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ECG Monitoring System in Wireless Personal Area Network simulation and design using Zigbee Transceiver Module for Health Care Solution

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ABSTRACT
As we are familiar that population is growing exponentially over the time. The effect of which is the increased pollution and its major impact can be seen by the day by day increasing health issues among people. It's our responsibility to take the initiative to adapt a way for healthy and peaceful lifestyle. With the increasing nuclear family culture and busy schedule, people are looking forward for the non- invasive methods for diagnosis and treatments. There is hardly a person to whom the question of health is not a matter of concern. In this scenario engineering the products that could be an answer for the health care solutions will definitely help the living easier. In this setup we use a wireless technology with the help of ZigBee and AvR microcontroller. With the help of this system configuration, the diagnostic details of a person sitting in any place could reach continuously to his/her family doctor or to the nearest hospital. If any shortcomings related to heart are detected, the person could raise an alarm to the nearest doctor for which we connect our WSN system so that the response could be given as soon as possible.

Keywords
Zigbee Transceiver, Wireless PAN,ECG Sensor.

1. INTRODUCTION
To give a view of architectural design, a wireless technology will be used involvingZigBee and AvR microcontroller. As a benefit, the person sitting in any place could be monitored for his medical diagnostic signals which will continue reaching to his/her family doctor or nearest hospital.Wireless technology for medical applications like IEEE 802.11 based WLANs was used in this study The IEEE 802.15.4 standard was developed to address a demand for low power and low-cost in low-rate wireless personal area networks (LR-WPAN). If any problem is detected, the person could raise an alarm for which we connect our WSN system so that the response could be given as soon as possible. With the facility of Zigbeetransceiver we can continue sending the information of the patient and the current diagnosis signals. It will be helpful to reduce the stress level of those people who take a step back from diagnosing themselves due to various reasons.

2. BLOCK DIAGRAM

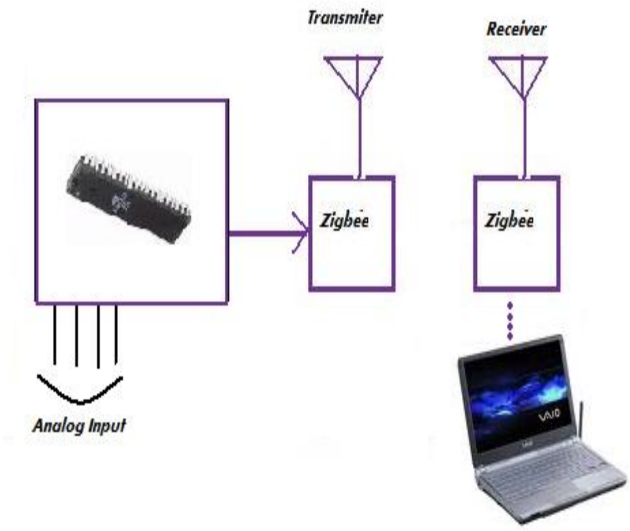

Fig.1:System overview of receiver and transceiver system through Zigbee modem.

3. HARDWARE DEVELOPMENT

3.1 Transmitting SystemDesign
Transmitting system design for the communicating mode ofcollecting and transmitting ECG sensor data, so it can bedesigned to reduced function device for reducing thepower and cost. The chip CC2500and ECG sensor constitutesthe slave node. CC500 is the first SOC solution whichsupports the ZigBee protocol , an ATMEGA 32 MCU and a2.4GHz wireless transceiver that suits to IEEE802. 15.4standards are integrated inside. There's an 2 KB randomaccess memory in it, including 32 Flash storage unit, A/Dconverter, timer, watchdog timer, , meanwhile 1 UARTinterfaces and 32 programming I/O pins are contained in thechip.

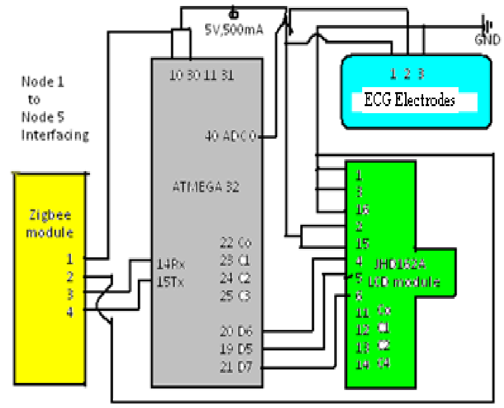

Fig.2: Interfacing model with Zigbee and Controller Atmega32.

A. Power supply unit -This unit is basically designed to power up the transmitting system or slave node. This provides 5 V, 500mA output to drive the nodes.

B. Sensing module-We used QUASAR's sensor. This is a packed in ECG sensor that doesnot need preparation on skin, gels, or adhesive. It includes not onlya sensing device, but also signal conditioning circuitry such as low noiseAmplifiers and voltage reference chips.

Fig.3:Image of QUASAR's Sensor

Its output signal is adjustable from ‑4.5 V to 4.5 V to single-ended 0 V to 4.5 V. It measures only 15 mm (diameter)x3.8 mm (height) and weighs is 5 g. Also, its power consumptionis only 1 mW active power on average.This kind of specification of this sensor allows our monitoring system.

C. Microcontroller –We used ATmega16 microcontroller it is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed.

D. LCD module -The LCD unit receives character codes (8 bits per character) from a microprocessor or microcomputer, latches the codes to its display data RAM (80-byteDD RAM for storing 80 characters, transforms each character code into a 5 ´ 7 dot-matrix character pattern, and displays the characters on its LCD screen.

E. Transmitting module (ZigBee) -This is the radio frequency receiver module, which can facilitate the OEM designers to design their remote control applications in remote control in the rapidest way. It has 250 kbs speedThe circuit is designed with SMD components and the module size is small enough to be able to be fitted in almost any application. These modules are based on IC CC2500 made by Texas Instrument. It works at frequency of 2.4GHz,and it's power consumption is 30 mA TX, standby 3µA

Fig .4: Transmitting view of the System

3.2 Receiving system design

This system plays an important so it should be designed to a Full Function device; the main tasks of it are network establishing and maintenance, ECG data received in a wireless way, communication with the upper computer by serial port. We select CC2500 chip as the processor of the major-node, and expanding the serial communication port base on the CC2500 typical application circuit, MAX3232 chip is used to realizing level switch between TTL and RS232.

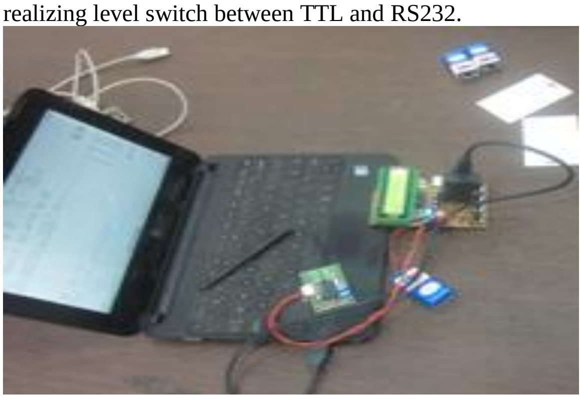

Fig.5: Receiving view of the System

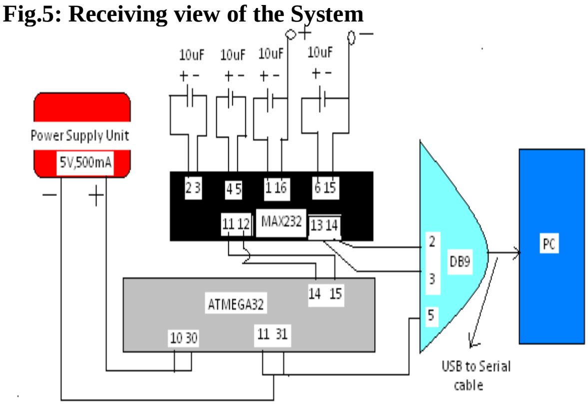

Fig.6: Connecting diagram of the Receiver

A. Power supply unit- same as used in section3.1

B. Microcontroller- same as used in section3.1

C. LCD module - same as used in section3.1

D. Receiving module (ZigBee) - same as used in section3.1

E. Max 232(level converter)-The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into EIA-232 levels.

F.USB to Serial cable-this provide the interfacing between coordinator node and personal computer

G Personal computer- data logged off on PC with the help HyperTerminal and V1.9b Terminal

4. SOFTWARE DEVELOPMENT

Firmware for the modules has been developed with the help of WinAVR compiler and AVR studio. The controller is programmed with help of AVRDUDE.

The software is written in C language and compiled using the open source compiler AVR-GCC. For project management AVR Studio was used. I have used my fully buffered, interrupt driven USART library for USART related job. The library comes in two files.

- USART.c
- USART.h

Function to transmit and receive data

Initialization of USART

This function will initialize the USART.

voidUSARTInit(uint16_t ubrr_value)
{
UBRR= ubrr_value; //Set Baud rate
UCSRC=(1<<URSEL)|(3<<UCSZ0);// Set Frame Format
UCSRB=(1<<RXEN)|(1<<TXEN);// //Enable The receiver and transmitter
}

Reading From theUSART:

This function will read data from the USART.

charUSARTReadChar()
{

while(!(UCSRA & (1<<RXC))) //Wait until a data is available
{
//Do nothing
}
return UDR; //Now USART has got data from hostand is available is buffer
}

Writing to USART:
voidUSARTWriteChar(char data)
{
while(!(UCSRA & (1<<UDRE))) //Wait until the transmitter is ready
{
//Do nothing
}
UDR=data; //Now write the data to USART buffer
}

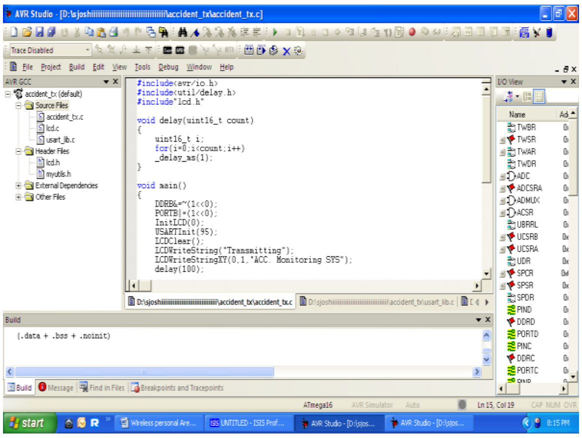

Fig .7: AVR studio screen for transmitter program

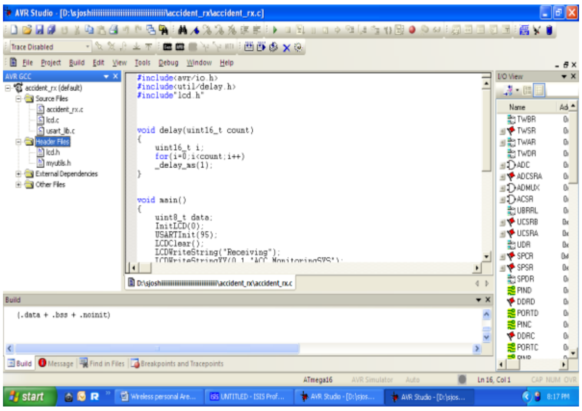

Fig .8: AVR studio screen for receiver program

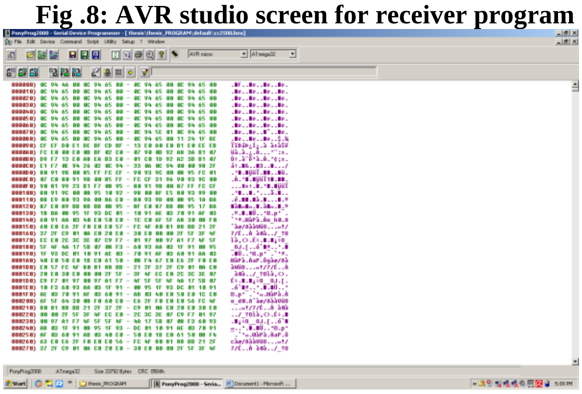

Fig.9:softwarePonyProg 2000v2.06f.

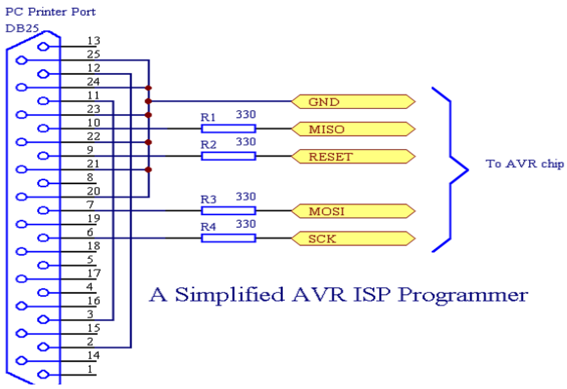

Fig.10: A simplified AVR ISP Programmer

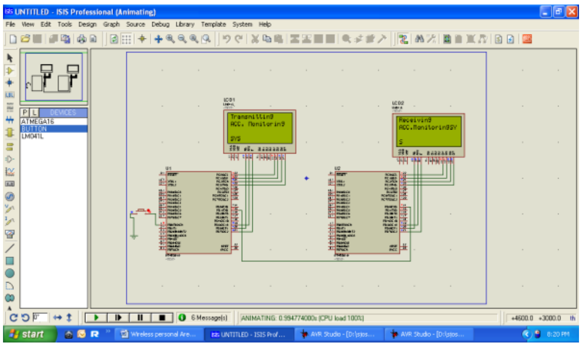

Fig.11: Simulation of the model using Proteus(trial) View 1

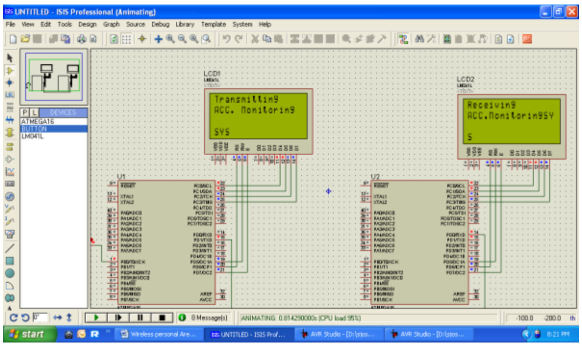

Fig.12: Simulation of the model using Proteus (trial) View 2

Fig .7 shows AVR studio screen for transmitter program.

Fig .8 shows AVR studio screen for receiver program

Fig.9 shows the compilation of the C program converts it into machine language file (.hex). This is the only language the microcontroller will understand, because it contains the original program code converted into a hexadecimal format. During this step there were some warnings about eventual errors in the program in we use software pony Prog 2000v2.06f.

Figure.10 shows Atmega's Programmer (ISP) which is used to burn the program into AVR microcontrollers.

In summary it can be concluded that the various steps to debugging, compiling and burning the program into the hardware. To burn the program into ATMEGA microcontroller, we used the AVR ISP Programmer

Fig.11 shows Simulation of the model using Proteus (v7.8) it indicates the status of the ECG sensors when no accident has occurred.

Fig.12 shows Simulation of the model using Proteus (v7.8) after accident takes place, the bump sensors gives an active high output which is read by controller and transmits via Zigbee.

5. CONCLUSION AND FUTURE SCOPE

This system helps a lot for health care solution for those person who are living alone or in remote region .By the help of ECG sensors we will send the current information about patient to the nearest hospital or wherever required. It is good for a upcoming generation as they are becoming independent and nuclear. By this system we can view the patient's ECG data in real time,and view the patient's heart beat,and also we view the the beat type (either premature ventricular Contraction, normal or unknown).We can also use this as other biological measurement for adding sensors.With the prospect of lengthening the network topology and coverage by adding routers and more end devices, the use would suit the needs of a medical/elderly care Institution that has to monitor biological signals and whereabouts of the patients inoutdoors also.

6. REFERENCES

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