Intra-body communication in biomedical applications

Mr.G.Sathish kumar
Assistant professor, ECE department
RMKCET

Dhivya.M, Anubama.S, Kanimozhi.B, Akshara.B
Electronics and communication engineering,
RMK College of engineering and technology

dhivmurali1897@gmail.com, anubama1996@gmail.com, kanibasker28nov@gmail.com ,aksharabalaji1996@gmail.com

Abstract— This paper presents an unaccustomed mechanism for health care monitoring system that is wirelessly implemented. Intra-body communication is a promising wireless communication technology that uses human body as the transmission medium and thereby making it private, lower power consuming and more immune to risks from wired devices. This cable-free technology is added as a new physical layer with the IEEE standard 802.15.6. Nowadays portable devices everywhere make a revolutionary change. The proposed system is also implemented in the form a wearable device that can able to measure heartbeat, temperature and blood pressure.

Keywords—Cable-free technology,immune to risks, IEEE standard 802.15.6,Wearable device.

Introduction

WBAN is a (wireless body area network) technology network that is in the form of devices implanted onto the human body or mounted on the surface of human body to monitor the patient's health condition. This was developed around 1995 based on the concept of WPAN(wireless personal area networks).Imagine a world where a patient who suffers illness has to monitored daily. Intra body communication is a novel non-Rf wireless technology that uses human body as a medium of transmission. Our proposed system helps reducing the reliance of the medical personal and provides an one touch communication. Further through mobile computing visits to hospitals, quality of healthcare can also be improved. Apart from medical applications, real-time healthcare monitoring is in high demand for sport where a personalized training plan for each athlete should be developed by coaches to improve the performance of their team, especially at an elite level. In a recent WBAN
for live sport monitoring, 40000 runners of the Paris Marathon were equipped with
120000 (3 sensor nodes per athlete) on-body sensors through IEEE 802.15.4(Zigbee) for data communication.

TABLE 1. Characteristic data of wireless technologies

Technology	Frequency	Data rate	Transmission power	Size
WLAN	2.4/5.1GHz	54 Mbit/s	100Mw	PC card
Bluetooth	2.4GHz	723.1 Kbit/s	10mW	PCB module
Zig-bee	868MHz	20 Kbit/s	1mW	PCB module
Active RFID	134kHz	128 bit/s	<1mW	Pill
Intra-body COM	<1MHz	>64 Kbit/s	<1mW	Band-Aid/pill

There are situations where the cabling connected to sensors can be loosened or damaged, either due to human error or in most cases due to some other works done around it overall making the sensors unresponsive as a result of reconnection from the beginning or replacement at worst increasing complexity.
Wireless technologies provide possibilities for the clinicians providing easy access to sample and record the patient's data. Different wireless technologies are compared based on their transmission rate, frequency rate, power and size that is explained in the table1. Based on the above comparison IBC is chosen being a higher standard technology that operates at a higher data rate with comparatively low frequency and transmission rate factors.

The IBC technique has been defined to have the following characteristics :

- Security – This method involves electrodes compactly small in size that requires very low interference bandwidth and the entire communication being an end to end connection there is no data loss.
- Frequency reuse -The communication being formed entirely within the body offers only short range and hence therefore allows frequency reuse.
- Efficient power- The reticence of communication in IBC prevents energy dissipation in the surrounding environment and hence results in low power consumption.

II.OVERVIEW

A. The human tissue

The human body has the potential to emit some amount of electric signals with the presence of tissues and ion contents. the operation frequency range, temperature, intactness of cellular membranes, and tissue water content are some of the major factors which determine the tissue electrical properties in the human body.

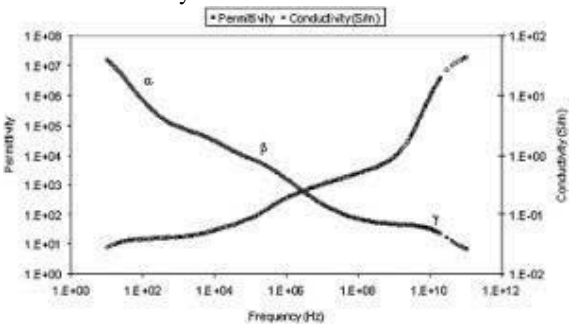

Fig1. Shows variations in the tissue properties

The electrical properties of human tissue are a key element (feature) for designing
an energy efficient, low noise, and cost effective IBC transceiver system achieved
through the modeling of the human body transmission channel characteristics.

B. The coupling method

The effects of human body tissues is the principle on which IBC is primarily based on. In general, there are two methods for body coupling (i.e) galvanic coupling and capacitive coupling that explains how data can be measured, stored and calculated from the human body.

Both methods involve the presence of an electrode pair to the human body. Galvanic coupling is chosen over capacitive coupling because the disadvantages of capacitive coupling are overcome.

In galvanic coupling, both electrodes are placed onto the human body where as one attached to the human body and other used as ground in the air in capacitive method.

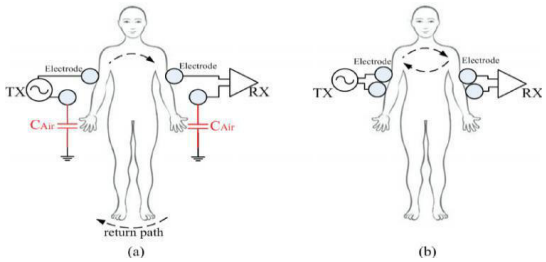

Fig.2 Capacitive coupling Galvanic coupling

III. METHODOLOGY

Augmenting the application of IBC, we introduce the human body networking technology **REDTACTON.** It is a chip like temporal that here is used as a transceiver device. The technology in today's world has great evolution that contributes many inventions to science. One such contribution is the invention of the above mentioned technology. Redtacton is a contemporarily developed technology by Robin Gaur Jind and introduced by the Nippon telegraph and telephone corporation(NTT). The basic principle that it relies upon is that the optical properties of an electro-optic crystal varies according to weak electric field. It uses the minute electric field emitted from the human body through the tisues. The difference between the deflections produced in the strong and weak pulses is converted into electric signals. The transmission path commences once when the transmitter attains contact with the surface of the skin and when the contact is loosened the transmission terminates. This could get as simple as two people equipped with RedTacton devices being able to exchange data just by shaking hands.

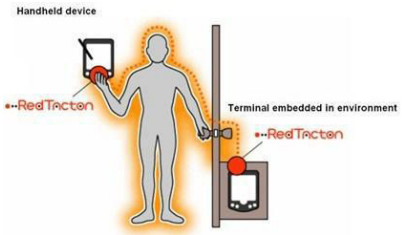

Fig 3. Redtatcton technology

A. Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

IV. PROPOSED MODEL

A. Hardware system

The proposed model embodies sensors to measure heart-beat(digital) and body temperature(analog) values which are transmitted through an integrated microcontroller. Data on the receiver side is displayed via lcd.

The microcontroller that we use here is pic16f877a. The conditioning circuit consists of transformer, bridge-rectifier and regulator all together forms the power supply. The pic controller is integrated internally with an ADC hence eliminating the need of an independent ADC.

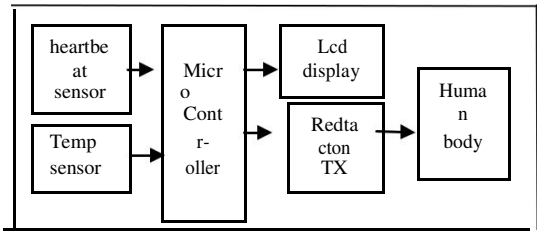

Fig 4. Architecture of the system

B.Implementation

The heart-beat sensor consists of an LED and a light detector. When the tip of finger is placed on LED, the detector detects the amount of light passed onto the finger and is converted into electric pulses.

The systolic and diastolic pressure from the heart causes the finger surface to be slight opaque which makes difference in the pulse signal. On every beat of the heart the detector's output changes and as a result the heart-beat rate is calculated as bits/min. LM35 sensor is used to measure the patient's body temperature. The temperature can be more accurately measured than a thermostat. This sensor's output is proportional to temperature in (degree Celsius).

The working of the system can be explained with the master and slave devices. The heart-beat and temperature modules act as slave devices from which all the required data from the human body is stored i.e. in the redtacton transceiver that acts as the master device. The data is then formed into a packet format which suitably helps identification of heartbeat and temperature datum individually.

Fig5 Proposed system transformed into a wearable device

IV. CONCLUSION

The introduced technique is concluded to be a better susceptible arrangement for the monitoring and measuring the health of a patient. The model mainly influences on the data collected from the human body, the frequency can be reused. The low-power consumption and their low BER values suggest that IBC technique is much efficient than other wireless technologies.

Successive developments will improve portable and wearable devices .Hence, this paper has introduced a promising methodology for monitoring the health care based on IBC. Future works will aim to optimize and utilize the same for variety of monitoring system. This effective technology is still at it's pace of development and suffers growing concerns.

References

[1] T. G. Zimmennan, B. S. , "Personal Area Networks (PAN): NearField Intra-Body Communication," Master's thesis, MIT, Cambridge, MA, 1995.

[2] Sang Don Kim, Sang Muk Lee, and Seung Eun Lee Seoul National University of Science and Technology, Seoul, Korea, "Secure Communication System for Wearable Devices Wireless Intra-Body Communication",IEEE International conference on Consumer Electronics,2015.

[3] M. S. Wegmueller, M. Oberle, N. Felber, N. Kuster, and W. Fichtner, "Signal transmission by galvanic coupling through the human body", IEEE Trans. Instrum. Meas., vol. 59, no. 4, Apr. 2010, pp. 963-969.

[4] Joonsung Bae, Hyunwoo Cho, Kiseok Song, Hyungwoo Lee, and Hoi-Jin Yoo, 'The Signal Transmission Mechanism on the Surface of Human Body for Body Channel Communication," IEEE Transactions on microwave theory and techniques. vol. 60, 2012.

[5] Sang Don Kim, Ju Seong Lee, Yeong Seob Jeong, Ji Hoon Jang, and Seung Eun Lee,"Intrabody Communication for Personal Area Network," Advanced Technologies, Embedded and Multimedia for Human-centric Computing, Lecture Notes in Electrical Engineering, vol. 260, pp 335-339, 2014.

[6] MirHojjat Seyedi, Student Member, IEEE, Behailu Kibret, Student Member, IEEE, Daniel T. H. Lai, Member, IEEE, and Michael Faulkner, Member, IEEE, "A Survey on Intrabody Communications for Body Area Network Applications",IEEE Transactions On Biomedical Engineering, Vol. 60, No. 8, August