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A PATH FOR HORIZING YOUR INNOVATIVE WORK

HUMAN BODY AS COMMUNICATION MEDIA

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Abstract: In today's world, people can communicate anytime, anywhere, and with anyone. A lot of data are handled on various types of mobile terminals, such as cellular phones, digital cameras, pocket games, personal digital assistants, and notebook-type personal computers. They can transmit the data over the wired network or wireless network. The typical drawbacks of the existing system are as follows: First, routing of the cable for wired network. Second, the wireless network is not secure because of the data signal are radiated outward. Third, data transmission speed is less because of the packet collision and security risk from unwanted signal interception. Fourth, the power consumed by the system is more. The drawback of the existing system is eliminated using Intra-body communication (IBC) because in this system data is transmitted using body as a medium. By touching the hardware connected with the device data can be transmit , eliminating the problem of routing cable, radiation of signal because the data is transmitted within the body, it is the secure transmission because no unwanted signal interception, and the power consume by the system is also reduced. Considering these advantages, IBC is a promising candidate for the forthcoming ubiquitous computing era. Intra-body communication (IBC) is a new, "wireless" communication technique that enables electronic devices on or sometimes near the body to exchange the information.
It uses the dielectric properties of human tissues so that human body can be used as the communication channel for data exchange. Transmitting data directly through the skin is can be much more efficient than current wireless transmission technologies (Bluetooth, Wi-Fi), since it requires much less energy. In this paper the concept of Personal Area Networks (PANs) is presented to demonstrate how electronic devices on and near the human body can exchange digital information through the body. Various methods available for Intra-body communication are studied and presented. The advantages of this method over current wireless communication techniques are discussed along with possible limitation. The technology can have a wide range of applications, hence future scope of the system is presented.

Keywords: Intra Body Communication; human area network; human body communication; personal area network

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INTRODUCTION

In today's world, wireless communication become popular day by day. People can communicate anytime, anywhere and with anyone. Various devices like mobile phones, laptops, personal digital assistants (PDA's), wristwatches, digital cameras are popular and use by many people. These are used to carry various personal or public information and communications in everyday activities. Most of the time it is require to transfer information from one device to another device.

Intra-body communication is a new, "wireless" communication technique that enables electronic devices on or sometimes near the body to exchange the information For transferring information we either use wired media or wireless media. Wired connections between electronic devices in human area networks are messy and can easily become entangled. Whereas Short range wireless communication systems such as Bluetooth and wireless local area networks have some problems. Throughput is reduced by packet collisions in crowded space such as meeting rooms and auditoriums filled with people and communication is not secure because signals can be intercepted.Power consumption is also more.

medium, then this would be an ideal way of implementing human area networks because it would solve at a stroke all the problems including throughput reduction, low security and high network setup costs Once developed there would be plenty of applications where we can implement this technology, like in our project we would be trying to integrate this technology to transfer file from one computer to other computer just by touching the hardware connected to both computers.

The basic idea is to achieve seamless communication by using human body as the transfer medium .The idea is to develop a hardware on both sending and the receiving end along with a software that will be installed on the devices. Whenever the two devices wish to communicate, we just touch the copper pads device at the sending and the receiving end. When there's human body in contact, the circuit is complete and the body acts as a transfer medium for the data.

In this paper, the principles of intra body communication. Section II explains the basic principles of intrabody communication, where the EO sensor is used to receive data signals. A simple and intuitive model is introduced to understand the essence of intrabody communication. Section III describes the comparison with other technologies and method of intra body communication. Section IV describes related work. Section V presents a transceiver

designed for intra body communication and the advantages and limitations of intra body communication.

- Intrabody Communication Concept

Intra Body communication was originally proposed by T. G. Zimmerman[2] [4]. The concept is to use a human body as communication channel among mobile computing terminals with which a man is equipped. He presented the concept of Personal Area Networks (PANs)- Near field Intra Body Communication, to demonstrate how electronic devices on and near the human body can exchange digital information by capacitive coupling pico amp currents through the body.

As shown in Fig. 1, the transmitter, human body, receiver, and earth form a large circuit loop, where each component is coupled with the others through an electric field. Considering this situation, we introduce a simple equivalent circuit model of the intrabody communication system in Fig. 2. The model helps us intuitively understand the principles and characteristics of intrabody communication.

A schematic of the intrabody communication model is shown in Fig. 1. In this case, we consider the communication between two mobile terminals through a human body. One terminal is expressed as a data transmitter. The other is a receiver. The data transmitter generates a voltage corresponding to data signals between a signal electrode and its circuit ground. The signal electrode is attached to a human body. As a first approximation, a human body is regarded as a conductor wrapped in an insulator [1]. Therefore, the signal electrode and the human body comprise a condenser. The electrical charge inside the human body moves according to the voltage applied to the signal electrode.

Another electrode attached to the human body also composes a condenser and conveys the received data signals to an EO sensor in the receiver.

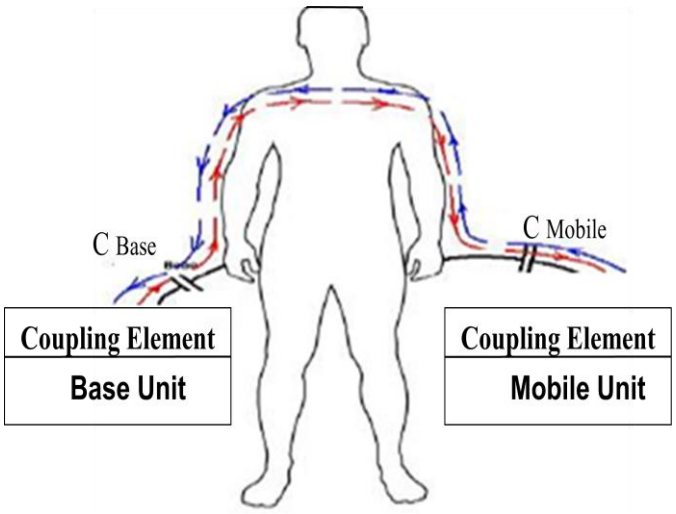

Fig. 1. Basic intra body communication

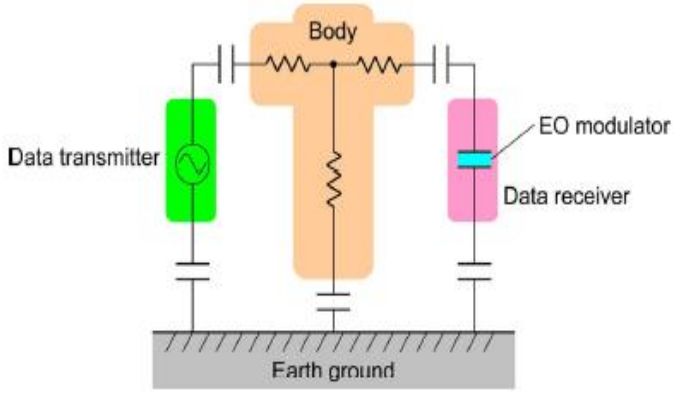

Fig.2. Equivalent circuit model of intrabody communication shown in Fig. 1.

- Comparison of IBC with Other Short-Distance Wireless Technology

There are various short range communication channels like Bluetooth, wireless LAN, Zigbee and UWB apart from Human area network. The throughput of these channels is reduced as number of devices increases in an area like crowded space. This happens due to packet collision. On other hand infrared communication has lost its popularity due to its highly directional nature and need to be in visible range for communication (LOS). These limitations can be easily overcome through Human Area Network since persons own body is used for communication. It forms an exclusive channel for communication. This exclusivity also helps in large throughput for the communication channel.fig.3. shows Data rate vs power consumption of various

wireless communication technologies. IBC is consider under BAN and it shows at high data rates power requirements is extremely less in the range of tens of miliwatts as compare to other technologies. Hence battery life of devices can be extend which is most important factor consider in today's communication.

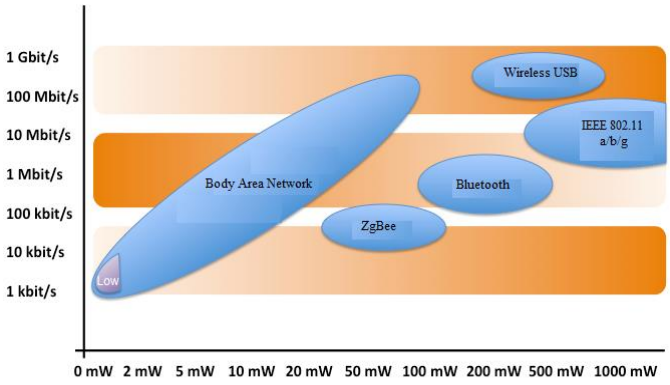

Fig. 3. Data rate vs. Power

- *Comparison Between BAN and RF*

Table 1. Comparison between BAN and RF

Particulars	BAN	RF(UWB,NB)
Communication medium	Human Body	Air
Frequency band	Centered at 21 MHz	402 MHz – 10GHz
Data rate	< 2 Mb/s	< 13Mb/S
Transmission range	< 2 m	10M
Signal attenuation	Low	High
On body antenna	No	Yes
Energy efficiency	High	Low

- *Methods of Intrabody Communication*

In general, IBC can be classified into two basic coupling types (i.e., how the electrical signals are transmitted): capacitive coupling (electric field) and the galvanic coupling (waveguide). Fig. 4 and 5 illustrates schematically the two different types of IBC coupling. For both coupling types the transceiver needs two pair of electrodes. In capacitive coupling only one of the electrodes (signal electrode) of the transmitter side and receiver side is attached to the body, while the other electrode (ground electrode) is floating. In the galvanic coupling method, both electrodes of transmitter and receiver side are attached to the human body.

On the other hand, galvanic coupling is achieved by coupling alternating current into the human body. It is controlled by an ac current flow and the body is considered as a transmission line (waveguide). In the galvanic coupled IBC, an electrical signal is applied differentially between the two electrodes of the transmitter. Major propagation of the signal occurs between the two transmitter electrodes and a largely attenuated signal is received by the two receiver electrodes. Fig. 5 shows pathways for a current flow between transmitter and receiver electrodes in the galvanic method.

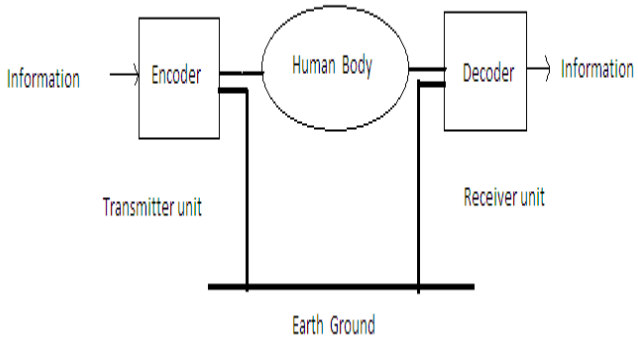

Fig.4. Electrostatics Coupling.

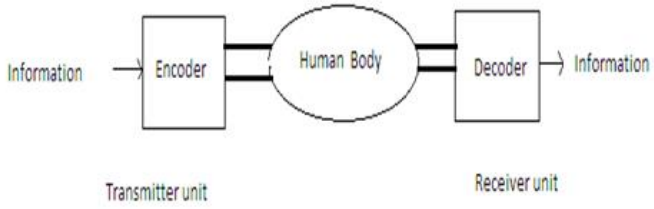

Fig.5. Wave guide Coupling

On the other hand, galvanic coupling is achieved by coupling alternating current into the human body. It is controlled by an ac current flow and the body is considered as a transmission line (waveguide). In the galvanic coupled IBC, an electrical signal is applied differentially between the two electrodes of the transmitter. Major propagation of the signal occurs between the two transmitter electrodes and a largely attenuated signal is received by the two receiver electrodes. Fig. 5 shows pathways for a current flow between transmitter and receiver electrodes in the galvanic method.

IV. RELATED WORK

Sasaki et al [4] tried to illuminate the principles of intrabody communication in his paper, where the Electro Optic [EO] sensor is used to receive data signal. He with his team describe the detailed structures and performance of a newly developed sensitive EO sensor. They measured the characteristics of communication systems including a human body using the EO sensor. The use of new EO sensor is to reduce the influence of common mode noise. With EO sensor, Manchester-coded 10-Mb/s data signals were successfully received under all conditions. With the EO sensor, it is always possible to receive distortion-free data signals. This is a crucial advantage of using the EO sensor for intra body communication.

Two Japanese Telecommunication companies, Nippon Telegraph & TelephoneCorp. and its subsidiary NTT DoCoMo Inc.,[2][5] They explain the concept of REDTACTON .explain three distinctive features of Red tact on and various applications of red- tact on have developed a technology that turns the human body into a broadband link. The technology uses the body's conductivity and allows the exchange of data between personal digital assistants (PDA) by human touch. The intra-body communication system is enabled by electro-optic probes. The electric field passed through the electro-optic crystal is detected as changes in the polarization of a laser beam. The electro-optic sensor features a high input impedance, high-sensitivity and high-speed operation capability. A data rate up to 10Mbit/s is claimed.

The researchers at MIT's media lab discovered that capacitive coupling of the human body to its environment and certain parts of the near field could be exploited to make the human body act as a medium for data transmission.

TABLE 2. SUMMARY OF CHALLENGES AND FUTURE WORK IN THE IBC TECHNIQUE

Challenges	Future work
1. **The frequency dispersions of human tissue limits maximum carrier frequencies and data rate.**	New techniques to improve data rates in low frequency ranges required
2. **Channel models incorporating human movement required. In addition, the effects of all component devices in the measurement setup should be considered.**	Theoretical models to understand the body channel characteristics and constraints. Human channel modelling will be necessary while the body is in motion
3. **Effect of long term use on health**	Studies on tissue effects for IBC use in the long term, e.g. Cancer.
4. **Transceiver specifications based on**	The specification of WBAN needs to be

	WBAN standard (low power consumption, transmit mask, receiver sensitivity, and signal modulation and coding) difficult to fulfil.	considered in future IBC transceiver design
5.	**Networking issues such as security for information, QoS, interrelationship in different environments, and mobility.**	New transceiver design based on high security, low power consumption, enhanced data rate, and small form factor for ease of use compared to current IBC systems.

According to Zimmerman [2] [5], near-field communication can operate at very low frequencies and low transmission power. The prototype of the PAN transmitter operates at 330 kHz, 30V, with a transmission power consumption of 1.5mWfor charging the electrode capacitance. The PAN technology was proposed for integration into a custom CMOS chip to achieve lower size and cost. A demonstrator system allowed the modest transmission of 2.4 Kbit/s. Digital information has been encoded using on-off keying with quadrature detection to reduce stray interference and increase the receiver sensitivity. Several interesting applications have been proposed. The potential of this technology lies in identification and biomedical applications. The principle of Zimmerman's PAN system has served as a reference for further capacitive coupling body transmission.

MirHojjat Seyedi et al [1] in his paper done a survey to examine the ongoing research in the area of Intra- Body communication for body area network applications and highlights IBC core fundamentals, core mathematical models of the human body, IBC transceiver designs, and the remaining research challenges to be addressed. And it is found that IBC is a new short range non-RF wireless communication technique specified by the IEEE 802.15.6 using the human body as a transmission medium. As it stands, the IBC technique potentially offers a more power efficient and naturally secure short range communication method for body sensor networks, compared to wireless RF.

Yong Song [5] in his paper the Simulation Method of the Galvanic Coupling Intrabody Communication With Different Signal Transmission Paths, Gives a method for the mathematical simulation of the galvanic coupling IBC with different signal transmission paths. The mathematical simulation results coincide with the measurement results over the frequency range from 100 kHz to 5 MHz. To guarantee the safety of the human body, the software simulation is considered as an important method for the investigation of the IBC. Two methods have been used for the simulation of the IBC. One is the finite-element method [8] and other method is transfer function method.

V. A TRANSCEIVER DESIGNED FOR INTRA BODY COMMUNICATION

The mothods used for intrabody communication are electrostatic coupling and glavanic couplingas explained in previous section.In proposed work aim is to transfer datafrom one personal compuetr to other personal computer using Galvanic coupling method.ARM7 LPC2148 microprocessor is heart of design .it consumes very less power .As none of modulation technique is used power required for this system is very less.It is the range of miliwatts.Voltage requirement of the ciruit is just 3.3 V TO 5V.at baud rate 9600b/s.we are able to tranfer text file as well as image files at high speed from one personal computer to other personal computer just by touching the hard ware connected to both transmitter and reaciver end.

A. Advantages

- Provides High Speed and Accuracy.
- Very secure Data Transmission i.e., there is no problem of Hacking since medium is our Individual Body.
- No need to insert smart cards, connect cables, tune frequencies, or any of the other inconveniences usually associated with today's electronic devices.

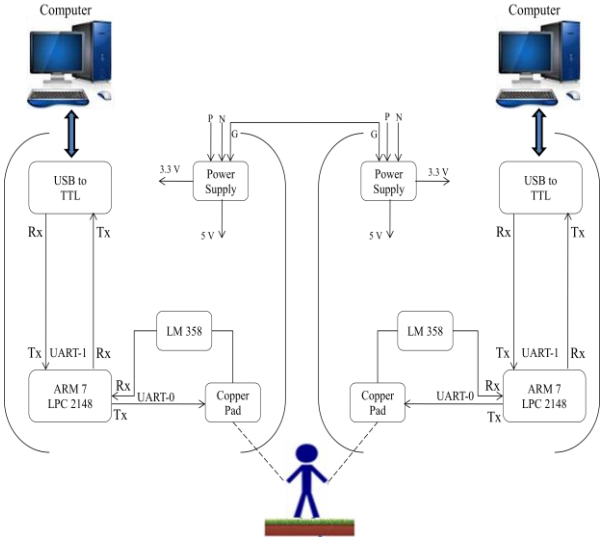

Fig. 6. Block Diagram of IBC Intrabody Communication

- Transmission speed does not deteriorate in congested areas where many people are communicating at the same time.

- Low power consumption.
- Communication by just a Simple Touch thus eliminating use wires.

B. Limitations

- Very high initial cost
- High Sensitivity of Receiver is required
- Complexity in design
- It can be useful within Few Centimeters only

VI. CONCLUSION AND FUTURE WORK

Intra body communication is a relatively new communications technology, and research is still on going to address the many challenges and issues in the field. Many areas can benefit from this technology. Human society is entering an era of ubiquitous computing, where everything is networked. HAN is gearing up to compete with Bluetooth, Zigbee, IrDA (infrared data association), UWB (ultra wide band). It can clearly say that, this technology will spawn revolutionary changes in the modern communications and become a pivot technology. When we compare HAN with other technologies, HAN will give a better performance over other. If HAN is introduced into cyber market it brings a marvelous & tremendous change and will be adopted by many more people. In few years from now everything is going to fall under this super technology.

Intra body communication is a new short range non-RF wireless communication technology specified by the IEEE 802.15.6 using human body as a transmission medium. Many authors have presented the issues and challenges of this field in their papers. Still research is going on to address different issues.

In our project we have realized one of the category of intra body communication system i.e. transmission of data between two devices which are portable or say mobile and for that we developed an external transceiver hardware for transmission of data between two computers. Further in future we can place designed external hardware inside the system. Data transmission security can be provided. Video, audio or image file can also be transmitted with increased data rate.

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