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ONLINE REAL TIME HEALTH MONITORING OF PATIENT USING INTRABODY COMMUNICATION

Kirti Thosar[1], Geetha Narayanan[2]

[1]*P.G. Student, Department of EXTC, VIT College, Wadala, Maharashtra, India*

[2]*Associate Professor, Department of Biomedical Engineering, VIT College, Wadala, Maharashtra, India*

Abstract – *This paper presents a communication system which uses human body as the medium and transfers the data without any cables. It is important in medical field at it sends data wirelessly and it is very accurate. The accuracy and speed of data transmission are significant in medical field as lives are dependent on the data being transferred from one place to another. This communication uses wearable device which is embedded with different sensors to measure vital parameters like heartbeat, temperature, blood pressure, ECG etc. This device has ARM7 as central processing unit and provides Intra body communication using insulating material. It is very secure system and provides data in real time as the device is always on the patient's body. This proposed method is very robust and simple communication system using human body as transmission medium. This technology provides more security than other wireless technologies.*

***Key Words*: ARM7, Sensors, Wireless technology, Intra-Body Communication, communication system, Zigbee.**

1. INTRODUCTION

Health is very important aspect in everybody's life. Thus, it is essential to take good care of health. As the technology is improving many new systems are entered in health care field. There are new health monitoring devices and system which can monitor one's health 24 hours. This is because the treatment and diagnosis is heavily dependent on the monitoring reports. Without these reports it is impossible to give treatment to the patient. Though there are new instruments available for monitoring most of them use cables and wires attached to the patient's body. This makes them uncomfortable and system become very messy . This is mostly unbearable if the monitoring is done for longer period and continuously.

Monitoring is done using different sensors which sense parameters from the patients and send them to the device. The parameters like temperature, blood pressure, ECG, heartbeat etc. plays a very vital role in medical examination and helps in correct diagnosis and deciding the treatment plan. The current system uses sensors which are wired to the monitoring devices. It makes patient uncomfortable and unable to move freely. They also tend to make the treatment difficult as wires can mess when get tangled with each other. So there is need to make things simple and error free with wireless devices. It can provide better comfort to the patient and make them mobile. This can be achieved using different wireless technologies like ZIGBEE, BLUETOOTH etc. These technologies will help in simplifying the surgical monitoring and the critical patient data can be stored in the database for better diagnosis and it can also be used for future reference[2][3].

It is clear that one sensor cannot generate data at the rapid pace and its data is in the range of few Kbits/s. So it is necessary to interconnect different sensors for more data which can be in the range of few thousands of Kbits/s. This can be achieved using wireless technology for better transmission and security. The different technologies for certain characteristics and found out that WLAN and BLUETOOTH emits lots of power i.e. power dissipation is very high. RFID and ZIGBEE provide very low data rate for transmission and therefore cannot be deployed in medical monitoring system. Following is the table shown the difference in technologies we studied for this project [1].

Table -1: Comparison of Wireless technologies

Technology	Frequency	Data rate	Transmission power	Size
ZIGBEE	868MHz	20 Kbits/s	1mW	PCB module
WLAN	2.4/5.1 GHz	54 MLitts/s	100mW	PC card
Active RFID	134 KHz	128 bits/s	<1mW	Pill
BLUETOOTH	2.4 GHz	723 Kbits/s	10mW	PCB module
Intra-body communication	<1MHz	>64 Kbits/s	<1mW	Band aid/pill

It is clear that new technology Intra-body communication has high data rate and also emits very less power which is desirable in medical monitoring. Also it is available in very small sizes which make it very suitable in surgical and critical monitoring of patients.

2. OVERVIEW

Intra-body communication refers to the method of transmitting electrical signals using human body. We can simplify the interconnection between different sensors using Intra-body communication as shown in the figure 1. The connection between different sensors is made using central link sensor which is then connected to the monitoring device. The sensors are connected to human body and they communicate with central link and other sensors through human body. Data is send to center link and it is then transferred to monitoring devices. The central link gets data through human body thus demonstrating intra-body communication. If the sensors cannot be attached directly to link sensor then relay sensors can be use between them which will again use intra-body communication. The central link is connected to monitoring device through any standard wireless technology like BLUETOOTH, ZIGBEE etc. As single power source is used for complete setup the power consumption is not a big issue [4].

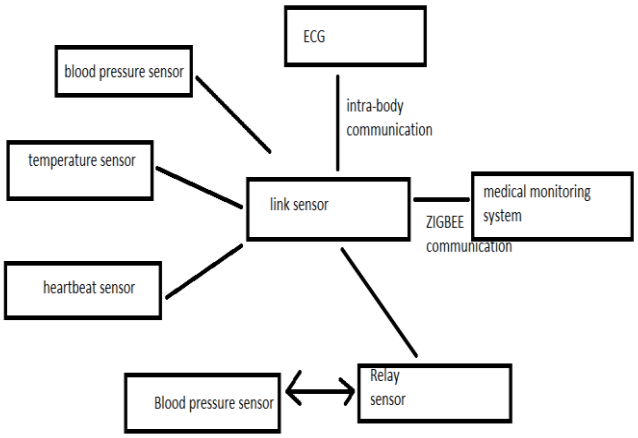

Fig -1: Intra-body communication block diagram

The proposed system is implemented using ARM7 and ZIGBEE technology. This system can be fitted in smaller size for the future scope and can be used as a wearable wristwatch or band.

3. METHODOLOGY

There are two methods used for transmitting electrical signal through human body. They are Galvanic coupling and Capacitive coupling. These two methods permit the flow of electrical signal through human body. Two methods differ in the coupling methods for electrical signal. This flow of electric voltage controls the electric signal induced in the human body. Two pair of electrode are needed for both methods [5].

3.1 Galvanic Coupling

This method uses two electrodes which are signal and ground. Both of these electrodes are attached to human body in this coupling. Basic principle of galvanic coupling is based on the fact that alternating current is coupled in the human body. This induces electric signal which depends on the flow of current in the body. This method uses human body as the medium and transfers signal between ground and signal electrodes. Most of the signal flowing between these two electrodes gets attenuated and get very less signal at the receiver electrodes [6].

Galvanic coupling overcomes the drawback of the ground as return path which was there in capacitive coupling. In galvanic coupling the current flows through human tissues and it does not required returned path of the external ground. Thus, galvanic coupling is more used for the intra body communication. In proposed system, copper is used for coupling.

3.2 Capacitive Coupling

In this coupling also two electrodes are used, which are signal and ground but only signal electrode is attached to the human body and ground is floating in air. The current is produced by ground which is in the loop form and generates signal with human body as a channel. The electric signal is induced in human body through signal electrode and body acts as good conductor and ground provides the return path [6].

4. PROPOSED SYSTEM

4.1 Description

The proposed system uses ARM7 as processing unit with other sensors and peripherals. The sensors which are attached to body senses temperature, Oxygen level, heartbeat, ECG and blood pressure and transfers those to the ARM7 using copper plate for intra-body communication. The ECG is analog signal which is amplified using amplifier and comparator circuit before transferring to ARM7.
All data like Temperature, BP, Oxygen level, Heart beats send to ARM7 for Analog to Digital conversion. Arm7 sends these digital values with ECG analog graph to receiver through ZIGBEE communication. At the receiver end all data is displayed for the expert doctors to see and make a treatment plan for patient.

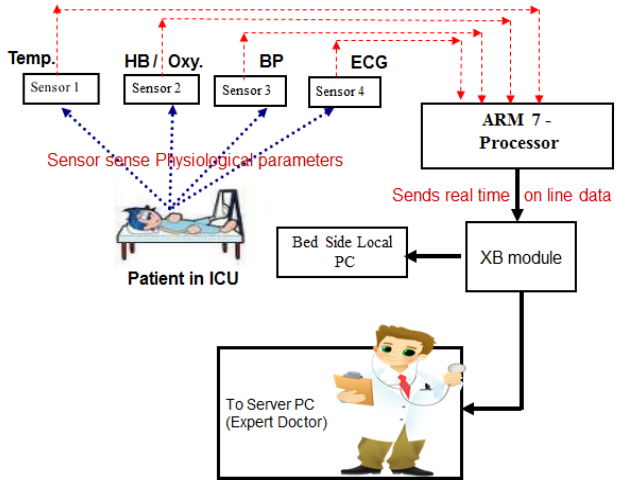

Fig -2: block diagram of proposed system

4.2 Implementation of the system

The device can be divided in three sections.
First section:- In this section, human body and temperature, heartbeat, Oxygen level and BP sensor are used. The figure 3 shows temperature sensor connection with human body and ARM7. Likewise, other sensors are also attached to human body and their data is transferred to system through copper coupling.

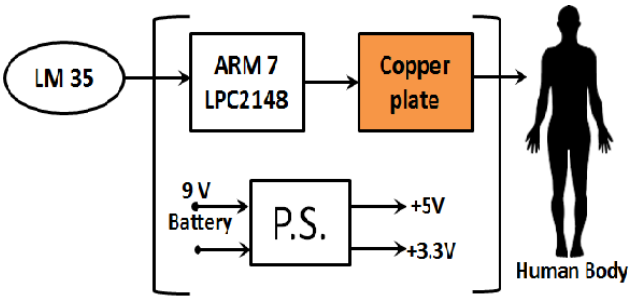

Fig -3: Block diagram of temperature sensor connection

Second section:- In this section transmitter which has ARM7 and ZIGBEE module for wireless transmission. As the data from various sensors is received by ARM7, it is wirelessly transmitted to receiver through ZIGBEE. This transmitter acts as link sensor for the various sensors and collects data to be sent to the receiver section.
Third section:- In this section, ZIGBEE receives the data and all vital parameters are displayed on the PC besides the bed and also transfer to server PC so that expert doctor can monitor from remote place and suggest the medical treatment. Device is continuously monitoring data in real time Thus, enabling the doctors to keep eye on the patient's progress in real time.

Fig -4: Complete hardware circuit when power OFF

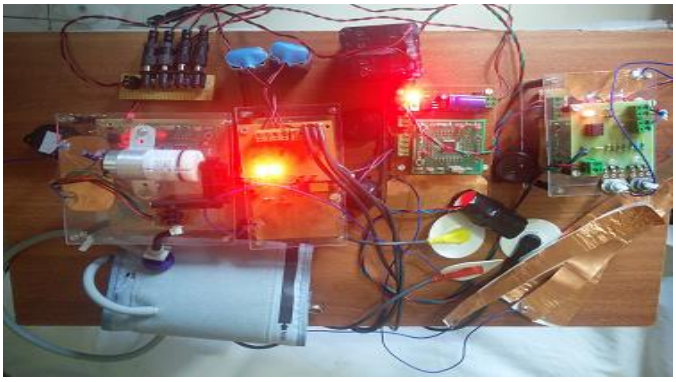

Fig -5: Complete hardware circuit when power ON

Fig- 4 and 5 shows the complete hardware with power OFF and ON respectively which is implemented for intra body communication to monitor the health of the patient.

4.3 Data transmission

Fig.-6 shows the format of transmission packet. Here all Values like temperature, BP, Heart Beats, Oxygen level and ECG data are sent via data packets. The packet has total 5 bits in which first two bits as starting bits which starts the transmission. These are known as start bits. They can be either alphabetical character or a constant. Next bit indicates packet length and it is one byte long. Next bit gives the data type i.e. heartbeat or ECG etc. And next bit gives value of this data. Last bits provide system status or command type.

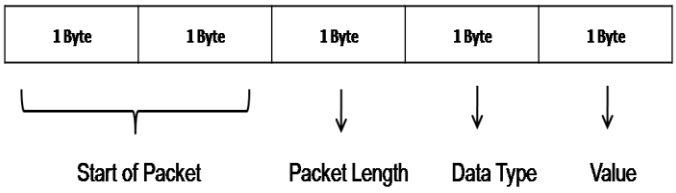

Fig -6: Format of transmission packet

5. RESULTS

The system is implemented and results are shown on the PC. There is simple software program running on PC which is developed in VB dot net. This program receives the data from the receiver hardware and then after processing it digital values are displyaed on the screen. The live values of temperature after conversion in degree Celsius ,heartbeat HB and oxygen level are shown in digital form which are shown in Fig-7.

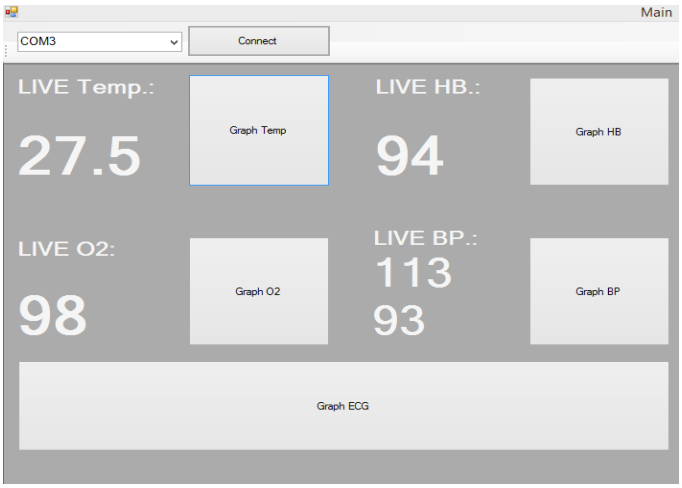

Fig -7: Screen shot of result

These digital values are live and continuous so these the values of temperature, heartbeat, BP and oxygen can be plot in graphical form which are shown in following Figures.8 to 12.

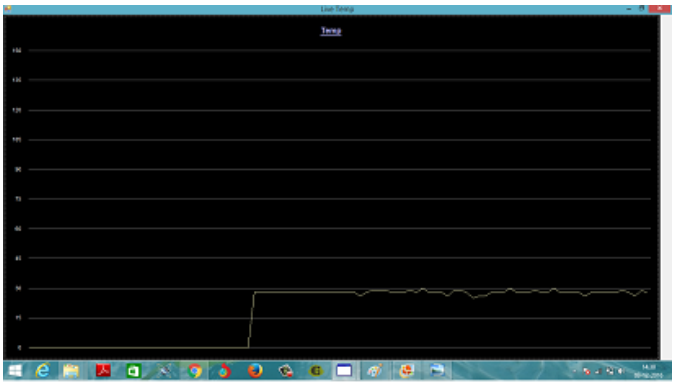

Fig -8: Temperature graph

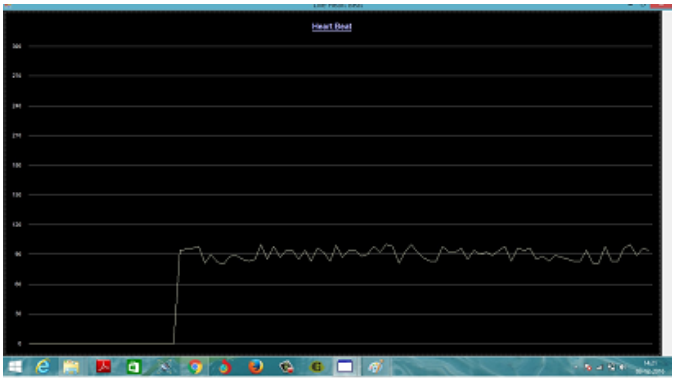

Fig -9: Heartbeat graph

As all the values of vital parameters are showing correctly and showing good graphs for all parameters.

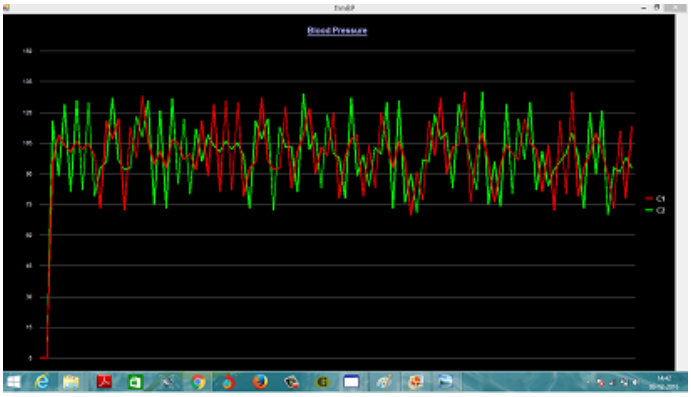

Fig -10: BP graph

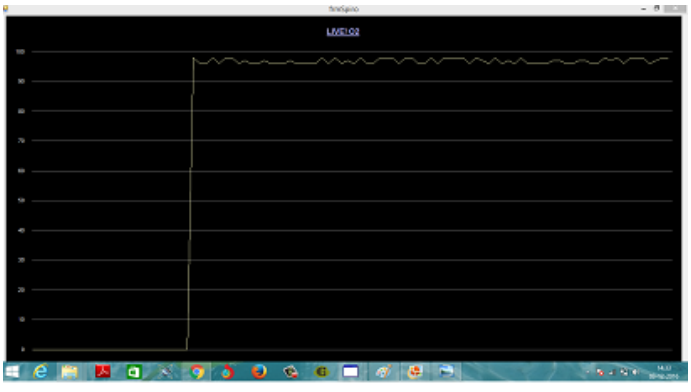

Fig -11: O_2 graph

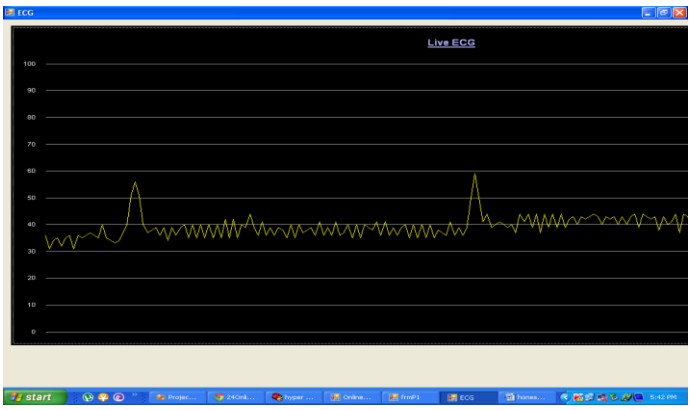

Fig -12: ECG graph

5. CONCLUSION

Online real time monitoring of patient using Intra Body communication is a very recent technology in communication field. This system shows the Intra-body communication can be used in medical monitoring and can generate a good result. The system has many sensors communicating through body and has ARM7 prototype for processing the vital parameters which then can be given to PC for displaying and studying by experts.

The future scheme for this devise will have the smaller system that can be worn like a wristwatch. This system can be used with other wearable devices for health monitoring and has shown less complex system for patients. It also has less power consumption due to intra-body communication and gives accurate results.

The device can be upgraded with more sensors and different communication technologies for the future. This will give better transmission and provide better health monitoring with more accuracy and low power.

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