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Implementation Of Real Time Health Monitoring System Using Zigbee For Military Soldiers

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Abstract*—This project is created mainly for monitoring of military soldiers during war situations, so that their health conditions are updated and timely diagnosis can be provided. Two important parameters for a soldier to survive are temperature and normal heart beat rate. We use heart beat sensor and temperature sensor to measure these parameters. These sensors are mounted in a hand gloves so that it is convenient and reliable for the soldier to use. Power supply is provided to the controller and the sensors using two 9V batteries. Wireless transmission is useful in cases where interconnecting wires are inconvenient, hazardous, or impossible. An efficient, reliable and secure health flow is important to manage the soldiers in war situations, their health records smoothly and for the right care to reach them at the right time. The purpose of our project is to measure the temperature, heart beat rate and updating this information in PC via ZigBee. The existing system is based on Bluetooth communication which is also reliable but the range of communication is very low of about 10 meters.
Keywords*—Heart Beat rate, Temperature, sensor, ZigBee.

I. INTRODUCTION

Health monitoring systems become a hot topic and important research field today. Research on the unit, hospital, sports training and emergency monitoring system. In this project, we have proposed a novel architecture monitoring were developed for many applications such as military, homecare for improving health care system with the help of microcontroller and sensors with ZigBee. The vital signs of health status that are the important parameter in health monitoring system consists of blood pressure, heart rate, oxygen saturation, body temperature and respiratory rate. In this work, we consider two parameters which are temperature and heart rate. We adopted the wireless sensor ZigBee for using as a real-time health monitoring system on military soldiers. The temperature and heart beat sensors can measure temperature, pulse signals which are sent to the microcontroller. The data are then transmitted by ZigBee to the PC. The sensors are connected to the I/O port of the microcontroller AT89s52. It is electronic device which provides a voltage analogue of the temperature of the surface on which it is mounted. The LM35 series are precisionintegrated-circuit Temperature Sensors whose output voltage is linearly proportional to the Celsius temperature. The sensor circuitry is sealed and not subject to oxidation. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The LM35 is rated to operate over a −55°C to +150°C temperature range. The output voltage is converted to temperature by a simple conversion factor. Normally the body temperature for a normal adult is about 35 degree Celsius. The general equation used to convert output voltage to temperature is: Temperature (oC) = Vout * (100 oC/V). So if Vout is 1V, then, Temperature = 100 oC. The output voltage varies linearly with temperature. The Heart Beat Sensor provides a simple way to study the heart rate. This sensor monitors the flow of blood through a clip that can also be used on a fingertip or on the skin between the thumb and index finger. Heart rate varies between individuals. At rest, an adult man has an average pulse of 72 per minute. Athletes normally have a lower pulse rate than less active people. Children have a higher heart rate (approx. 90 beats per minute), but also show large variations. The system consists of an infrared (IR) LED as transmitter and an IR photo-transistor as a receiver that acts as a fingertip sensor. The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified through an amplifier which outputs analog voltage between 0 to 5V logic level signal. ZigBee wireless network technology is launched and made by ZigBee Alliance. The alliance, founded in August 2001, is a fast-growing organization. ZigBee is a simple packet data communication protocol for lightweight wireless networks. It mainly focuses on reliability, simplicity, low power and low cost. The ZigBee module is used to transfer information

from the patient section to the server section. With ZigBee communication between the person in the hospital ward and the distant monitoring room,(about 50-100m away) becomes easy under the control of the doctor in charge of that ward. There will be a ZigBee at the transmitting end for transfer of information and a receiving ZigBee at the receiving end for receiving the transmitted information. The processed information is transmitted using the transmitting ZigBee and the information is received using the receiving ZigBee and finally the received data is sent to the PC. In the PC a coding is written using Visual basic for transmitting the information of any abnormal health conditions.

II. SYSTEM ARCHITECTURE

The architecture of the ZigBee-based health monitoring system using a hand gloves comprises of a heart beat sensor and temperature sensor connected to a microcontroller board.Power supply is provided to the controller and the sensors using two 9V batteries. Both the heart beat and temperature outputs are displayed in the LCD fixed in the hardware board. The same output is transmitted to the base server (PC) using the ZigBee.The data are transmitted serially to the pc using UART. The ZigBee receiver voltage is adjusted using MAX232.

Data received through ZigBee

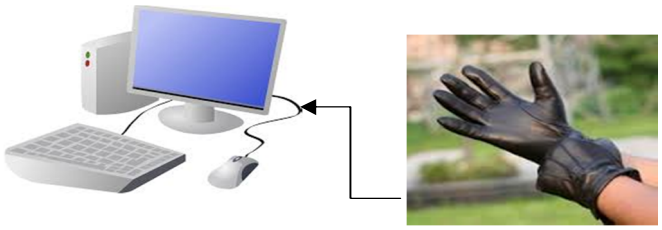

Fig. 1. System for health monitoringglove with sensors

The heart sensor monitors heart activity. One version of the heart sensor has a single-channel bio amplifier for threelead ECG. This sensor is capable of sending either raw ECG signal (signal is filtered) or R-peak events recognized by the on-sensor feature extraction software modules. The other version of the heart sensor interfaces a standard Polar belt and it can record each heart beat. As it does not require ECG electrodes (and thus increases the user's comfort), we used this heart sensor in our experiments. The user typically carries the heart sensor in his/her hand glove. The sensor attached to the glove is kept in such a position that the index finger is in contact with the LED of the sensor. The LED flashes bright light and a light detector is fixed opposite to the LED such that the finger is in between the LED and the detector. Now when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reaches the detector. With each heart pulse the detector signal varies This signal is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by an LED which blinks on each heart beat. The heart beat reading is displayed in the LCD. The heart beat rate is twice the value obtained in the LCD. The Temperature sensor is also kept within the glove such that it is placed touching the wrist of the user. The reading is given in Degree Celcius. These sensor outputs are connected to the microcontroller AT89s52. An LCD monitor is connected to it which displays the ouput. It is also connected to the ZigBee module which is used to transmit the information to the base or the pc. For easy and secured transmission of data UART is used which serially transmits the data to the receiver.

III. HARDWARE AND SOFTWARE ARCHITECTURE

A. Hardware

The Hardware consists of the major blocks namely Microcontroller AT89s52, LCD, Temperature sensor, Heart beat sensor, ADC, ZigBee, Hand glove and PC.

The sensors are connected inside the gloves though wires from the microcontroller kit. The kit is connected to a ZigBee transmitter for transmission of data.

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Heartbeat of a human body varies according to the age of a person. The normal heart beat rate of 25 year old human ranges from 140 to 170 Beats Per Minute(BPM). A 60 year old person's heart beat ranges from 115 to 140 BPM. In this project the heart beat rate is monitored and transmitted to the pc for analysis.

The temperature is monitored using LM35 temperature sensor. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes.

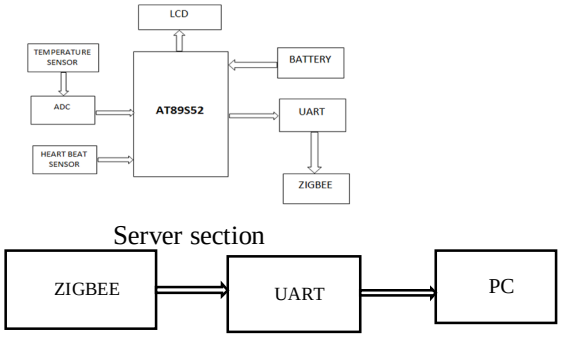

Fig.2. ZigBee based Human health monitoring system

With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1^{o}C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/^{o}C. Both the sensor outputs are connected to the Zigee. Since the temperature sensor is analog in nature ADC is used to transmit the data as digital to the microcontroller.ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headPhones connecting with cell Phones via short-range radio.

B.Software

The main purpose of using the micro controller in our project is because high-performance CMOS 8-bit micro controller with 8K bytes of in-system programmable Flash memory. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful micro controller which provides a highly-flexible and cost-effective solution to many embedded control applications. The programs of the micro controller have been written in Embedded C language and were compiled using KEIL, a compiler used for micro controller programming. The communication between PC and the micro controller was established MAX 232 standard and those programs were also done in C language.The software used for programming the microcontroller is Keil compiler. Keil compiler is an embedded C programming software. The pin configurations are programmed using this software. The data received using the ZigBee transmitter is displayed in the pc software. This software is programmed using Visual Basic. The software consists of 2 textboxes displaying the two parameters and the data.

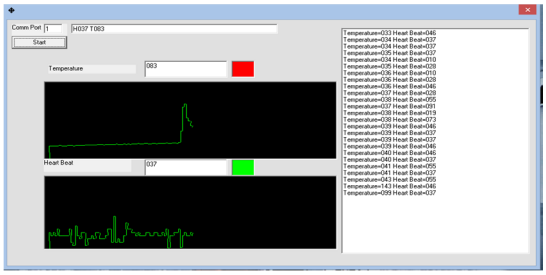

Fig 3. Software display

IV. RESULTS

The Heart beat rate of the human is monitored in a delay of 100 micro seconds. One heart beat produces a 6-byte record. Assuming a typical heart rate range between 30 bpm and 220 bpm, and similar memory budgets to the activity sensor, we can buffer from 4.65 min [6144 B / (6 B/b*220 b/min)] to 34.2 minutes of heart activity in the local RAM buffer, and from 13 hours [1 MB / (6 B/b * 220

b/min)] to 4 days if the external flash is used.The temperature sensor takes the reading in analog. The ADC converts it into digital and sends to the microcontroller. The data are stored in the register and transmitted to the pc via ZigBee. The software in the pc programmed using Visual Basic shows two text boxes namely Heart beat and Temperature. The current values are displayed in the nearby textbox. The value changes time to time as the pulse changes. This helps the monitoring base to check the time to time changes of the host, so that the required diagnosis can be given to the soldier in need.The following parameters like transmission range and reliability results from existing system are compared with proposed system.Using ZigBee in this system provides more transmission range and high reliability than using NFC techniques and Bluetooth techniques

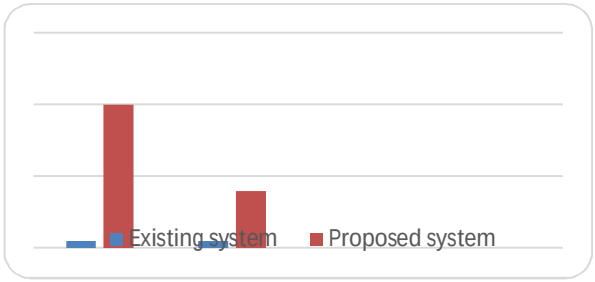

Fig 4. Comparison of Existing and Proposed System

V. CONCLUSION

Thus the ZigBee based wireless Heartbeat and Temperature monitoring system is designed and implemented using microcontroller AT89s52, in which all signals directly measured from the human body and all parameters values displayed on LCD on the transmitter side. This data is transmitted to the receiver wirelessly through ZigBee. The received signal send to pc wirelessly using ZigBee and is shown digitally in the screen. This project can be further enhanced by using gsm technology so that the range of transmission is very high and information can be given easily to necessary persons. In future a temperature regulator can befixed to the glove so that the body temperature can be stabilized accordingly.

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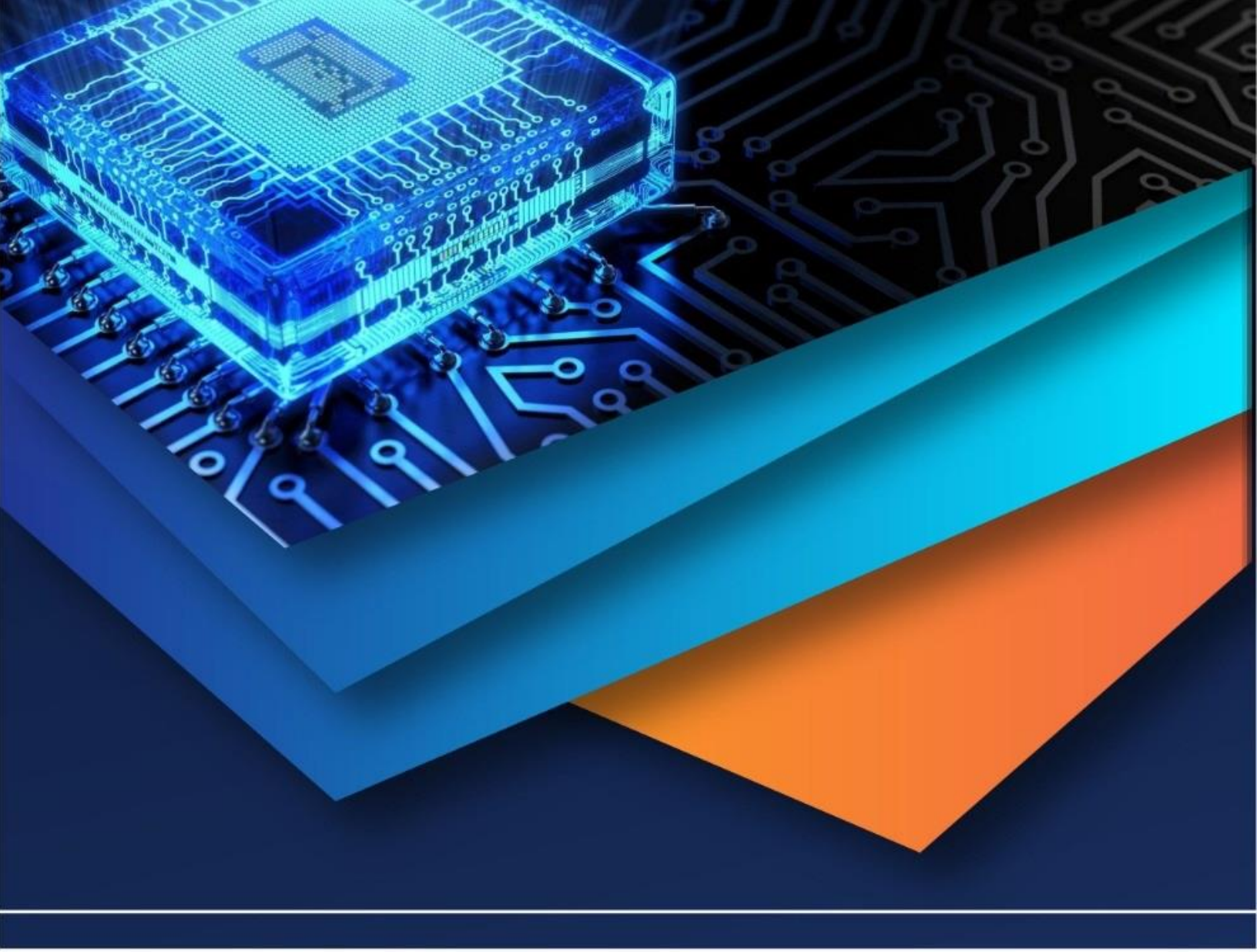

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