technology that can be used to incorporate these devices & thereby provide health monitoring applications in healthcare. These networks have a wide variety of applications. Various technical problems in these application areas are being resolved by researchers across the world. These sensing component networks play a significant role in healthcare. These networks have deep roots in various sectors viz; engineering, medicine& science & can show good performance even in harsh climatic conditions. Therefore, this paper provides an associated degree of exposure for the analysis and applications of wireless body area networks (WBAN's), and body sensor networks (BSN's).*

Keywords: Wireless Body Area Networks (WBANs), Body Nodes, Quality of Service (QoS), Wireless sensor network (WSN), Network.

1. INTRODUCTION

Wireless sensor network (WSN) is widely considered as one of the most important technologies for the twenty-first century. In the past decades, it has received tremendous attention from both academia and industry all over the world. A WSN typically consists of a large number of low-cost, low-power, and multifunctional wireless sensor nodes, with sensing, wireless communications and computation capabilities. These sensor nodes communicate over short distance via a wireless medium and collaborate to accomplish a common task. The basic philosophy behind WSNs is that, while the capability of each individual sensor node is limited, the aggregate power of the entire network is sufficient for the required mission. In many WSN [10] applications, the deployment of sensor nodes is performed in an ad hoc fashion without careful planning and engineering. Once deployed, the sensor nodes must be able to autonomously organize themselves into a wireless communication network. Sensor nodes are battery-powered and are expected to operate without attendance for a relatively long period of time. In most cases it is very difficult and even impossible to change or recharge batteries for the sensor nodes. WSNs are characterized with denser levels of sensor node deployment, higher unreliability of sensor nodes, and sever power, computation, and memory constraints. Thus, the unique characteristics and constraints present many new challenges for the development and application of WSNs. Due to the severe energy constraints of large number of densely deployed sensor nodes, it requires a suite of network protocols to implement various network control and management functions such as synchronization, node localization, and network security. The traditional routing protocols have several shortcomings when applied to WSNs, which are mainly due to the energy-constrained nature of such networks. A large number of research activities have been carried out to explore and overcome the constraints of WSNs and solve design and application issues.

2. NETWORK CHARACTERISTICS AND DESIGN OBJECTIVES

The characteristics of sensor networks and application requirements have a decisive impact on the network design objectives in term of network capabilities and network performance.

Network Characteristics

As compared to the traditional wireless communication networks such as mobile ad hoc network (MANET) and cellular systems, wireless sensor networks have the following unique characteristics and constraints:

Dense sensor node deployment: Sensor nodes are usually densely deployed and can be several orders of magnitude higher than that in a MANET.

Battery-powered sensor nodes: Sensor nodes are usually powered by battery and are deployed in a harsh environment where it is very difficult to change or recharge the batteries.

Severe energy, computation, and storage constraints: Sensors nodes are having highly limited energy, computation, and storage capabilities.

Self-configurable: Sensor nodes are usually randomly deployed and autonomously configure themselves into a communication network.

Unreliable sensor nodes: Since sensor nodes are prone to physical damages or failures due to its deployment in harsh or hostile environment.

Data redundancy: In most sensor network application, sensor nodes are densely deployed in a region of interest and collaborate to accomplish a common sensing task. Thus, the data sensed by multiple sensor nodes typically have a certain level of correlation or redundancy.

Application specific: A sensor network is usually designed and deployed for a specific application. The design requirements of a sensor network change with its application.

Many-to-one traffic pattern: In most sensor network applications, the data sensed by sensor nodes flow from multiple source sensor nodes to a particular sink, exhibiting a many-to-one traffic pattern.

Frequent topology change: Network topology changes frequently due to the node failures, damage, addition, energy depletion, or channel fading.

Network Design Objectives

Most sensor networks are application specific and have different application requirements. Thus, all or part of the following main design objectives is considered in the design of sensor networks:

Small node size: Since sensor nodes are usually deployed in a harsh or hostile environment in large numbers, reducing node size can facilitate node deployment. It will also reduce the power consumption and cost of sensor nodes.

Low node cost: Since sensor nodes are usually deployed in a harsh or hostile environment in large numbers and cannot be reused, reducing cost of sensor nodes is important and will result into the cost reduction of whole network.

Low power consumption: Since sensor nodes are powered by battery and it is often very difficult or even impossible to charge or recharge their batteries, it is crucial to reduce the power consumption of sensor nodes so that the lifetime of the sensor nodes, as well as the whole network is prolonged.

Scalability: Since the number sensor nodes in sensor networks are in the order of tens, hundreds, or thousands, network protocols designed for sensor networks should be scalable to different network sizes.

Reliability: Network protocols designed for sensor networks must provide error control and correction mechanisms to ensure reliable data delivery over noisy, error-prone, and time-varying wireless channels.

Self-configurability: In sensor networks, once deployed, sensor nodes should be able to autonomously organize themselves into a communication network and reconfigure their connectivity in the event of topology changes and node failures.

Adaptability: In sensor networks, a node may fail, join, or move, which would result in changes in node density and network topology. Thus, network protocols designed for sensor networks should be adaptive to such density and topology changes.

Channel utilization: Since sensor networks have limited bandwidth resources, communication protocols designed for sensor networks should efficiently make use of the bandwidth to improve channel utilization.

Fault tolerance: Sensor nodes are prone to failures due to harsh deployment environments and unattended operations. Thus, sensor nodes should be fault tolerant and have the abilities of self-testing, self-calibrating, self-repairing, and self-recovering.

Security: A sensor network should introduce effective security mechanisms to prevent the data information in the network or a sensor node from unauthorized access or malicious attacks.

QoS support: In sensor networks, different applications may have different quality-of-service (QoS) requirements in terms of delivery latency and packet loss. Thus, network protocol design should consider the QoS requirements of specific applications.

3. WIRELESS SENSOR NETWORK APPLICATIONS

Wireless sensor networks may comprise of numerous different types of sensors like low sampling rate, seismic, magnetic, thermal, visual, infrared, radar, and acoustic, which are clever to monitor a wide range of ambient situations. Sensor nodes are used for constant sensing, event ID, event detection & local control of actuators. The applications of wireless sensor network mainly include health, military, environmental, home, & other commercial areas.

In this pandemic when even the doctors treating the Covid19 positive patients are being affected from the virus, the doctors can make use of wireless sensors networks with respect to health monitoring system that is Wireless Body Sensor Networks/Wireless Body Area Networks.

4. WIRELESS BODY SENSOR NETWORKS/WIRELESS BODY AREA NETWORKS

The Wireless Body Area Network (WBAN) [1-4] is creating a new milestone in managing the human health. With increasing ailing population at this pandemic the need to monitor the health of the patients has increased both inside the hospitals and outside also. This increasing demand has been met by breakthrough in the wireless technology that is there are sensor nodes and mobile electronic devices connected in the network forming WBANs. This functions by interacting with the medical aids and sensors. WBANs have diverse function, so QoS [5-6] ensure that the technology is tapped at its fullest and the challenges can also be overcome. The limited resources and the power needed to charge the sensors are some of the WBANs are facing at the present moment. The various QoS metrics for WBAN technology majorly focus on how to decrease the overall utilization of energy and maximize the life of the network along with the network throughput. It also aims to reduce the end to end delay and ensure more reliable communication with avoiding the collisions and congestion.

5. HOW WILL WBSN/WBAN HELP THE IN THIS PANDEMIC?

WBSN/WBANs [7] provide interface for medical specialty, remote monitoring of human physiological knowledge. Patients can be treated remotely. WBAN Provides healthcare application that offers immense contribution in improving patients healthcare and diagnosing and monitoring. Moreover, it provides medical rehabilitation and supervising of patients. Patients can now be examined at their homes while performing daily activities. They provide an extremely reliable infrastructure for medical devices, particularly those ingrained inside the body.

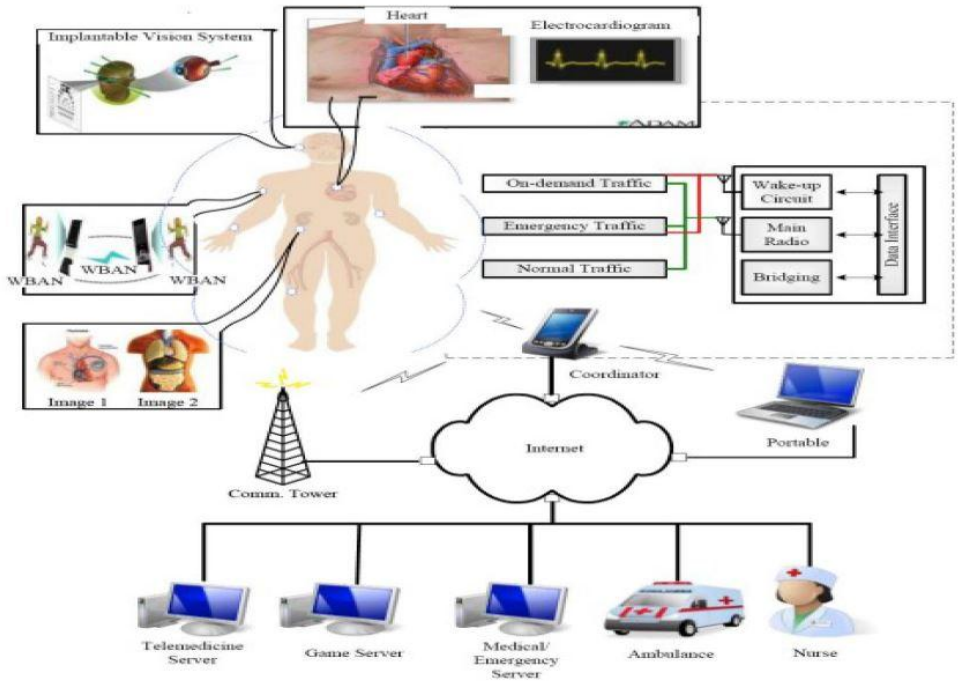

Figure-1 : A WBAN design for Healthcare

They consist of a variety of small sensors that may be fixed on the body as microchip, either beneath the skin or deeply embedded within the body tissues. This increases the capability of doctors to monitor the health of patients in a secure manner and this can reduce the spread of virus, thereby increasing the quality of life.

6. SECURITY OF WBAN

Before instigating encoding, the protection strategy should be considered. Wireless Body area Networks (WBAN) [9] are used to diagnose various diseases in patients .WBAN provides three levels of security viz level 1, level2 & level 3.Level 1 has no inbuilt mechanism for security. Level2 provides a mechanism for authentication only whereas level 3 provides a mechanism for encryption as well as authentication of data.

A. Data Confidentiality& Integrity

Data confidentiality in WBAN's is the most important issue that needs to be addressed. It avoids information leakage. Knowledge integrity is equally important. Importing formation of the patient could be lost & this could be detrimental from a privacy perspective.

B. Data Authentication

Authentication helps establish proof of identities.MAC (Message Authentication Code) computed using secret key can ensure data authentication.

C. Data Freshness and Secure Localization

Data needs to be refreshed time &again. Old data is stale & useless. Data freshness has two types of strong freshness wherein data is sent quickly with less delay & weak freshness wherein only partial data is sent with some delay.

D. Availability and Secure Management

In healthcare, it is very important to respond to a patient quickly, supply him the medicines etc. Thus there should be systems that are available 24/7 for a fast response .If any node of the network is attacked, to ensure response to the patient; the compromised node should be changed to ensure secure management & high availability.

7. CONCLUSION

The aim of this paper is to study an emerging technology called Wireless Body Area Networks (WBANs). Wireless Body Area Network is providing a never perceived before service in computerizing the health care application. It being a relatively new field, researchers are increasingly adding their bit into this and greatly contributing by working on the various parts of WBAN including QoS [8]. This technology can be used in this pandemic to treat covid19 patients remotely so that even the doctors or other staff can be safe.

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