Wireless Body Area Networks: An Overview

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Abstract - *The increasing use of different new technologies related to wireless networks and the objective of improving the quality of life cases to development of Wireless Body Area Networks (WBANs). In WBAN, type of variable are attached or implemented on the body. These technology bring new application where called medical application. The objective of medical application is to collect sensitive data which using with healthcare service provider. Healthcare service provider access to the resource to monitor the state of object in any time of day and night. Using these technologies and medical application help to reducing the cost of medical application and also the healthcare service provider able to monitor the objects remotely instead of face to face. This paper focused on the concept of WBANs and the open research issues and challenges are discussed for future study.*

Key Words: Wireless Body Area Networks (WBANs), Body Area Networks (BANs), Security, Healthcare, Medical, Wireless networks.

1. INTRODUCTION

The increasing use of different new technologies related to wireless networks and the objective of improving the quality of life cases to development of Wireless Body Area Networks (WBANs). In WBAN, type of variable sensor (e.g., blood pressure, Electroencephalography called EEG, blood bump Electrocardiogram (ECG) and etc. (see the Figure1)) are attached or implemented on or in the body. These sensor able to collect and transfer data between each other in small and big scale. These technology bring new application where called medical application [1]. The objective of medical application is to collect sensitive data which using with healthcare service provider [2, 3]. Healthcare service provider access to the resource to monitor the state of object in any time of day and night. Using these technologies and medical application help to reducing the cost of medical application and also the healthcare service provider able to monitor the objects remotely instead of face to face [4, 5].

WBANs may interact with plenty of wireless technologies such Rube, ZigBee, type of Bluetooth and so on. Regarding to this, this technology help to people to freely move within different environment while healthcare service provider need to access to their health record to monitor the remotely. This opportunity bring some new challenges regarding the nature of WBAN and wireless technologies such as active and passive attack [6]. It is important to focuses more on the interaction of WBAN with existing technology such as Wireless Sensor Network, which can help to identify the security requirement in medical environment. This can be archive by investigate the existing study in WBANs. This paper focused on the concept of WBANs and the open research issues and challenges are discussed for future study.
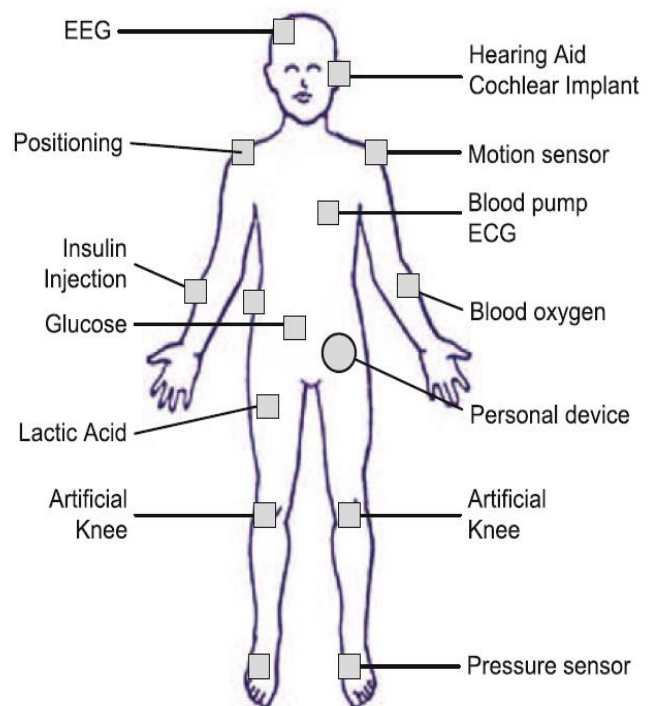

Figure 1: Type of Sensors in BANs

2. REQUERMENT

The main applications in wireless body area network (WBANs) is medial application where using in healthcare area. The example of this application illustrated in Figure 1. As shown in Figure 1, the plenty of sensor can be attached on body or may implemented under skin [6-8]. These sensor collect vital data from body where the patient is in different situation such as bed, running, working at office and so on [2, 9]. In addition, the safety domain is the other domain that we able to use WBAN to collect sensitive data and transfer collected data to the server for further services. As explained

in detail in [10], in the US the usage of healthcare service increase as shown in Figure 2.
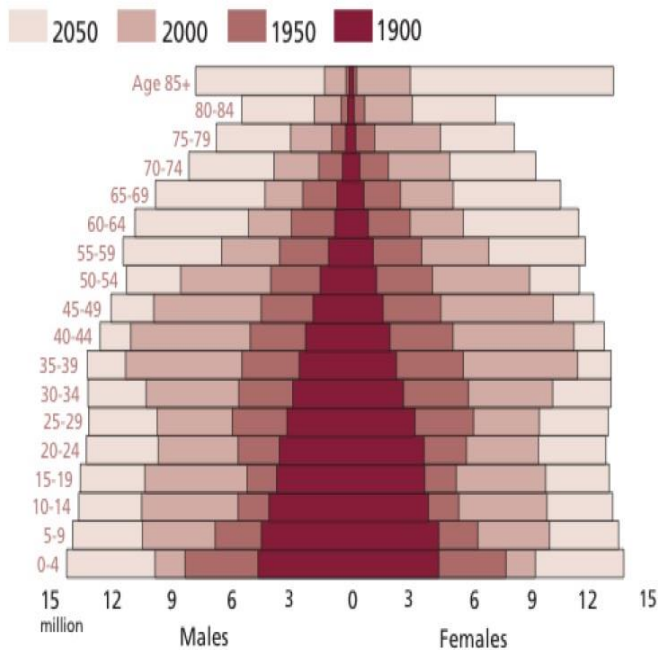

Figure 2: U.S. Age Pyramid [10]

2.1 Type of device in WBANs

Sensor nodes: as we discussed earlier, there are plenty of sensor that used to collect vital data and then these data transfer to next node called PDA (Personal Digital Assistance).

Personal Digital Assistance (PDA): PDA or other exiting device such as smart phone aggregate medical data from body sensors and process it. The aggregated data will be transfer to next hop called base station.

Base Station (BS): there are plenty of device such as access point that working as a switch in the network. The data will be redirect from local place into cloud via the internet. As a result the medical data will be recorded in different server in cloud or any medical server in hospitals.

2.2 Number of node

The number of node using in WBANs is depends on some factors such as nature of network and the regulation of medical application.

2.3 Energy

Energy consumption is one main aspects in WBANs that must be consider before deployed it. The energy consumption must be consider in 3 way in WBAN. Firstly, energy consumption related to type of sensor using in WBANs. Secondly, energy consumption related to type of

communications between and within WBANs in same and different domain [11]. And finally is energy consumption related to proceeding. There are several researcher focusing on type of sensors to reduce the energy consumption [12-17].

2.3 Usability

The other important issue in WBANs is usability that must be consider before deployed WBANs in small and big area. Regarding WBANs characteristics and plenty of device carry with which includes some variable sensors attached or implemented on/in body and also PDA that collected data from variable senor, we need to provide model to support them in small and large scale. Also, due to characteristics of WBANs, patent able to move from their place to another place or their domain to other domain very easy. As a result, there are plenty of interaction between their communications that need to consider before deployed WBANs. Figure 3 shown the position of WBAN.
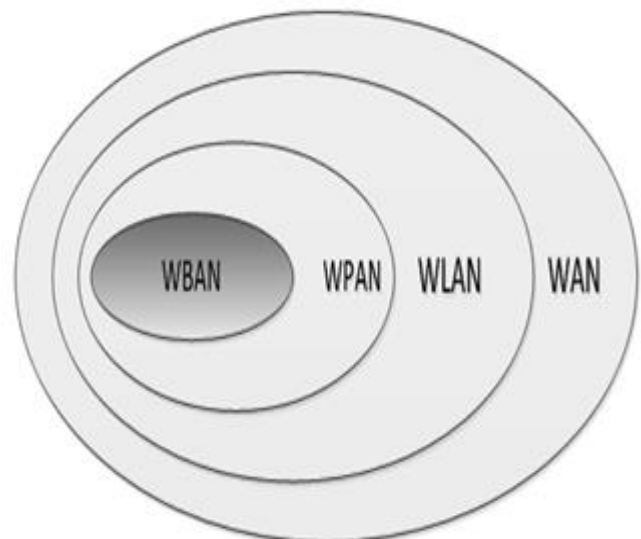

Figure 3: WBANs position

2.3 Security and Privacy

As we discussed earlier due to using plenty of devices such as variable sensors and PDAs and so on, the sensitive medical data will transfer over different type of wireless communication which possess several challenges in terms of security and privacy. Researchers need to consider the privacy in WBANs to protect the share data from untheorized users. And also, we need to provide some security mechanisms to secure communication between and within WBANs in same and different domain. There is a plenty of techniques proposed in terms of security and privacy in WBANs to address existing problem but we need to focus more to proposed efficient techniques to meet the requirements of WBANs as well [18]. Figure 4 shown the

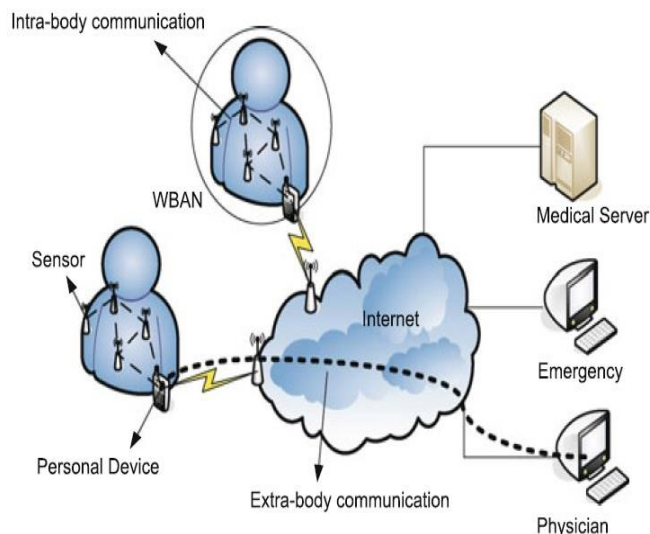overall wireless communications between WVBAs and their service providers.

Figure 4: WBANs communication [8]

3. Communication in WBANs

As discussed earlier in this article, sensitive data collected from body sensors and these data aggregate with personal devices such as smartphones [10, 19]. And then proceed data will be forward into medical server in cloud and so on. Regarding to this, the communication between and within WBANs can be categories in three section, firstly, the communication between sensors called intra communication, Secondly the communication between sensors and personal devices called inter communication. And the rest of communications in the healthcare networks called beyond networks. As mentioned in security section, different security mechanism needed for each communication layer. Also, the strong security and privacy techniques required to meet the WBANs and security requirements (See Figure 5). Type of existing wireless technique illustrates in Figure 6 with their data rate and existing frequency [11, 20].
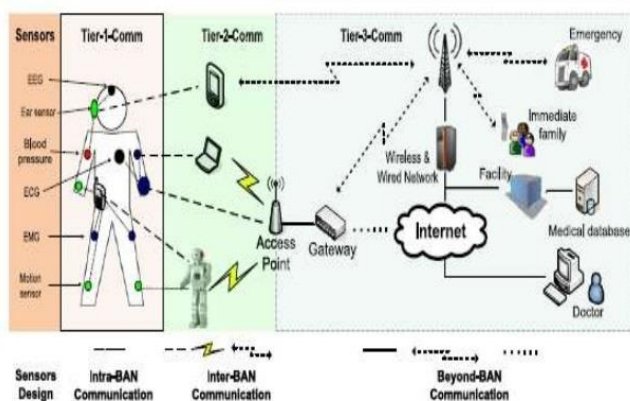

Figure 5: WBAN commination

Technology	Frequency	Data Rate
Bluetooth V.1 802.15.1	2.4 GHZ ISM	780 Kbps
Bluetooth V.2 + Enhanced Data Rate (EDR)	2.4 GHZ ISM	3 Mbps
Bluetooth V3.0 + High Speed (HS)	2.4 GHZ ISM and 5 GHz	3-24 Mbps
Bluetooth V4.0 + Low End Extension (LEE)	2.4 GHZ ISM	1 Mbps
. ZigBee (IEEE 802.15.4)	868 MHz, 915 MHz, 2.4 GHz ISM	20,40,250Kbps
Ultra Wideband (UWB)	3.1-10.6 GHz	110-480Mbps
RFID (ISO/IEC 18000-6)	860 to 960 MHz	10 to 100Kbps
Near Field Communication (NFC)	13.56 MHz	106,212,424 Kbps (1 Mbps planned for future)
Sensium	868 MHz,915 MHz	50 Kbps
Zarlink (ZL70101)	402-405MHz,433-434 MHz	200-800 Kbps
RuBee (IEEE 1902.1)	131 KHz	9.6 Kbps
Z-wave	900 MHz ISM	9.6 Kbps
ANT	2.4 GHz ISM	1 Mbps

Figure 6: Type of Wireless Technique in WBANs [10]

3. WBAN Applications versus WBAN Techniques

As we discussed above, medical application is one of promising application that used to improve the quality of life. Although wireless communication in WBANs provide a platform to how data transmit from sensor to medical server, but wireless techniques are also important that must be consider before deploy networks [21]. There are a plenty of wireless techniques such as IEEE 802.15.X where researcher used in their model, but IEEE 802.15.6 is the best wireless technique that meet the primary requirement of WBANs[16, 21-25]. Reliability, energy consumption, data rate, latency and physical layer security is some of main characteristics of IEEE 802.15.6 where highlight it [16, 26, 27]. To provide strong security mechanisms between sensors nodes in BANs in better to use the characteristics physical layer security such as wireless channel [5, 9, 28-31].

3. CONCLUSIONS

Wireless Body Area Networks (WBANs) is an emerging technology where used in healthcare environment to improve the quality of life. In WBAN, type of variable are attached or implemented on the body. These technology bring new application where called medical application. The objective of medical application is to collect sensitive data which using with healthcare service provider. Healthcare service provider access to the resource to monitor the state of object in any time of day and night. Using these technologies and medical application help to reducing the cost of medical application and also the healthcare service provider able to monitor the objects remotely instead of face to face. In this paper we focused on the concept of WBANs.

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