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AN ANALYTICAL SURVEY ON BODY AREA NETWORK AND ITS CHALLENGES

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Abstract:-

Body area network (BAN) technology has emerged in recent years as a subcategory of wireless sensor network technology targeted at monitoring physiological and ambient conditions surrounding human beings and animals. However, BAN technology also introduces a number of challenges seldom seen before due to the scarcity of hardware and radio communication resources and the special properties of the radio environment under which they operate. By reviewing the foundations of BANs along with the most relevant aspects relating to their design and deployment. By introducing the current, state-of-the-art applications of BAN, as well as the most challenging aspects concerning their adoption and gradual deployment. And discussing the issues pertaining to sensor node communications, trade-offs, and interfacing with external infrastructure, in addition to important aspects relating to wearable sensor technology, enabling software and hardware, as well as future trends and open research issues in BANs.

Keywords: - [Body Area Network, BAN, BAN Technology]

1. INTRODUCTION

The field of computer science is constantly evolving to process larger data sets and maintain higher levels of connectivity. At same time, advances in miniaturization allow for increased mobility and accessibility. Body Area Networks represent the natural union between connectivity and miniaturization. A Body Area Network (BAN) is defined formally as a system of devices in close proximity to a person's body that cooperate for the benefit of the user.

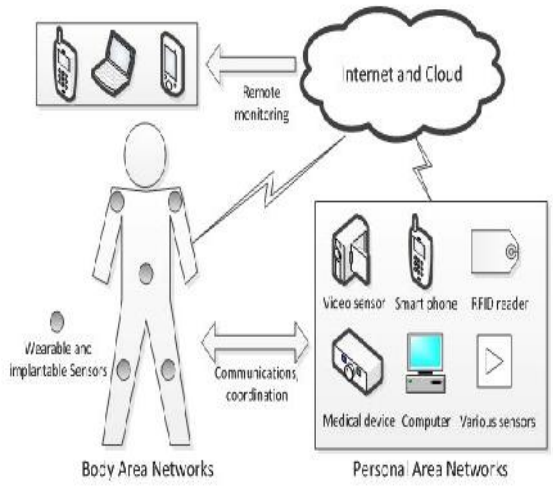

Figure 1: Body Area Network Infrastructure

BAN technology is still an emerging technology, and as such it has a very short history.BAN technology emerges as the natural byproduct of existing sensor network technology and biomedical engineering. Professor Guang-Zhong Yang was the first person to formally define the phrase "Body Sensor Network" (BSN) with publication of his book Body Sensor Networks in 2006. BSN technology represents the lower bound of power and bandwidth from the BAN use case scenarios. However, BAN technology is quite flexible and there are many potential uses for BAN technology in addition to BSNs. Some of the more common use cases for BAN technology are:

Body Sensor Networks (BSN)

Sports and Fitness Monitoring

Wireless Audio

Mobile Device Integration

Personal Video Devices

2. CHALLENGES IN A WBAN

For quality life healthcare is always a big concern for an individual. The growing population of developed countries presents arising slice of government's budget, and presents new challenges to healthcare systems, particularly with elderly people living on independent senior housing. Generally, health monitoring is performed on a periodic check basis, where the patient must remember its symptoms; the doctor performs some tests and plans a diagnostic, then monitors patient progress along the treatment. Healthcare applications of wireless sensor networks allow in-home assistance, smart nursing homes, clinical trial and research augmentation. Before describing medical applications of WBANs, the following section focuses on several challenges and general aspects that describe this kind of technology. Challenges in healthcare application includes: low power, limited computation, security and interference, material constraints, robustness, continuous operation, and regulatory requirements

2.1 Power challenge

As most wireless networks based devices are battery operated therefore, power challenge is present in almost every area of application of wireless sensor networks, but limitation of a smart sensor implanted on a person still poses even further challenge. In a full active mode a node can't operate more than a month because a typical alkaline battery provides about 50 watt-hours of energy. In practice, for many applications, they have to guarantee that the device will work for a year or two without any replacement. This could include devices such as heart pacemakers. To deal with these power issues the developers have to design better scheduling algorithms and power management schemes.

2.2 Computation

Due to both limited power as well as memory, computation should also be limited. The biosensors cannot perform large bit computations due to lack of enough memory. Unlike conventional wireless sensor network nodes, biosensors do not have much that computational power. Since communication is vital and memory is low, little power remains for computation. A solution is that some sensors may have varying capabilities that communicate with each other and send out one collaborative data message.

2.3 Security and Interference

One of the very important issues that could be consider, especially for medical systems is Security and interference. Physiological data collected by the sensor network is the health information, which is of personal nature. It is critical and in the interest of the individual, to keep this

information from being accessed by unauthorized entities. This is referred to as Confidentiality, which can be achieved by encrypting the data by a key during transmission. Data Authenticity is also one of the security requirements. This property is very important for the biosensor network because absence of this property may lead to situations where an illegal entity disguise as a legal one and reports false data to control node or gives wrong instructions to the other biosensors possibly causing significant harm to the host.

2.4 Material Constraints

Another issue for wireless sensor networks application to healthcare is Material constraints. A biosensor should be implanted within the human body; therefore the shape, size, and materials might be harmless to the body tissue. For example, a smart sensor designed to support the retina prosthesis might be small enough to fit within an eye. Also chemical reactions with body tissue and the disposal of the sensor are of extreme importance.

2.5 Robustness

Whenever the sensor devices are deployed in harsh or hostile environments Robustness rates of device failure becomes high. Protocol designs must therefore have built-in mechanisms, that the failure of one node should not cause the entire network to cease operation. A possible solution is a distributed network where each sensor node operates autonomously though still cooperates when necessary. For instance, if the sensor part is not working, the communication part should be used if it benefits the network and communication is operating as expected. One way to achieve this would be that a node might be comprised of a sensing block, a communication block, a scheduling block, and a data block. This would be a good way to isolate the malfunctioning block from the rest of the components in the node, as well as reducing power consumption among the various components. In order to ensure that the proper data is being sent and received, there are few alternatives that can be used, like checksums, parity check, and cyclic redundancy check.

3. BAN HARDWARE

Selection of an appropriate hardware platform is one of the most important aspects to consider during the inception of any BAN system. In particular, application specific requirements unequivocally highlight battery consumption, form-factor (i.e., physical shape and packaging) and processing capabilities at the core of a BAN's architecture design. In this section, here discussing the most important characteristics and limitations of the sensor types commonly seen in BAN devices, as well as their data processing and communication features that full fill the needs Inherent to this type of networked system.

3.1 Sensor Types

Sensors turn BANs into useful systems with well-defined purposes. The objective of using sensors in or around the body is to collect signals corresponding either to physical activities or to physiological conditions of the user. In addition, the data they provide can be referenced to make assessments on the effectiveness of a drug and/or medication therapy. Sensors yield data in the form of analog or digitized signals that are fed to the sensor node's MCU for immediate processing. However, depending on the circumstances, some form of specialized pre-processing or filtering can also take place beforehand, either as part of an algorithm implemented in the MCU, or as part of an intermediate hardware component (though the former case has become prevalent).

3.2 Wearable Sensor Devices

Compact sensors employed in BAN devices need to be in direct contact with the user or patient in order to obtain the desired readings. However, realizing small devices that are amenable to everyday monitoring had proven an elusive goal through the years. It was until recently that noteworthy advancements in field of solid-state electronics fabrication enabled the design and fabrication of devices with such characteristic. In particular, micro electromechanical systems (MEMS) technology plays a crucial role towards implementing effective and efficient wearable sensor devices aimed at physiological and bio-kinetic user monitoring that may not necessarily be bounded to life-critical requirements. This has the added potential to reducing medical services and health-care cost by enabling users or patients to reduce their dependence on direct monitoring at medical facilities.

3.3 Implantable Sensor Devices

Some types of sensor devices can be implanted in the human body, though this practice is often considered less desirable because of the associated risks to patients, including: (1) the natural rejection of the body towards extraneous objects and (2) the risk of sensor malfunctioning due to either a body-induced chemical reaction or external factors. Because of this, their size and bio-compatibility to human tissue become properties of foremost importance. Additionally, implantable sensors have to reliably and effectively deal with aspects pertaining to antenna design for efficient signal propagation, ultra-low-power consumption for long-lasting operation, and recovery from unexpected errors due to faulty software if applicable.

CONCLUSIONS

It has been reviewed a broad range of topics concerning BANs. BANs are formed by devices that possess unique features and work together to enable well-defined applications. In particular, BAN devices (sensors/actuators) have the distinct feature of operating in close proximity to the human body, and can even be embedded into it in order to provide a physiological monitoring service. Although BANs are expected to play an important role in many aspects of everyday life, as of today, deployment of this type of network is rather limited. This can be explained by pending issues of technology advancement, legal and ethic aspects, and user acceptance.

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