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Analysis of Trends in Wireless Body Area Networks (WBAN)

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Abstract: *The extreme development of the wireless networks and the constant miniaturization of electrical invasive and non-invasive sensors have led to a drastic change in the e-Health Environment. Without any constraint in daily activities, efficient health monitoring is now possible including the Biofeedback and Assisted Living. Wireless Body Area Network (WBAN) is a new trend in the technology that allows the user to monitor his/her bio medical data. The data could be Heart Rate, Breath rate, Sleep management etc .The WBAN system integrates several bio-sensors on a platform to analyze the health informatics of the End Users. The Wban Device is flooding the Consumer market offering varied functionality from activity tracking and mobile connectivity to medical monitoring. This paper provides a dynamic insight to the Wearable Technology and Challenges faced to Optimize Performance .It also exposes the fireworks on global Consumer Segments.*
Keywords-WBAN, E-Health Environment, Wearables

I. Introduction

Over the past years, vast monitoring systems are already being used based on wired connections to monitor human vital organs activity .However the wired connection can be problematic if worned by a person restricting his/her mobility .In order to avoid such situations ,the IEEE 802.15 defines the Body Area Networks (BAN) as the network of wireless sensor nodes which are low power devices operating on, in or around the human body to serve a variety of applications including personal, medical, consumer electronics / personal entertainment etc .These nodes communicate with central hub as well as with each other using either RF or non-RF based communication techniques to provide effective health monitoring services [1].The on body transmitters should be capable to transmit the bio-data in form of non-RF signals/RF signals into the human body via electrode .Similarly the receiver end should be fast ,secured, energy efficient so that the received signal is less attenuated [2][3].

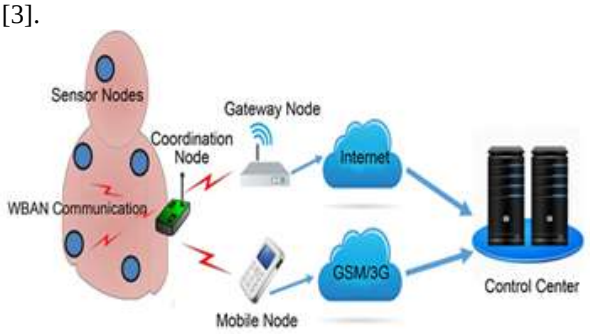

Figure 1. *WBAN Architecture[5]*

II. WBAN Architecture

Figure 1 shows the architecture of WBAN which can be divided into several sections to provide the necessary services .All the sensors can be used for continuous monitoring of movement, vital parameters like heart rate, ECG, Blood pressure etc. and the surrounding environment.Most popular wireless technologies used for medical monitoring system are WLAN, WiFi, GSM, 3G, 4G,WPAN (Bluetooth, ZigBee) etc. WMTS (Wireless Medical Telemetry Service) and Ultra-Wide Band operate in low transmission power and hence can be used for body monitoring system .[4]Sensors are the key components of a WBAN, as they bridge the physical world and electronic systems.Generally, they can be classified into chemical,thermal, mechanical, and acoustic sensors. However, what kind of and how many sensors a WBAN system employs depend largely on the application scenario and the system infrastructure.To monitor vital signals, behavior, and surrounding environment, a wide range of commercially available sensors can be deployed, such as accelerometer and

gyroscope, ECG,electromyography(EMG),and electroencephalography(EEG)electrodes ,pulse oximetry,respiration,carbon diox-ide(CO_2),blood pressure, blood sugar,humidity, and temperature sensors. Sensors used in BAN are classified as Wearables and Implatable sensors depending upon the target application .Some critical WBAN application involves the combination of both.Since the sensors in the wearables are located within the vicinity of the body they are inexpensive,lightweight and small in size and mostly used for physiological monitoring.An implantable BAN is located within the tissues of the human body and are widely used in applications such as drug delivery through a micro-pump or micro-port,insulin, etc.

In a generic WBAN architecture, we can consider intra-BAN communications between body sensors and a master node, where energy, latency and throughput concerns may be involved.Inter-BAN communications between the master node and one or more access points (APs), where collisions and interferences can easily occur over a shared channel.Beyond-BAN communications are required to enable authorized healthcare personnel (e.g., doctor or nurse)to remotely access patients medical information by means of cellular network or the Internet.

III. Wearable Technology

The growing popularity of mobile networks has led to the deveplopment in the Wearable Technology . It basically refers to devices incorporated into clothing or worn on the body as implants or accessories.There are many types of wearable technology but some of the most popular devices are activity trackers and smart watches. One of the major features of wearable technology is its ability to connect to the internet, enabling data to be exchanged between a network and the device. The ability to both send and receive data has pushed wearable technology to the forefront of the Internet of Things (IoT). Market has gained as it incorporates the smart phones, mobile applications, computing, and broadband connectivity into small chip .Bluetooth headsets, smart watches and web-enabled glasses allow people to access data hands-free from Wi-Fi networks exploding the Wearable Technology Sector. People have now began to seek new personal insights through real time data collection.

IV. Integrated IoT and WBAN

One of the major characteristics of the WBAN devices is that it supports a number of standardized technologies such as IEEE 802.16 Task Group 6,Bluetooth,Bluetooth Low Energy (BLE),Wifi,ZigBee and other Radio technologies . An appropriate radio technology for WBANs can be decided upon based on the specific requirements of a WBAN application and at which level of the architecture it will be deployed[6]. In order to give an account of the new possibilities in the area of HealthCare,the term "e-Health"was broung in the health arena in 2000. The E-health environments can be referred as using of telecommunication devices to monitor health parameters [7].Telemedicine,Electronic Medical Record (EMR)and Health Informatics are some of the areas under E-health.However the e-Health canvas is huge and under severe research .There are number of challenges such as physical characteristics of the sensor or actuators,power issues,Networking ,resource management schemes,and several Computational Limitations .However the potential of WBAN still stands strong and from the current situation of industrialization,the demand is increasing giving rise to technological inventions driven by HealthCare companies /research Institutions .The promotion and application of the WBAN is optimistic and in the recent years WBAN application has enhanced the mainstream of Internet company and Consumer Electronics.

V. Related Work

The WBAN area is wide and is having tremendous scope of research .The literature review highlights a range of sensing devices and their Contribution in WBAN field depending upon the application.

Sr.No.	***Title***	***Authors***	***Contribution***
1	"Ultra low power wireless and energy harvesting technologies-An ideal combination"	*Li Huang, Valer Pop,Ruben de Francisco,Ruud Vullers, GuidoDolmans, and Harmkde Groot.IEEE Inter-national Conference on Communication Systems(ICCS),2010.*	Using ULP wireless module, demonstration of the feasibility of energy autonomous sensor nodes(i.e. WATS) with the current energy harvesting technology[9]
2	"A Study on Energy Efficient and Reliable Data Transfer(EERDT)Protocol for WBAN"	*Deepak Sethi,Partha Pratim Bhattacharya. Second International Conference on Computational Intelligence and Communication Technology (CICT),2016.*	A reliable,power efficient and high throughput routing protocol named Energy Efficient and Reliable Data Transfer(EERDT)for WBAN is proposed [10].
3	"Cooperative compressed sensing schemes for telemonitoring of vital signals in WBANs"	*Aris S. Lalos,Elli Kartsakli,Angelos Antonopoulos.IEEE Global Communications Conference(GLOBECOM), 2014.*	Presents a novel Compressed Sensing (CS) based telemonitoring scheme, in order to achieve an energy efficient signal reconstruction

			at the BNC [11].
4	"ESR:Energy aware and stable routing protocol for WBAN networks"	*Omar Smail,Adda Kerrar,Youssef Zetili.International Wireless Communications and Mobile Computing Conference (IWCMC),2016.*	A stable, reliable, energy efficient routing protocol for mobile Wireless Body Area Networks is proposed.It preserves the residual energy of nodes with an increase network lifetime [12].
5	"FLEXOR:A modular wireless network tool for WBAN systems"	*A.Barrera,M.Gutierrez ,Juan S. Rodriguez.IEEE Colombian Workshop on Circuits and Systems(CWCAS),2014*	This paper presents the FLEXOR platform,a modular tool for prototype Wearable Body Area Network (WBAN) applications [13].

VI. WBAN Applications

WBAN has wide range of applications targeting from Health parameters monitoring to its analysis and further treatment.Inorder to provide clinical health and monitoring from a distance ,the branch of tele-medicines is under going several developmental inventions [14][15].Tele-monitoring and Tele-medicines are the variants of WBAN .It is majorly used to overcome distance barrier and to improve access to medical services that is not available in distant rural communities. It also includes remote health assessment and consultations over the telecommunication infrastructure .Application of WBAN extends from education and research to administration and public health.Telemedicines can bridge the distance and facilitiate healthcare in remote areas where people struggle to access timely ,good quality substandard specialty medical care.

VII. Conclusion

This paper shows the analysis of on going research in WBANs in terms of system architecture and applications. WBANs will thus allow for continuous monitoring of patients in medical applications,capable of early detection of abnormal conditions resulting in major improvements in the quality of life. Importantly, even basic vital signs monitoring (e.g. heart rate) can enable patients to engage in normal activities as opposed to being home bound.WBANs will provide major enhancements in human life style through the use of ubiquitous networking,various challenges remain in this area that need to be taken into account before being widely deployed .

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