ISSN: 2278-0181
CONFCALL - 2019 Conference Proceedings

Biophysical Modeling, Characterization and Optimization of Electro-Quasistatic Human Body Communication

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Abstract:- **Now a day's electronic devices become smaller and lower in power Requirements, and they are less expensive. We have begun to adorn our bodies with personal information and communication appliances. Such devices include cellular phones, pagers and personal digital assistants and many more. But currently there is no such method for these kinds of devices to share data. Networking these kinds of devices can reduce functional I/O redundancies and allow new Conveniences and services. Human society is entering an era of modern computing, when networks are smoothly interconnected. The implementation of ubiquitous services requires three levels of connectivity: Local Area Networks (LAN), Wide Area Networks (WAN), and Human Area Networks (HAN) for connectivity to personal information, share data, media and communication appliances within the much smaller areas for communication. RedTacton is a technology that uses the surface of the human body as a high speed and safe network transmission path. So in this paper we are explaining the unique new functional features and enormous potential of RedTacton as a Human Area Networking technology. Here, the human body acts as a transmission medium supporting half duplex communication at 10Mbit/s.**

1. INTRODUCTION

Today's aging population is leading to a wide-scale demand for health-state monitoring in hospital and at home. Wireless health-state monitoring can effectively reduce the inconvenience of wire links, and save time and resources. As a typical usage, the wireless device is a vital sign sensor with communication function for collecting blood presser, electrocardiogram (ECG), electroencephalogram (EEG), and so on. The wireless techniques in a wearable BAN may employ 400 MHz band, 2.4 GHz band, ultra wide band (UWB), and human body communication (HBC) band. Because of the rapid spread of the 400 MHz and 2.4 GHz transceiver integrated circuits (ICs), most existing wearable ECGs are employing these two frequency bands. For example, a 433 MHz frequency shift keying (FSK) transmitter was used for sending the ECG signal to a personal computer (PC) for health-state monitoring in, and a 2.4 GHz Bluetooth based wireless ECG with a built-in automatic warning function was equipped in an intelligent telecardiology healthcare system in. Also using the 2.4 GHz band, a wireless steering wheel was developed for fast and noninvasive ECG monitoring in. The commercial transceiver ICs at 2.4 GHz is especially easy to get for wearable ECG use. However, the on-body propagation mechanism depends on the working frequency. As described in, above 400 MHz, more than 80% received signal components are contributed by the on-body surface propagation. Since the human body is a lossy dielectric body, the higher the frequency is, the larger the on-body path loss should be. Compared to the 2.4 GHz band or UWB, however, the HBC usually operates at frequencies from dozens of kHz to dozens of MHz by employing the human body itself as a communication route . At these frequencies the onbody path loss is smaller than 2.4 GHz and UWB. Its propagation along the human body is also much superior to that through the air. So HBC provides a new possibility for wireless health-state monitoring. Not only its low propagation loss may yield a superior communication performance compared to other frequency bands, but also its low radiation toward outside of the human body may bring to a high security. These features are especially important in healthcare and medical applications. Fig. 1 shows a promising application of HBC in monitoring health-states. Some vital sign sensors are set on the human body to collect the vital data such as blood presser, blood glucose, ECG, EEG and electrooculography (EOG), and the collected data are sent to an access point in the front of the body by HBC technology automatically. In general, it is not necessary to acquire various vital data at the same time. When there are multiple sensors on the human body, the sensors can sample the data at different timing and then send them to the access point with a time division multiplexing scheme. After re-arranging these data with appropriate header into one frame in the access point, we can send out them from the access point to an HBC receiver (Rx) in one touch. The access point may
With the rapid development of wearable technology,wearable devices are experiencing an exponential growth.Wearable devices are generally small, portable, low power consumption, and worn on the multiple locations on theuser for diverse functions such as video recording, pedometerand health monitoring .As the information stored in thewearable devices are almost private, such as personal photo,video and health data measured by the biosensors includingheart rate, blood pressure, and electrocardiogram , it isimportant to prohibit the unauthorized persons from accessingthe wearable device. Biometric authentication is an excellentapproach to

solve this problem.Biometric authentication refers to verifying or identifyingindividuals based on the physical or behavioral characteristicssuch as face, fingerprint, hand geometry, iris, typing rhythm,voice, gait. Biometric is inherently more reliable than thepassword-based authentication as biometric traits cannot belost or forgotten. It is also more difficult to forge biometrics.A number of biometric characteristics have been in use for different applications. Several groups have studied thebiometrics in the mobile platforms. Wang et al. and Liu et al.utilized the finger-vein recognition system for mobile devices. Klonovs et al. and Tao et al. introduced EEG-based
biometric and face recognition, respectively. Otherresearchers combined several biometrics such as face, voice,and teeth to provide a better performance. However,considering that the wearable devices may be worn ondifferent position such as legs, the aforementionedbiometric are not suitable for some wearable devices. Inaddition, the device of the authentication system must be smallenough to be integrated into wearable devices. For this reason, some biometrics, like gait, typing rhythm ,hand veins, DNA, hand geometry, and iris recognition arenot acceptable for wearable application. Therefore, there is aneed to propose a biometric trait which is small enough andsuitable for wearable systems.Human body communication (HBC) is a short-rangewireless communication in the vicinity of, or inside a humanbody by using the human body as a propagation medium. HBC is divided into two solutions: galvanic coupling and capacitive coupling. The former requires one pairs ofelectrodes in both the transmitter (TX) and the receiver (RX),whereas the latter only requires a single electrode for the TXand the RX. The capacitive coupling makes it possible tominiaturize the size of device, and is more suitable forapplications requiring the devices to be miniature enough.Since HBC can transfer in high data rates while maintaining low power consumption, and provide high security andeasy integration within body-worn devices, HBC showsgreat potential for wearable devices. Moreover, as theproportion of biological tissues such as muscle, fat, andskeleton is different between individuals, the overall dielectricconstants of human body are diverse, as well as the signalpropagated through human body. The diverse HBCpropagation signal can be utilized as the biometric trait toauthenticate individuals. By means of employing the HBC asboth the authentication and the communication approaches, thesize of wearable devices will be more miniature. Due to the use
of propagation signal between devices, the HBC authenticationis suitable for wearable device regardless of the location.Therefore, it is of great significance to research HBC-basedauthentication.RedTacton technology is an electronic future whereinformation can be accessible whenever andwherever needed at our finger tips. Some of thecommunication equipment that is required to providethis immediate access to information will beIncorporated into our attire. Justas a quick look attoday's wristwatch saves a trip to the nearest clock; aglance at tomorrow's wristwatch will replace findinga terminal to check e-mail. RedTacton is a newHuman Area Networking technology which wasintroduced by Nippon telegraph and TelephoneCorporation (NTT's) that uses the human bodysurface is a high speed and safe network transmissionpath. RedTacton is a Break-through technology thatenables reliable high-speed HAN for the first time. Inthe past, infrared Communications (IrDA), Bluetooth,radio frequency ID systems (RFID),and othertechnologies have been Proposed to solve the "lastmeter" connectivity problem.

2. PROPOSED SYSTEM:

I. WORKING:

RedTacton takes a different technical approach. Instead of depending on electromagnetic waves or light waves to carry data. RedTacton using weak electric fields on the surface of the body as a transmission medium as shown in figure.

i.) The RedTacton transmitter induces a weak electric field on the surface of the body.

ii.) The RedTacton receiver senses changes in the weak electric field on the surface of the body caused by the transmitter.

iii.) RedTacton relies upon the principle that the optical properties of an electro-optic crystal can vary according to the changes of a weak electric field.

iv.) RedTacton detects changes in the optical properties of an electro-optic crystal using a laser and converts the result to an electrical signal in a optical receiver circuit.

Multiple transceivers can be used simultaneously. The reason is RedTacton uses a proprietary CSMA/CD (Carrier Sense Multiple Access with Collision Detection) protocol that allows multiple accesses with the same medium from multiple nodes.

Background:

Intra-body communication was proposed for the first time by IBM in 1996 and was eventually appraised and reported by several research bodies on the globe. However, many of these reported technologies were prone to shortfalls including operating range (of tens of centimeters) and speed, which is only 40 bits/s. 2 Similarly, technologies such as infrared, Bluetooth and Radio Frequency ID System(RFID) are in use and were proposed to address what is termed "last meter" connectivity problem. But shortcomings such as the sudden decrease in speed of transmission especially in multi-user environment leading to network congestion were peculiar to them.

The solution to all these problems is therefore RedTacton which is an implementation of ubiquitous network services among other two connectivity levels (WAN and LAN) for connectivity to personal information, media and communication devices in a sphere of ordinary daily activities (achieving the last one meter). This condition of network system is thus termed HAN.

ISSN: 2278-0181

II. REDTACTONTRANCIVER:

RedTacton Technology was introduced by NipponTelegraph and Telephone Corporation (NTT).

TACTON- meaning “action triggered by touching”and RED - It is an auspicious color according toJapanese culture for warmth. It is a technology thatuses the surface of the human body as a safe, highspeed network transmission. The study of HumanArea Networking

i.) RedTacton uses the minute electric field emittedon the surface of the human body. It is completelydistinct from wireless and infrared.

ii.) A transmission path is formed at a part of thehuman body which comes in contact with aRedTacton transceiver. Physically separating endsthe contact and thus ends communication.

iii.) Using RedTacton, communication starts whenterminals carried by the user are linked in severalcombinations according to the user's natural, physicalmovements.

iv.) Communication is possible using any bodysurfaces, such as the hands, fingers, feet, face, legs,skin or torso. Red Tacton works through shoes andclothing as well.

Features

RedTacton Technology has three main functional features:

i.) Touch: Touching, sitting, walking, stepping, gripping and other human movements can be the used as triggers for unlocking or locking, starting or stopping the equipment, or obtaining data.

ii.) Broadband & Interactive: Bandwidth does not deteriorate even with duplex operations and also simultaneous access by many users. Duplex, interactive communication is possible at a maximum speed of 10Mbps. This is because the transmission path is on the surface of the body; transmission speed of red tacton does not deteriorate in congested areas Where many people can communicate at the same time.

iii.) Any media: In addition to the human body, there are various conductors and dielectrics can also be used as transmission media. Conductors and dielectrics may also be used in combination.

Previous Work on Electric Field Sensing

Human Area Network(HAN) development grew out of a meeting between Professor Mike Hawley's Personal Information Architecture Group and Professor Neil Gershenfeld's Physics and Media Group, both at the MIT Media Laboratory. Professor Hawley's group needed a interconnect body-borne information appliances, and Professor Gershenfeld's group had been applying electric field sensing to position measurement.

RedTacton Transceiver:

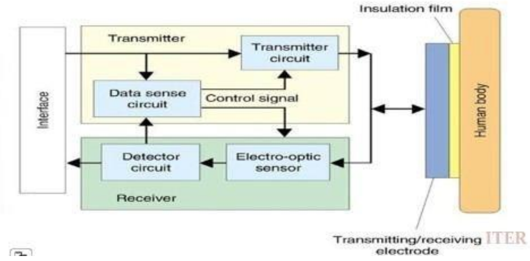


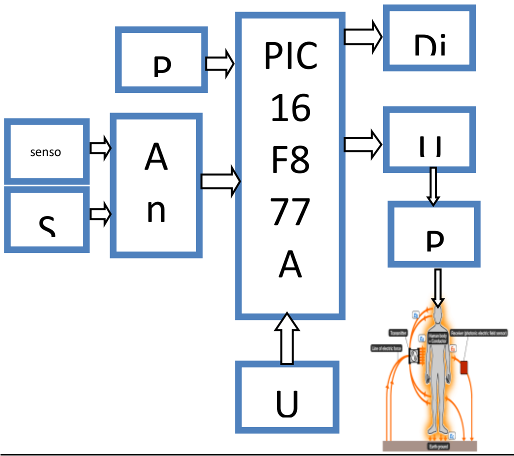
Fig. Block diagram of RedTacton Transceiver

Transmitter consists transmitter circuit that has electric fields towards the body and a data sense circuit, which distinguishes transmitting and receiving modes by detecting both transmission and reception data and outputs control signals corresponding to the two modes to enable two way communication.

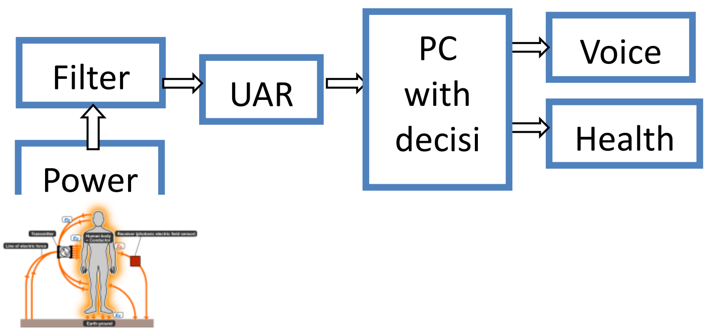
Implementation of receive-first half-duplex communication scheme that sends only after checking to make sure that there is no data to receive in order to avoid packet collisions. RedTacton takes advantage of the long-overlooked electric field that surrounds the human body.

III. BLOCK DIAGRAM

i. Transmitter Side:



ii. Receiver Side:



3. INTRODUCTION TO LABVIEW

The program LabVIEW uses the technique of graphical programming. This type of coding is referred to as G-Code (for graphical code). The program developed by National Instruments is widely used in industry for a variety of applications. One of these important applications is the automation of information gathering. Since many experiments are done under controlled conditions, changing these controlling conditions becomes a big part of the experiment. When using LabVIEW many settings of the instruments can be changed remotely instead of manually. This also comes in handy when a variety of measurements are needed over a large range of values. For instance, later this term you will be asked to use LabVIEW to make voltage measurements for a circuit. There are about 4 measurements per input voltage change, and over a few input voltage changes these measurements add up to a large amount of measurements (and time). What if there was a way to set up a computer program to change and measure all of the different measurements? What happens is that experiments become more efficient and take less time. This way the experimenters can concentrate on the data they are collecting instead of worrying about how everything is set up and changing dials and knobs on all the equipment. In this lab, the basics of LabVIEW programming will be discussed, and it will be left to the student(s) to learn how to manipulate the programming to fit the needs of the experiment.

The first thing to learn about LabVIEW programming is the type of interface that the devices are connected. In the lab the devices use what is called GPIB, or General Purpose Interface Bus, and has become the IEEE 488.2 standard. There is also an RS-232 connection (serial port) but that is not of use for the equipment that is at hand. The GPIB connections are much like a SCSI connection on computer equipment. This is due to the 'daisy chain' connection capability that the devices have. Looking at the back of the devices on the lab table there are tags that say 'IEEE 488' or 'GPIB Connector' on them. These cables go back down to the system controller located inside the computer. This is the device that the computer uses to talk to the individual pieces of equipment. The way to determine exactly which device that needs to be addressed is taken care of in the programming. By changing the GPIB address in the program any and all devices connected to the bus can be used or manipulated in LabVIEW.

4. REFERENCES

[1] Mainwaring, Alan, et al. "Wireless sensor networks for habitat monitoring." Proceedings of the 1st ACM international workshop on Wireless sensor networks and applications. ACM, 2002. [2] N. Javaid, U. Qasim, Z. A. Khan, M. A. Khan, K. Latif and A. Javaid, "On Energy Efficiency and Delay Minimization in Reactive Protocols in Wireless Multi-hop Network", 2nd IEEE Saudi International Electronics, Communications and Photonics Conference (SIECPC 13), 2013, Riyadh, Saudi Arabia.

[2] B. Manzoor, N. Javaid, O. Rehman, M. Akbar, Q. Nadeem, A. Iqbal, M. Ishfaq, "Q-LEACH: A New Routing Protocol for WSNs", International Workshop on Body Area Sensor Networks (BASNet-2013) in conjunction with 4th International Conference on Ambient Systems, Networks and Technologies (ANT 2013), 2013,

[3] Halifax, Nova Scotia, Canada, Procedia Computer Science, Volume 19, 2013, Pages 926-931, ISSN 1877-0509

[4] N. Javaid, R. D. Khan, M. Ilahi, L. Ali, Z. A. Khan, U. Qasim, "Wireless Proactive Routing Protocols under Mobility and Scalability Constraints", J. Basic. Appl. Sci. Res., 3(1)1187-12001, 2013

[5] N. Javaid, Z. Abbas, M. S. Farid, Z. A. Khan and N. Alrajeh, "M-ATTEMPT: A New Energy-Efficient Routing Protocol for Wireless Body Area Sensor Networks", The 4th International Conference on Ambient Systems, Networks and Technologies (ANT 2013), 2013, Halifax, Nova Scotia, Canada, Procedia Computer Science, Volume 19, 2013, Pages 224-231, ISSN 1877-0509, http://dx.doi.org/10.1016/j.procs.2013.06.033. Procedia Computer Science

[6] H. Ando, K. Takizawa, T. Yoshida, K. Matsushita, M. Hirata, and T. Suzuki, "Wireless multichannel neural recording with a 128-Mbps UWB transmitter for an implantable brain-machine interfaces," IEEE Trans. Biomed. Circuits Syst., vol. 10, no. 6, pp. 1068–1078, Dec. 2016.

[7] M. Vidojkovic et al., "A 2.4 GHz ULP OOK single-chip transceiver for healthcare applications," IEEE Trans. Biomed. Circuits Syst., vol. 5, no. 6, pp. 523–534, Dec. 2011.

[8] C. Ma, C. Hu, J. Cheng, L. Xia, and P. Y. Chiang, "A near-threshold, 0.16 nJ/b OOK-transmitter with 0.18 nJ/b noise-cancelling super-regenerative receiver for the medical implant communications service," IEEE Trans. Biomed. Circuits Syst., vol. 7, no. 6, pp. 841–850, Dec. 2013.