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Research paper

Biotelemetry Using Human Area Networking

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Abstract

Human Body Communication (HBC) is a novel communication method between devices which use human body as a transmission medium. This idea is mostly based on the concept of wireless biomedical monitoring system. The on-body sensor nodes can monitor vital signs of a human body and use the body as a transmission medium. This technology is convenient for long durations of clinical monitoring with the option of more mobility and freedom for the user. Biotelemetry is remote monitoring, measuring and recording of a living organism's function, activity or condition. Network of sensor nodes placed on or implanted inside the body of a subject is called Human Body Area Network (HAN). RedTacton is a user-friendly pervasive technology that establishes a communication between human body and devices in a closer proximity. This paper proclaims model of a human area networking technologies that enables communication by means of "Touching". Redtacton technology was implemented to overcome the weak radio signals, data speeds and security –risks on unwanted signal interceptions. Here, human body is the transmitting medium supporting IEEE 802.3 half-duplex communication at 10 Mbits/s. RedTacton uses the minute electric field generated by human body as a medium to transmit the data.

Keywords: *Human body communication, RedTacton, IEEE 802.3, Human Body Area Network (HAN), Biotelemetry, Body Coupled Communication (BCC).*

1. Introduction

In the era of digital communication, data transmission is a common need of every individual to communicate their devices with the remote devices or sometimes nearby devices. Even a common man now is everyday indulged in transferring data in some or the other way like the voice calls, SMS, chats, etc. This is nothing but transmission of data from one end to the other. Some data are securely transferred that should not be readable or writable to public as in the case of defence, bank data, etc. But still there is a vast risk of data being hacked by the anti-social elements. For the distance communications, also called Far-field communication, it requires radio frequency (RF) waves to transmit data over long distance where Personal Area Network is not possible to setup and hence Human Area Network (HAN). But for the communication type which can be reached within our hands, also called as Near-field communication, Human Area Network can be introduced as a medium for transmission of data from start point to end point.

Medical biotelemetry is used to remotely track physiological functions of patients, like body temperature, heart rate, blood pressure, ECG, EEG signals, etc., and even to operate devices such as drug delivery systems and prosthetics. Implantable biotelemetry focuses on the transmitter devices implanted in the human or animal being studied, like cochlear implants or implantable pacemakers.

The main constituents of a biotelemetry system are sensors of physiology functions located on the transmitters, transmission path and receivers. Transmitters with sensors are placed on the surface of or implanted inside the human body. In contrast to the medical biotelemetry, the implantable implies the absence of wires as a transmission medium between a transmitter and a receiver. Still, the wires are impractical for monitoring, since they disturb the patient and the medical personnel. Using different wireless technologies provides better freedom of movements and the mobility of the patient, which is of particular importance in a long-term monitoring, every day activities of non-ambulatory patients and during the surgeries. Wearable sensor network placed on the human body is called Body Area Network (BAN).

RedTacton technology is a Human Area Networking (HAN) technology which was introduced by Nippon telegraph and Telephone Corporation (NTT's) that uses the human body surface as a high speed and safe network transmission path. It is completely distinct from wireless and infrared technologies as it uses the minute electric field emitted on the surface of the human body. A transmission path is formed at the moment a part of the human body comes in contact with a RedTacton transceiver. Communication is possible using any body surfaces, such as the hands, fingers, arms, feet, face, legs or torso. RedTacton works through shoes and clothing as well. When the physical contact gets separated, the communication is ended.

RED - It is an auspicious colour according to Japanese culture for warmth/TACTON- meaning "action triggered by touching". In the past, Bluetooth, infrared communications (IrDA), radio frequency ID systems (RFID), and other technologies have been proposed to solve the "last meter" connectivity problem. But, they each had a various fundamental technical limitations that constrain its usage, such that precipitous fall-off in transmission speeds in multiuser environments producing network congestion. The concept of intra-body communication was first proposed by IBM in 1996.This communication mechanism was later evaluated and reported by several research groups around the world. Finally, all limitations were overcome by NTT (Nippon Telegraph and Telephone Corporation) located in Tokyo, Japan by using

photonic electric field sensors and finally came up with a human area networking technology called "RedTacton".

Features of RedTacton

Generally, there are three features based on RedTacton they are as follows,

- Touch - Touching, gripping, sitting, walking, stepping and other human movements can be the triggers for unlocking or locking, starting or stopping equipment, or obtaining data.
- Broadband and Interactive - Duplex, interactive communication is possible at a maximum speed of 10Mbit/s. Because the transmission path is on the surface of the body, transmission speed does not deteriorate in congested areas where many people are communicating at the same time.
- Any media - In addition to the human body, various conductors and dielectrics can be used as transmission media. Conductors and dielectrics may also be used in combination.

2. Literature Survey

Zimmerman et al. (1995) discovered body coupled communications by accident while doing human interface research on position sensors at MIT. Simultaneously at the Sony Labs a similar technology was developed that resulted in the wearable key prototype. These discoveries led to initial media frenzy. But soon afterwards interest was lost in body coupled communications because of what was then thought were fundamental limitations of the technology (Zimmerman thesis mistakenly stated that the technology had fundamental limit of 852 Kb/s). During the initial stages there was also research done at powering devices via the body.

Robin Gaur Jind et al. (2004) developed RedTacton with an electro optical implementation, a speed of 10 Mb/s was reached. It was a major breakthrough came from NTT (Nippon Telegraph and Telephone). One of their applications was sending video through the human body. In mid of 2004, the Skinplex technology became available which was very simple implementation with very low speeds and very low energy consumption. This implementation was not advanced enough for body sensor networks and was mainly used to identify the user.

M.Shingawa et al. (2004) describes a near-field-sensing transceiver for intra-body communication, in which the human body is the transmission medium. The key component of the transceiver is an electric-field sensor implemented with an electro-optic crystal and laser light. This sensor is suitable for detection of small and unstable electric fields produced by the human body because it has extremely high input impedance. This transceiver enables IEEE 802.3 half-duplex communication of 10 Mb/s through a person's body in an operating range of about 150 cm between the hands. The packet error rate of 0.04% is obtained at packet size of 1070 octet.

T.C.W. Schenk et al. (2008) revealed the influence of electrode design, electrode position and body motion on the propagation loss and to characterize the experienced interference in the experimental characterization of body-coupled communications channel. It is concluded that the maximum propagation loss for the whole body channel is below 80 dB. Moreover, the frequency dispersion and the influence of body movement on channel attenuation are shown to be much smaller than for radio frequency (RF) WBAN channels.

H. Ando et al. (2016) described that Simultaneous recordings of neural activity at large scale, in the long term and under bio-safety conditions, can provide essential data. These data can be used to advance the technology for brain-machine interfaces in clinical applications, and to understand brain function in Wireless Multichannel Neural Recording With a 128-Mbps UWB Transmitter for an Implantable Brain-Machine Interfaces.

3. System Architecture

On the basis of above literature survey the proposed block diagram for biotelemetry using human area networking is shown in figure 1. The setup has two sections namely, Transmitter and Receiver. The proposed system uses the human body as a transmission medium for data communication. Here, the bio-medical data of a patient will be transmitted from the transmitter to the receiver section through human body. For biotelemetry, few sensors are attached to the human body along with RedTacton transmitter and the data at the receiver section can be collected using the RedTacton receiver.

Here, the sensor module which is present in the transmitter section consists of Heart rate sensor, Respiratory sensor, Glucose sensor, Blood pressure sensor along with a PIC microcontroller. It is attached to the RedTacton transmitter.

The receiver section has RedTacton receiver and a monitor to display the data for biotelemetry function. A common ground must be connected between the transmitter and receiver.

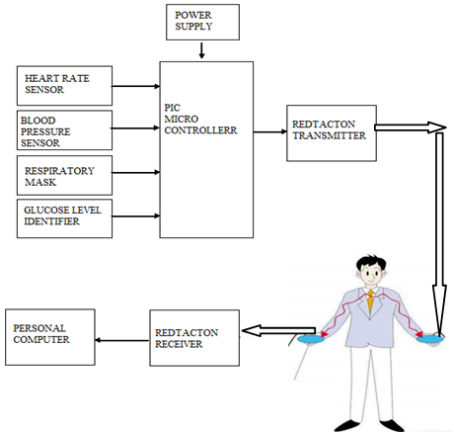

Fig. 1: Biotelemetry system

Working Principle of RedTacton

Similar to other technologies, RedTacton Technology, will have a transmitter and a receiver. As soon as the physical contact is established between the transmitter and the body transmission gets triggered and it continues until the contact is there. The transmitter will induce a mild electric field on the body surface and a transistor or photonic electric field sensor will be installed on the receiver side and this sensor detects the electric field present on the body and processes the signals and after processing the data is to be downloaded in the receiver end. Other than the actual signal carrying electric filed there will be other electric signals which are small and have no role in the communication. This can be compared to noise in communication and these are automatically sent to ground in the receiver end.

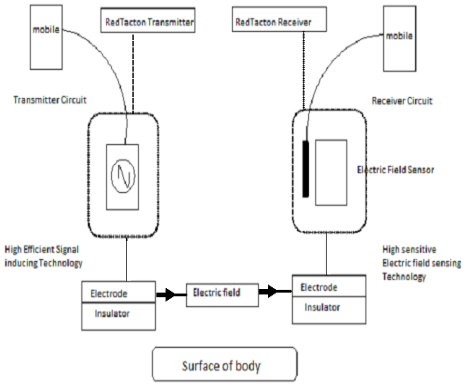

Fig. 2: Working principle of RedTacton technology

4. Results and Discussion

The simulation result of the proposed biotelemetry system is shown in figure 3. The real time data will be collected and displayed at the receiver section using RedTacton transmitter and receiver with the human body as a transmission medium. [14]
Here, AC voltage is converted into DC voltage and given as an input voltage to the PIC microcontroller. Data from the sensor module which consists of Heart rate sensor, Respiratory sensor, Glucose sensor, Blood pressure sensor will be given as the input to the controller through the input pins. The output will be displayed using the LCD interface in the transmitter section.
The same output will be displayed in the receiver section using RedTacton transmitter and receiver.

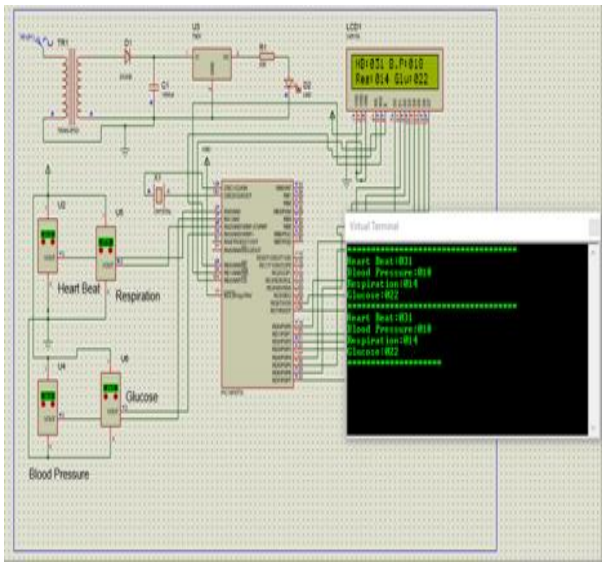

Fig. 3: Simulation result of biotelemetry system

5. Future Development

RedTacton has a wide range of unique new functional features and enormous potential as a Human Area Networking technology. In future, RedTacton can be developed as a portable device which can be used everywhere. Biotelemetry can be done through Wireless Body Area Network. Data transmission may happen through the user's clothing, handbag or shoes, anyone carrying a special card can unlock the door simply by touching the knob or standing on a particular spot without taking the card out. It will have many future applications such as walkthrough ticket gate, a cabinet that opens only to authorized people and a television control that automatically chooses favourite programs. The system also improves security. It ensures that only drivers can open their cars by touching the doors if the keys are in their pockets, not people around them.

Advantages

- Data transfer is faster and easier.
- Data transmission speed is 10Mbps for shortest distance.
- Data loss during the transfer is low.
- Power consumption is lesser.
- Security is more.

Disadvantages

- Though it is been used only within a few centimetres, the data can be transmitted via multiple person by touching each other.
- Cost is more; it can be reduced in future.

6. Conclusion

Red-Tacton technology is better when compared with other technologies; it is well-known for its data transmission at 10 Mbps within a shortest distance. This technology that enables the first practical Human area networking between body-centred electronic devices and PCs or other network devices embedded in the environment a new generation of user interface based on totally natural human actions such as touching, holding, sitting, walking or stepping on a particular spot. RedTacton technology is expected to overcome the Bluetooth technology in the future. This technology could put the use of cables to an end. Finally, I conclude that "Future Technology Is On Red-Tacton Technology".[15]

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