Signal Transmission By Galvanic Coupling Through Human Body

K.D.Chaudhari[1], D.G.Agrawal[2]

PG Student [CE], Dept. of ECE SSGB College of Engineering & Technology, Bhusawal, Maharashtra, India[1]

Assistant professor, Dept. of ECE SSGB College of Engineering & Technology, Bhusawal, Maharashtra, India[2]

ABSTRACT

Galvanic coupling is a method for injecting an electrical communication signal into the body. The body acts as the communication channel and the injected signal is transmitted primarily through the skin. Normally, devices on the body communicate wirelessly through radio frequency (RF) technology. However, galvanic coupling provides a more power efficient and more secure means of communication. These advantages make galvanic coupling useful for many applications, especially in the medical field. This report discusses these applications, how galvanic coupling works, its advantages over other communication techniques, and electrical properties of the body that affect galvanic coupling.

KEYWORDS: *Body sensor networks, capacitive coupling, electrode, galvanic coupling, intrabody communication (IBC), measurement setup, modeling, simplified equivalent circuit.*

I.INTRODUCTION

1.1 Communication today:

In today's world, people can communicate anytime, anywhere and with anyone over a cell phone. Also, through internet people can download large quantities of quality data from remote locations. These technologies facilitate far-away communication for the users. Most electronic devices including personal digital assistants (PDA's), pocket video games and digital cameras have reduction in size, so that they can be carried around and used at the instance of requirement. These are used to carry various personal or public information and communications in everyday activities. Communication between electronic devices on the human body and one's embedded in our everyday environments is also critical, so this has driven extensive research and development on human area networks.

Wired connections between electronic devices in human area networks are messy and can easily become entangled. 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. The principle drawback of infrared communication is the tight directionality of beams between terminals is needed for the system to be effective.

1.2 Intra Body Communication:

The ultimate solution to all these constraints of conventional technologies is "intra body" communication, in which the human body serves as the transmission medium. If we could use the human body itself as a transmission 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 our file to the printer just by touching the computer. This would be a boom to the human computer interaction concept.

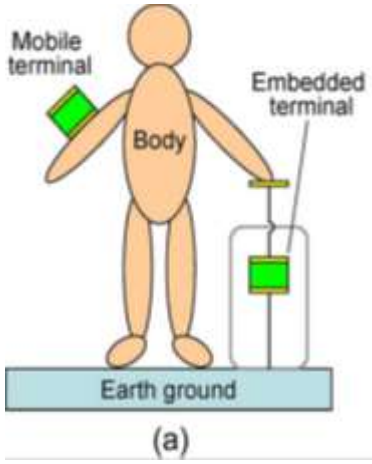


Figure 1.Intra Body Communication

1.3 Overview:

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, just as we turn on Bluetooth, we just touch the system 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. This happens(and is completely safe) because our body houses weak electric field and taking advantage of that, the transfer of the data takes place. Now because of earthing, the signal becomes weak and data may not be able to reproduce at the receiving end. But this is completely taken care by having an amplifier at the receiver which amplifies the signal so that data is intact. Giving a thought to safety factor, this is completely safe for the human body since the signal sent will be of very small voltage.

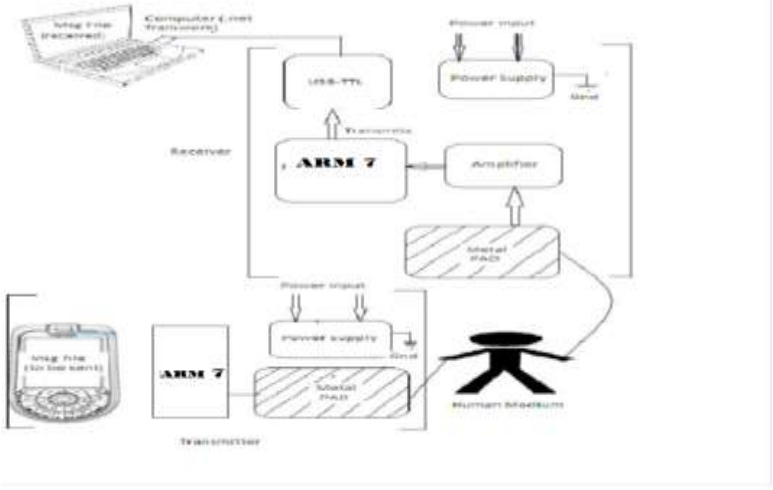


Figure 2.Block Diagram of Intra Body Communication

1.4 Process (Data transfer):

1. Select the option start sending at the application window
2. Touch the device at the senders end
3. Touch the device at the receiving end
4. The data will appear at the receivers application window and data transfer is complete One of the major advantages over existing systems is that it does not need the radio links which all the systems till now do.

Secondly since human body is the medium, connection achieved is dedicated which results in higher data transfer rates. Transfer speed is also much higher than other technologies. For the development part: two interfaces need to be developed, one for each end of the communicating systems. Selecting the file to be transferred from one of the interface, the file will start transfer as soon as the touchpad is touched.

II.SYSTEM MODEL AND ASSUMPTIONS

Galvanic coupling is a method of inserting an electrical signal into the body for intra-body communication.There are two different kinds of electrical current: direct current (DC) and alternating current (AC). Direct current travels in one direction and does not change. Alternating current can switch directions or vary in magnitude, usually at a specific frequency. In galvanic coupling an alternating current is injected into the skin. The skin acts like a wire and carries the signal throughout the body. This signal causes a voltage to appear across two receiving electrodes elsewhere on the body.

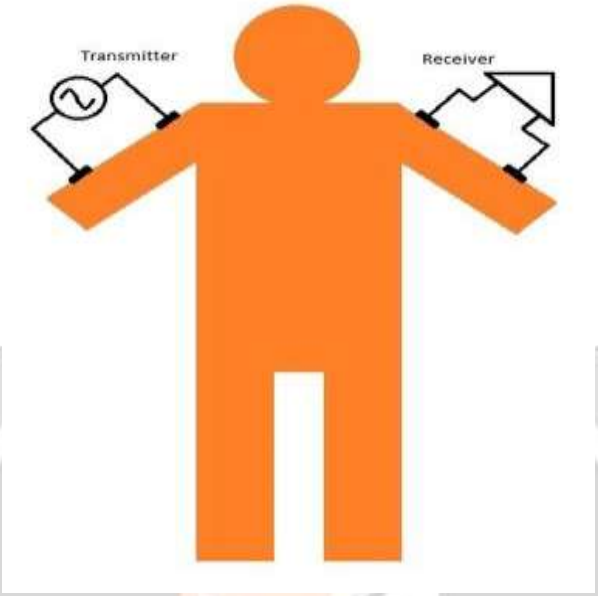


Figure 2. Human Body Communication Using Galvanic Coupling

Because the signal is completely contained within the human body, the performance is not affected by the surrounding environment [3]. However, the body is not a perfect wire and affects the signal in non-ideal ways, one of which is adding a delay [4]. Just like there is a limit on radio frequency transmission power due to safety reasons, there is one for galvanic coupling as well. The maximum allowed contact current is 20 milliamps because 50 milliamps is the current used for nerve stimulation. The injected current must be low enough as to not damage any nerves or tissue, especially when being applied over a long time.

2.1 Effects of the Body:

2.1.1 Electrical Properties of Tissue

Although galvanic coupling is not affected by the environment, it is affected by the electrical properties of the human body. The relative permittivity (how well an electromagnetic wave can pass through a material) of skin, fat, muscle, and bone affects the signal. These properties depend on operation frequency, temperature, structure of cellular membranes, tissue water content, and more. As the frequency of the signal increases, different tissues conduct the signal more easily and it penetrates deeper into the body. The most power efficient tissue is skin so this not ideal that the signal spreads to other tissue layers.

2.1.2 Attenuation

Due to the resistive nature of the human body, signal attenuation occurs. That is, the signal strength gets smaller. Signal attenuation increases exponentially with distance when transmitting over the arms and legs [5]. An increase of 5 cm between the transmitter and receiver on the arm can increase attenuation by a factor of 2 to 3 times. Joints can increase the attenuation by a factor of 2.5 times. The larger the joints the more the attenuation [2]. A decrease in muscle resistance leads to an increase in attenuation, and a decrease of fat resistance leads to a lower attenuation because more of the signal remains in the fat layer and does not penetrate to the muscle layer [2]. Although attenuation occurs, it is still possible to recover the signal.

2.2 Software for system:

The softwares used to build the system are as follows:

Microsoft Visual Studio

It is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows Forms or WPF applications, web sites, web applications, and web

services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile, Windows CE, .NET Framework, .NET Compact Framework and Microsoft Silverlight.

Java Platform, Micro Edition

Java Platform, Micro Edition, or **Java ME**, is a Java platform designed for embedded systems (mobile devices are one kind of such systems). Target devices range from industrial controls to mobile phones (especially feature phones) and set-top boxes. Java ME was formerly known as **Java 2 Platform, Micro Edition** (**J2ME**).

Java ME was designed by Sun Microsystems, acquired by Oracle Corporation in 2010; the platform replaced a similar technology, PersonalJava. Originally developed under the Java Community Process as JSR 68, the different flavors of Java ME have evolved in separate JSRs. Sun provides a reference implementation of the specification, but has tended not to provide free binary implementations of its Java ME runtime environment for mobile devices, rather relying on third parties to provide their own.

2.3 Design Considerations

The architecture of the system contains two main modules:

1. Transmitter
2. Receiver

Transmitter:

The transmitter has the following components:

- Mobile device
- ARM 7
- Power supply
- Metal pad

Receiver:

The receiver has following components:

- Metal Pad
- Power supply
- Amplifier
- ARM 7
- USB to TTL

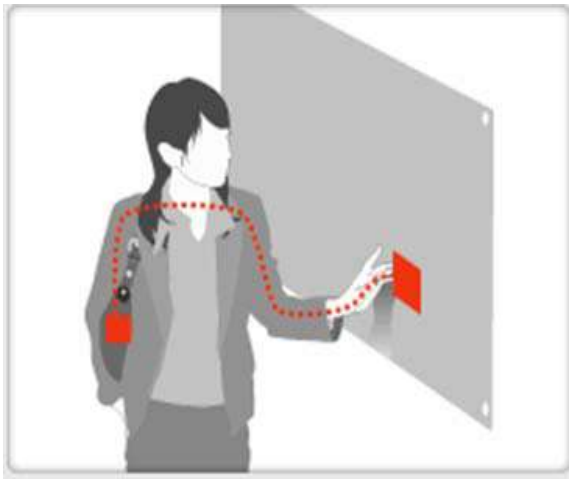
III. RESULT AND CONCLUSION

3.1 Advantages:

- Cables are eliminated
- Secure than other mode
- Large Throughput
- Can stop Whenever we want.

3.2 Application:

- **Touch Advertising and Receive information**

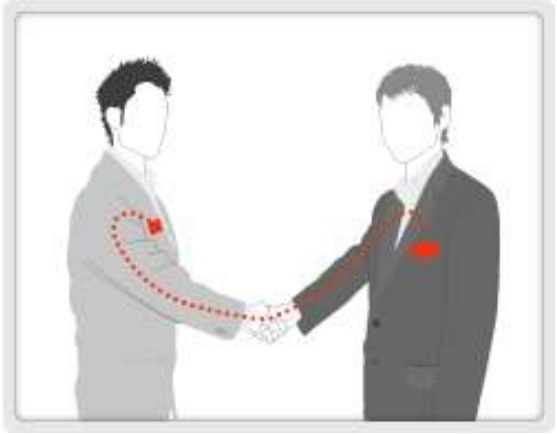


When a consumer stands in front of an advertising panel, advertising and information matching his or her attributes is automatically displayed. By touching or standing in front of items they are interested in, consumers can get more in-depth information.

- **Touch a Printer to Print**

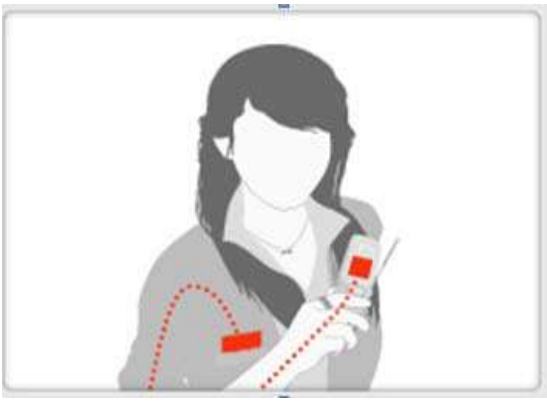
Print out where you want just by touching the desired printer with one hand and a PC or digital camera with the other hand to make the link Complicated configurations are reduced by downloading device drivers "at first touch".

- **Instanteous private network via personal handshake**



By shaking hands, personal profile data can be exchanged between mobile terminals on the users. (Electronic exchange of business cards) Communication can be kept private using authentication and encryption technologies.

- **Just Touching a Phone makes it your own**



Your own phone number is allocated and billing commences. Automatic importing of personal address book and call history.

3.3 Future of System:

The system will not replace Bluetooth but can act as a support to it by improving the speed of the communication. Further development in this system is to reduce the size of the hardware and to embed the system into the communicating devices. We believe that this system can bring about revolution in the way the world communicates with each other.

IV.CONCLUSION

We believe this idea will prove to be a new, innovative. We firmly believe that the implementation of the project will be smooth as it is expected to be in accordance with the detail study of our project that we have achieve till this stage. The various modules and their detailed design studied above will help define our project's implementation and provide strong base for developing the various modules practically. Overall, galvanic coupling is a very effective method for intra-body communication. It is secure because the signal is contained completely in the body. It is more power efficient than wireless RF communication and is more reliable than capacitive coupling. Also, its lack of wires makes its comfortable and hassle free for the patient. Galvanic coupling has many potential applications and could revolutionize the medical field.

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