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WBAN: A Persuasive Area in Ubiquitous Health Care

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***Abstract*-The emerging technologies of wireless communication system, on chip and low power sensor nodes give importance to Wireless Body Area Networks (WBAN). WBAN consists of small sensors. It includes many applications such as healthcare, entertainment, gaming, and military applications. It provides instant monitoring anywhere they move that is Ubiquitous healthcare. In this paper we provide a survey on different architectures of Wireless Body Area Networks, which is used for Ubiquitous healthcare monitoring. Different standards and devices used in paper are also discussed. Path loss is very big problem in this Wireless Body Area Networks. It shows great impact on communication. This can be solved by different In-Body communication and different factors.**

Index-Terms: **WBAN, Ubiquitous healthcare, Path loss, Architecture.**

1. INTRODUCTION

Population is drastically increasing these days. Old people who are more fragile to health diseases needed comprehensive health system. WBAN is providing healthcare infrastructure consists of tiny sensors which are placed in or around the body to monitor a patient. In case of any emerging, elderly people are monitored by this system and can be treated in time. The problem of elderly people is they can't frequently visit the doctor or they can't move easily from place to place. This problem can be solved by this Ubiquitous HealthCare.

By using this WBAN, Elderly people can reduce the number of visits to doctor. For the constant monitoring the sensors are placed on the body. For the data communication in the WBAN many data transfer mechanisms are used like ZigBee, Bluetooth, etc. To collect the patient's vital signs information and that information to be transferred to the medical practitioner. Different devices are used like Oximeter, wearable shirt, wearable watch, chest belt etc.

The path loss in in-body and on-body should be depending on the frequency of operations as well as the distance between transmitter and receivers. Different architectures are used for different types of body languages. Based on the scenario of body communication different antennas are chosen.

The communication between the sensor nodes and the server which is located in the remote area should be done by Base Station Transceiver (BST) that should be connected to serverPC. Component based architecture in UHC is provided to help the elderly people. The prototype of that component based architecture should be maintains the location of patent and the heath conditions via Bluetooth and smart phone with a accelerometer as Intelligent Control Node (ICN).

By using this architecture we can provide the information to the family members and medical authorities directly to identify the status of patient. Because of less power consumption of ZigBee compared to the Bluetooth, That ZigBee is used for the data rate applications. Different architecture is used for this WBAN. In this different wearable devices are used such as wearable smart shirt to monitor the patient's health conditions. In this wearable smart shirt, that shirt compares of multi-hop sensor networks and serverPC. BST is used for the communication between the sensors and serverPC in this network. Based on the information in the server, the medical officers monitor and treat the patient.

In this paper, the survey on the different path loss scenarios in the WBAN is discussed. The remaining part of this paper should give the following information. Section 2 represents the different standards used in this paper for the communication in WBAN including the architecture of WBAN. Section 3 represents the different wearable sensors used for the UHC and how path loss occurs in WBAN and different scenarios of path loss WBAN. Finally section 4 concludes this paper.

2. COMMUNICATION STANDARDS OF WBAN:

For the communication in WBAN, different standards are used like ZigBee, Bluetooth, and MICS.

ZigBee:

ZigBee can handle complex communication by using low power consumptions without any collision by using collision avoiding schemes. For this reason this standard is widely used. The power consumption of this standard is 60mm, and data rates are 250kbps. Security is provided in the WBAN by using the encryption techniques of the ZigBee controllers.

Bluetooth:

The data rate in Bluetooth is 3Mbps and range of 10m. It has high bandwidth and low length; due to this reason Bluetooth standard is used in the UHC monitoring. The disadvantage in this Bluetooth is high power consumptions. For this reason this is not widely used in UHC.

Medical Implant Communications Service (MICS):

The communication in WBAN is specifically done by this standard. It collects signal from different sensors on-body. Compared to the Bluetooth this MICS has less power consumption. MICS is the short distance standard suitable for UHC monitoring.

Architecture of UHC

The Wireless Body Area Sensor Networks integrated into multi tier telemedicine system. The tele medical system comprised of individual health monitoring systems that

connect to internet with the help of medical server tier which resides on top of hierarchy. The top tier, centered on a medical server, is optimized to service thousands of individual users, and encompasses a complex network of interconnected services. Each user wears a number of sensor nodes which are helpful to transfer the relevant data to a personal server through wireless personal network using the above methods where sensors are strategically placed on our body. The personal server, implemented on a personal digital assistant (PDA), cell phones, sets up and controls the WBAN, provides graphical or audio interface to the user, and transfers the information about health status to the medical server through the internet or mobile telephone networks.

The patient's physician can access the data from his/her office via the internet and examine it to ensure the patient is within expected health metrics like heart rate, blood pressure, activities etc. In order to ensure that the patient is responding to the exercises performed which are given as treatment. A server agent may inspect the uploaded data and create an alert in the case of potential medical conditions.

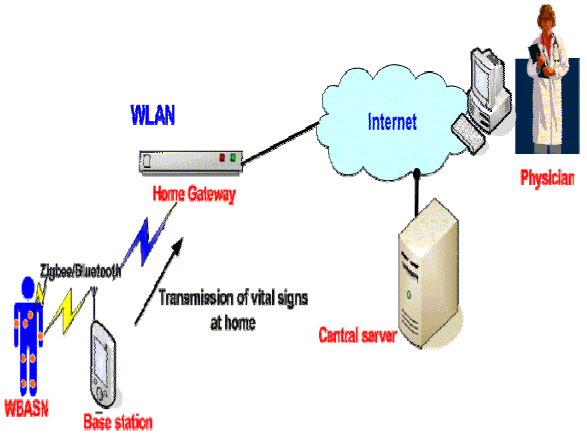


Fig. 1. Architecture of UHC

The second tier is the personal server which interfaces with WBAN sensor nodes for providing the graphical user interface and communicates with services at top tier. The personal server is particularly convenient for in-home monitoring of elderly patients. Network coordinator (NC) acts as a medium between the person and the personal server of WBAN, helps in implementing ZigBee or Bluetooth connectivity. Sensor nodes receive initialization commands and respond to queries from the personal server. The wireless network nodes are implemented as tiny patches or incorporated into clothes or shoes. The raw information stored locally is collected continuously by network nodes and send processed event notifications to the personal server.

The type and nature of the health care application will determine the frequency of relevant events like sampling, processing, storing and communicating. When local analysis of data is inconclusive or indicates an emergency situation, the upper level in the hierarchy can issue a request to transfer raw signals to the next tier of the network. The sensor node software samples and collects physiological data, analyzes signals in real time, and transmits the results wirelessly to the personal server. Sensor nodes and network coordinator software is implemented in the TinyOS environment. The personal server employed many networks like GPRS, 2G, 3g, or WLAN in order to communicate with to medical server.

3. WEARABLE SENSORS USED FOR UHC:

Several types of tiny sensors are used in UHC which are attached to the body for measuring vital signs such as glucose level, electro cardiogram (ECG), electro encephalograph (EEG), detection of cancer cells etc and surrounding parameters like temperature, atmospheric pressure, humidity etc. The size, shape, material of these sensors is of great importance. The sensors must be compatible with human body and their placement in/on body, since these sensors are very sensitive and can cause harm to the body. These sensors are designed to be easily wearable and also in providing comfort to the patients.

Various sensors which can be used normal clothing elements for the patients are as follows: wrist watch (eWatch), Oximeter, chest belt, wearable shirt type (smart shirt/life shirt) etc.

Path loss in WBAN:

Devices for UHC are generally placed inside or on the body sources where the communication can be effected due to the losses between the devices in turn degrading the performance. The path loss can be defined using three types of nodes as under:

Implant mode, this type of node is embedded inside the body either below the skin or deeper.

Body surface node, this type of node is placed on the surface of human skin or maximum 2cm away.

External node, this type of node is kept away from the body by a few cm up to a maximum of 5 m.

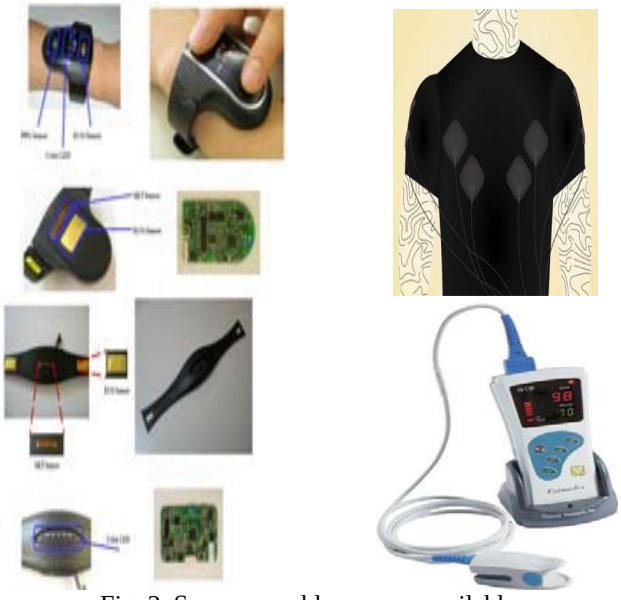


Fig. 2. Some wearable sensors available

Effect of WBAN antennas:

Antennas placed on the surface or inside the body are influenced by its surroundings. It is noticeable that the form factor of antenna is dependent on the requirements of applications, which in turn affects the overall system performance. Antennas used in WBAN communication are categorized into two types as follows:

Electrical antennas (dipole), these are mostly used for on-body communications. These are avoided for in-body communications because these are harmful for tissues and muscles of body.

Magnetic antennas (Loop), these are used for in-body and implant communications, since they don't overheat the body tissues and are not dangerous to human body unlike electrical antennas.

There are different scenarios of path loss of sensor nodes implanted either inside or on the body. Path loss is dependent on both distance as well as frequency as shown in fig.(5), where these scenarios affect the path loss model. Some of them are as mentioned below:

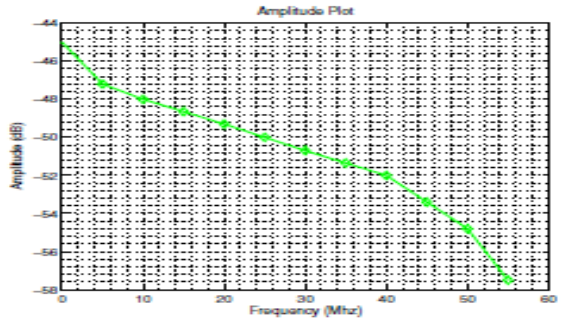


Fig. 3. Amplitude Attenuation

In-Body communication:

The study of physical parameters and their measurements are not feasible inside the human body. So 3-D visualization scheme is used here for the study of propagation characteristics inside human body. The reason for using this scheme is that the study of physical parameters and their measurements are not feasible inside the human body.

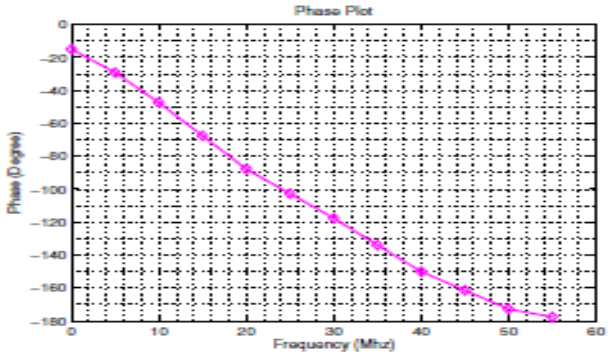
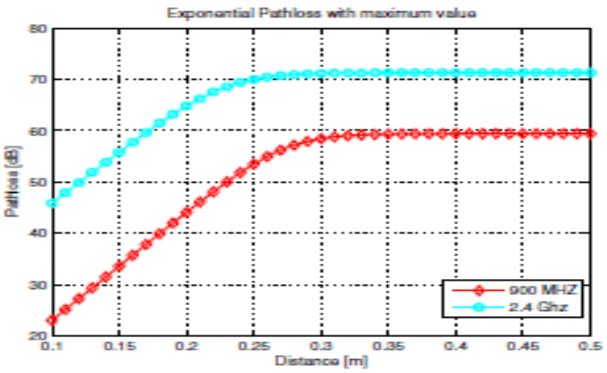


Fig. 4. Phase distortion

On-Body communications:

The placement of sensors and actuators on the body surface place a vital role in this type of communication. Simple path loss model that takes into account the placement of sensors and their communications with respect to body postures and movements is required. Channel response output as well as frequency response can be easily found here. As frequency increases, attenuation of amplitude also increases since the channel undergoes impairments, resulting in degradation of signal intensity as it travel from transmitter to the receiver node planted on the human body as shown in fig.(3). With increase in frequency the phase distortion of the signal increases in linear fashion and vice versa given in fig (4). Multiple frequencies occur at multiple phase distortions if the relationship is non-linear. From UHC point of view, amplitude, attenuation and phase distortion of the signal for on-body communication should be eradicated to achieve better monitoring results. UHC monitoring in WBANs depends on both in-body and on-body communications of sensor nodes which are attached to the patient's body for monitoring.



4.CONCLUSION

WBAN is an emerging in the field of wireless communication comprising of tiny sensors placed in or on the body. These sensors measure patient's vital information and transfer it to medical personnel for diagnosis. With UHC, patients are not required to visit doctor frequently instead they can get diagnosis of their decease while sitting at home. This paper consists of different communication standards used for WBAN. The architecture of the WBAN is represented in different tiers. While the sensor devices sense the information regarding the patient, path loss is occurred. Different methodologies are presented to overcome the effects of the path loss in WBAN.

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