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Mobile to Mobile data transfer through Human Area Network

Ms. Dhanashree Hinge, Dr. S. D. Sawarkar

Department of Electronics and Telecommunication Engineering
Datta Meghe College of Engineering
Navi Mumbai, India
Dhanashree1386@gmail.com , Sudhir_sawarkar@yahoo.com

Abstract

Technologies enabling communication between people and devices in close proximity are required for all modern user friendly gadgets. This paper demonstrates a design and implementation of Human Area Network technology that enables communication through human contact. Communication between mobile terminals and terminals that are embedded in the environment has become important. Use of cables is inconvenient as they can get tangled and are difficult to manage when used in Communication between devices which are in close proximity. When very weak radio signals are used for the communication, data speeds are reduced by packet collision in crowded places such as exhibition sites. There is also security risk from unwanted signal interception. For solving such problems we use body of a person as a signal path for communication. A transmission path is formed automatically when a person comes into contact with a device and communications between mobile terminals begin.

The hardware setup for this paper contains Transmitter and Receiver unit. These units contain BT-42, 32 bit ARM 7 TDMI Processor, LM 358 and Power supply. This platform consumes less power and it is cost effective. This concept will reduce load on other communication channels by introducing new communication mode.

***Index Terms*—Intrabody Communication, Personal Area Network, Red Tacton, Communication through Touch**

I. INTRODUCTION

A. General

Intra body communication was first proposed by Zimmerman [1]. In this type of communication human body is used and a communication channel among various devices. We live in a connected data intensive world today. Each person has various handheld devices such as cellular device, tablets, digital cameras, pocket games, notepad etc. Intra body communication can be an important tool for communication.

Intrabody communications can be used to communicate with devices embedded in our daily environment as well like password door locks, cars, mechanical instruments etc.

The concept of Intra Body communication was first proposed by IBM in 1996[1].This communication mechanism was later evaluated and reported by several research groups around the world. This method suffered from few disadvantages. NTT from Japan overcame this and introduced their own version of Human Area Network which overcame the limitations [2].

In Intrabody Communication need for cables is eliminated. This reduces the hassles of managing various cables and connectors for each device. It is also more secure compared to wireless communication since signals are not radiating in the surrounding environment and hence are not prone to interception. Communication is happening through human body and hence it is easy to control start and stop by just removing contact with human body.

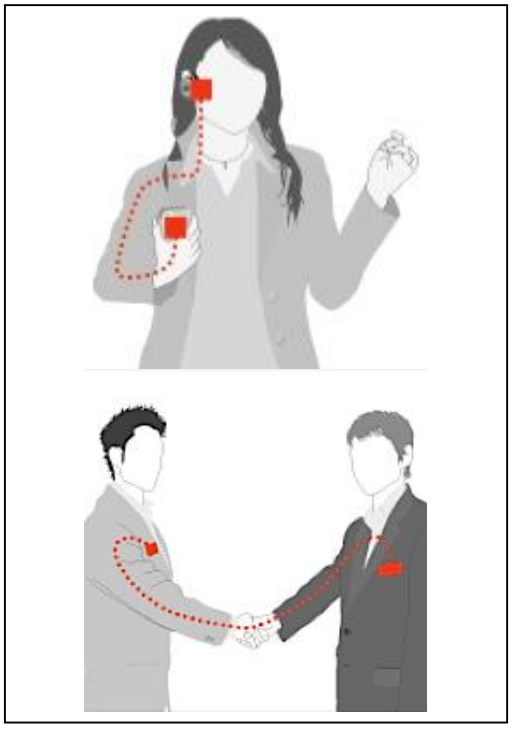

Fig. 1. Human Area Network Applications

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There are various short range communication channels like Bluetooth & wireless local area network 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. 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 [4]. Based on above reasons various groups and companies have studied and continue to study and experiment on Human Area Network.

The basic principal of Human Area Network is conduction of data through Human Body. In this case Human body and conductor attached to human body form a condenser [4].

B. Background

Today demand for wireless network has increased tremendously. Devices like cellular handset, PDAs, MP3 Player and digital cameras have become very popular. A person can have multiple devices at same time. This increased proliferation of devices requires a technique to communicate between these heterogeneous devices. There are various communication methods which are available such as Bluetooth, wireless LAN, Zigbee and UWB. There have been numerous efforts to reduce power consumption of these methods. Low power consumption is essential since majority of the devices mentioned above are wireless/mobile. [3] Modes mentioned above require power since they have to modulate signal to carrier frequency before transmitting. Also, they require setup time and effort. The Human Area Network is prime candidate for this since it requires low power and setup time.

C. Motivation

- A new mode of communication needs to be developed which is easy to use and can connect heterogeneous devices.
- The new mode needs to be easy to implement and cost effective
- Proposed system will be able to utilize Human Body as a conductor for data transmission
- Proposed system will be implemented using Open source object oriented program for easy and faster implementation
- When implemented commercially the proposed system will help in connecting various devices without any additional setup
- The proposed system will also help in reducing load on other communication channels by introducing new communication mode

D. Problem Definition

From the background and literature covered in above section we can clearly identify need for a new communication system. In this paper “Mobile-to-mobile data transfer through Human Area Network” data is transferred using Human Body as a conductor. Transmitting Mobile Device is connected to ARM 7. ARM 7 provides this signal to a copper plate. User touches his body to this copper plate. Similarly receiving Device is connected to another set of Copper Plate & ARM 7. User touches his body simultaneously to Receiving Copper Plate. This completes the circuit and enables communication using Human Area Network between the two devices.

E. Objective

- The system is designed for Mobile to Mobile Communication
- The system uses Human Body for transmitting data between two devices
- It uses Serial Communication Protocol
- Java Micro Edition 2.0 (J2ME) and Embedded C is used for programming
- Copper Plates and ARM 7 are used as transmitter and receiver
- The system enables file or data transfer through ARM 7 and copper plate. When Human body is in contact with these copper plate the communication is done through human body

II. LITERATURE SURVEY

Human Area Network (HAN) technology is still an emerging technology, and as such it has a very short history. HAN technology emerges as the natural byproduct of existing sensor network technology and biomedical engineering. Professor Guang-Zhong Yang was the first person to formally define the phrase "Body Sensor Network" (BSN) with publication of his book Body Sensor Networks in 2006. BSN technology represents the lower bound of power and bandwidth from the HAN use case scenarios. However, HAN technology is quite flexible and there are many potential uses for HAN technology in addition to BSNs. Some of the more common use cases for HAN technology are:

- Body Sensor Networks (BSN)

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- Sports and Fitness Monitoring
- Wireless Audio
- Mobile Device Integration
- Personal Video Devices

Each of these use cases have unique requirements in terms of bandwidth, latency, power usage, and signal distance. IEEE 802.15 is the working group for Wireless Personal Area Networks (WPAN) [IEEE 802.15]. The WPAN working group realized the need for a standard for use with devices inside and around close proximity to the human body. IEEE 802.15 established Task Group #6 to develop the standards for HAN. The HAN task group has drafted a (private) standard that encompasses a large range of possible devices. In this way, the task group has given application and device developers the decision of how to balance data rate and power.

Nippon Telegraph and Telephone (NTT) has made a breakthrough in the HAN. They have developed a technology known as Redtacton. This technology uses Human Area Network and sensitive EO (Electro Optic) sensors to achieve higher data throughput. Sensitive EO sensor comprises of laser diode (LD), a quarter-wave plate (QWP), an EO modulator (EOM), polarizing beam splitters (PBSs), and a photodiode (PD) [2].

Currently the interest in Human Area Network is due to its possible applications in Medical Field. As World Population skews towards higher age bracket we need monitoring mechanism which will be hassle free and will not hamper activity of elderly people. The HAN will help in monitoring patients without hampering their daily activity or need for carrying bulky devices with cables.

One of the widely cited work in this area is done by M Patel & Jianfeng Wang from Philips Research in North America. They did a comprehensive survey covering Key Research Challenges, Protocols, QoS, Standardization and comparison with other technologies in their Paper published in IEEE Journal in 2010 [5].

NTT has done extensive work in this field with aim of launching commercial applications with this technology. M. Shinagawa and others in their paper in 2004 have covered extensively the aspects about Transreceiver to be used and its configuration. They have also done Waveframe modelling and Packet transmission tests [2].

Japan has been pioneer in this field for last decade and apart from NTT researchers various researchers and students from Tokyo University doing research on the topic. One of the seminal work to originate from Tokyo University on this subject is by K. Hachisuka and others. In their paper in 2003 they demonstrated capability to transmit analog sine waves even with external noise through Human Body. During this experiment they achieved digital data transmission rates of 9600 bps using Frequency Shift Keying [6].

Another interesting study has been done by Ruoyu Xu and others from Hong Kong University. They focused on analyzing characteristics of Human Body during these communications and arriving at a model representing Human Body. They concluded that Intra Body Channel shows a band pass profile with central frequency around 42 MHz Below 100 MHz, the body appears to have uniform attenuation with about 15dB loss at distance of 15 cm [7].

III. IMPLEMENTATION AND DESIGN

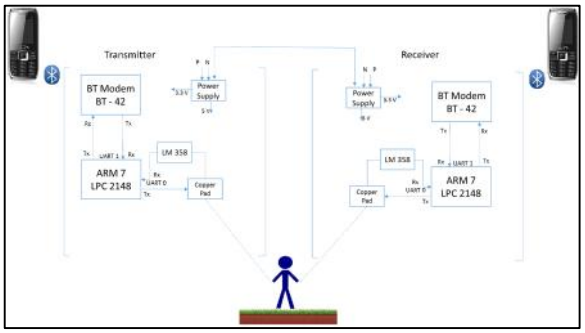

Fig. 2. Implementation Diagram

The above block diagram in Fig. 2 is the implementation design of the proposed system. It consists of Transmitter and receiver section. Each of this section has

- BT Modem BT – 42:
  We use BT – 42 Modem having rolling Network (RN) 42. It is a class 2 device. Its range is between 50 – 60 feet. Corresponding power consumption is reduced. It is used for short range, battery powered applications. It works on frequency 2.46 GHz. It supports multiple Bluetooth profiles like SPP and HID. It has simple UART hardware interface. It has low power sleep mode and works on 3.3 V. Programming language for BT – 42 is X-CTU/ HyperTerminal
- ARM 7
  It represents generation of ARM Processor design. Due to their tiny size and low power consumption these micro controllers are ideal for the application where miniaturization is the key requirement. It is general purpose 32 bit microprocessor with ISP or IAP. The LPC 2148 ARM-7 IC is used here. It is based on principle Reduced instruction set computer (RISC). This IC programmed to BT Modem and copper pad. Keil embedded C software is used for the programming.
- LM 358
  It is an operational amplifier. It can operate over wide range of voltage.
- Copper Pad
  Copper Pad are used as conductor.
- Power Supply
  Step Down transformer has been used with input voltage of 230 V ±50 Hz. The output is 15 V AC. The range of Transformer is 250mA. The

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LM 7805 regulator convert (regulate) 15V supply to 5V. LM317 regulate 3.3V (Fixed) supply forARM-7 IC and BT 42.

- Mobile
  Mobile based on Symbian platform is used. It has Bluetooth capability. A special application is designed for data transmission using J2ME.

IV. DISCUSSION

The design discussed in earlier section has following key parts – 32 bit ARM 7 TDMI Processor, BT 42, LM 358 and power supply with 3.3 V output. ARM 7 (LPC 2148) is connected to BT Modem through UART 1. UART 0 of ARM 7 is connected to Copper Pad. BT Modem is programmed to communicate with BT of Mobile device through the standard APIs. The software is under development which uses J2ME & Embedded C. A code is being developed for an Application residing on the Handset. It will act as an interface for user to use the communication channel. This application will have both functionalities of Transmitter and receiver. Embedded C programing is being used for ARM 7 configuration.

V. CONCLUSION

In this paper we implemented Human Area Network for transmitting data between two mobile handsets. This demonstrates the ease of implementation of such technology. This technology can be used for various other applications. Using the technique demonstrated we can have secure, Low power consuming and device independent communication channel. Some of the applications of this Technology are-

- Communication between two devices with same user
- Communication or data transfer between two people when they shake hands

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