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Wearable Bio-Sensor System Using ZigBee Network for Patients and Health Monitoring

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Abstract – This paper describes a wearable sensors and ZigBee technology to take care patients. For health monitoring no need to admit in bed and their health status is viewed when they are in roaming too. The health parameters like heart rate, respiration rate, temperature level are taken into account. By means of sensors which are fixed in patients dress, the parameter values are obtained. These sensors signals are given to the signal-conditioning unit, because signals from sensors are AC and voltage level is not suitable for microcontroller. And it makes this signal to suitable for microcontroller. Signal from temperature sensor is analog signal so it is given to the microcontroller through Analog to digital converter. Microcontroller receives all signals from sensors and analyses the values. Using the display the medical instructions and other necessary information are displayed to the patients. Then this signal is given to the ZigBee transceiver. Therefore without disturbing the patient from the cabin itself doctor can monitor the patient. Simulations are carried out describing the patient health parameters in LabView and the result is viewed. This paper not only concentrates on the patients but also for normal persons (especially sports person) who can monitor the day to day health condition. It acts as dual purpose by means of patient monitoring as well as health monitoring for normal persons.

Index terms – ZigBee transceiver, Health monitoring.

1. INTRODUCTION

The main objective of this paper is to develop a system that should be patient friendly, can be supplemented with real-time wireless monitoring systems which are designed and implemented through wearable Bio-sensors and the ZigBee technology. The theme of this paper is that health condition of the patient is monitored regularly wherever the patient are. Not only the patient even for old people and sports persons too. And history of disease or any abnormalities is completely maintained through a database. This database is maintained for individuals, this is immense for giving treatment in any serious illness condition. It is very useful for doctors to provide the treatment to their patients simply a reference.

2. SYSTEM ANALYSIS

2.1 Existing System:

The system which is now used to monitor the health status of the patients is to admit them in hospital and to check them. Especially for old patients the continuous health monitoring is must. In this method, the patients health problem is solved by means under the direct monitoring of doctors. This is too expensive too. Currently, patients visit doctors at regular intervals, self-reporting experienced symptoms, problems, and conditions. Doctors conduct various tests to arrive at a diagnosis and then must monitor patient progress throughout treatment

2.2 Proposed System

It is a well-known fact that the world population is aging and that both the number of people suffering from chronic illnesses and the elderly population in general are rapidly increasing. New technologies, wearable devices and communication networks are helping residents and their caregivers by providing continuous medical supervision, rapid access to medical data, and emergency communication both in the home and in geriatric care facilities. As the world's population ages those suffering from diseases of the elderly will increase. In-home pervasive networks may assist residents by providing memory enhancement, control of home appliances, medical data lookup, and emergency communication.

3. DESCRIPTION

This is the paper to monitor the patient even when they Rome using wearable sensor. Different parameters like heart beat, respiration rate, temperature are taken into account. Heart beat sensor senses the heart beat level of the patient. Respiration sensor senses the respiration status of the patient.

Temperature sensor senses the temperature level of the patient. Since these sensors are wearable these can be fixed in dress. These sensors signals are given to the signal-conditioning unit. Because signals from sensors are AC and voltage level is not suitable for microcontroller. And it makes this signal to suitable for microcontroller.

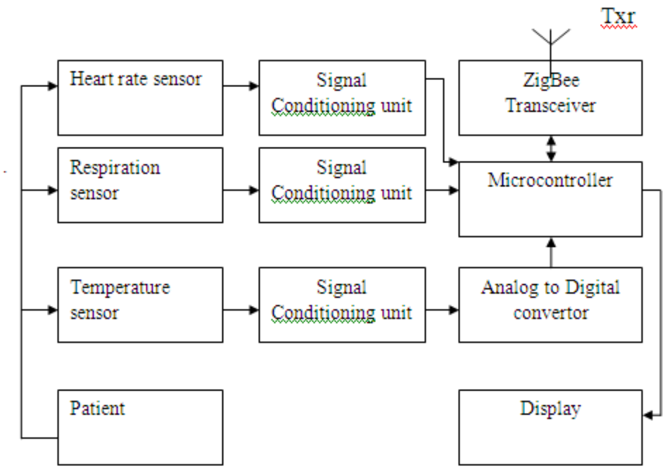

Fig 1 Monitoring Unit

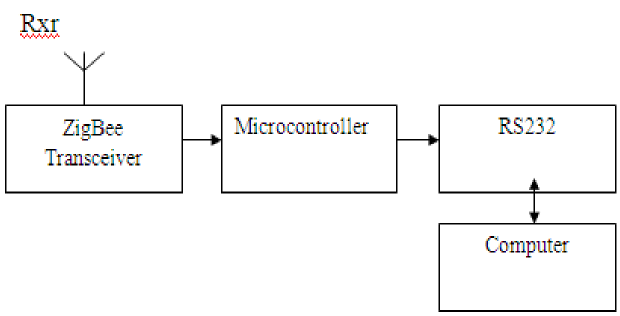

Fig 2 Data acquisition Unit

The Cardiac Sensor provides a easy way to study the heart's function. This sensor monitors the blood flow. As the Cardiac forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. The clip can also be used on a fingertip or on the web of skin between the thumb and finger. The signal is amplified, inverted and finally filtered, in the box. By graphing this signal, the heart rate can be determined. Then the signal is given to SCU and processed in microcontroller and transmitted.

Signal from temperature sensor is analog signal so it is given to the microcontroller through Analog to digital converter. Microcontroller receives all signals from sensors and analyses the values. Using the display the medication instructions and other necessary information are displayed to the patients.

Then this signal is given to the ZigBee transceiver . Each of them are analysed by the doctor and proper instructions are given to the patient by means of wireless using ZigBee module. Therefore without disturbing the patient and from the doctors cabin itself doctor can monitor the patient.

4. ZIGBEE PROTOCOL

The ZigBee protocol was engineered by the ZigBee Alliance, a non-profit consortium of leading semiconductor manufacturers, technology providers, OEMs and end-users worldwide. The protocol was designed to provide OEMs and integrators with an easy-to-use wireless data solution characterized by low-power consumption, support for multiple network structures and secure connections.

ZigBee builds upon the physical layer and medium access control defined in IEEE standard 802.15.4 (2003 version) for low-rate WPAN's. The specification goes on to complete the standard by adding four main components: network layer, application layer, ZigBee device objects (ZDO's) and manufacturer-defined application objects which allow for customization and favor total integration. Besides adding two high-level network layers to the underlying structure, the most significant improvement is the introduction of ZDO's. These are responsible for a number of tasks, which include keeping of device roles, management of requests to join a network, device discovery and security.

At its core, ZigBee is a mesh network architecture. Its network layer natively supports three types of topologies: both star and tree typical networks and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level (they are not ZigBee coordinators, but may act as 802.15.4 coordinators within their personal operating space), but they differ in a few important details: communication within trees is hierarchical and optionally utilizes frame beacons, whereas meshes allow generic communication structures but no router beaconing.

Device Types

There are three different types of ZigBee devices:

ZigBee coordinator *(ZC)*: The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys.

ZigBee Router *(ZR)*: As well as running an application function, a router can act as an intermediate router, passing on data from other devices.

ZigBee End Device *(ZED)*: Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

5. POWER SUPPLY

Since all electronic circuits work only with low D.C. voltage we need a power supply unit to provide the appropriate voltage supply. This unit consists of transformer, rectifier, filter and regulator. A.C. voltage typically 230V rms is connected to a transformer which steps that AC voltage down to the level to the desired AC voltage. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage.

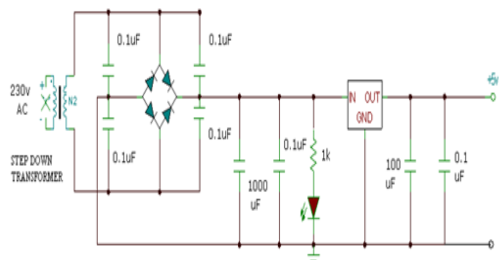

Fig 3: Power supply

This resulting DC voltage usually has some ripple or AC voltage variations regulator circuit can use this DC input to provide DC voltage. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage that not only has much less ripple voltage but also remains the same DC value even the DC voltage varies somewhat, or the load connected to the output DC voltage changes. The power supply unit is a source of constant DC supply voltage. The required DC supply is obtained from the available AC supply after rectification, filtration and regulation.

6. SOFTWARE IMPLEMENTED RESULTS

LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language developed by National Instruments. It uses icons instead of lines of text to create applications. In contrast to text based programming languages, where instructions determine the order of program execution, LabVIEW uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the Vis and functions.

The programming language used in LabVIEW, also referred to as G, is a dataflow programming. Execution is determined by the structure of a graphical block diagram on which the programmer connects different function-nodes by drawing wires. These wires propagate variables and any node can execute as soon as all its input data become available. Since this might be the case for multiple nodes simultaneously, G is inherently capable of parallel execution. Multi-processing and multi-threading hardware is automatically exploited by the built-in scheduler, which multiplexes multiple OS threads over the nodes ready for execution. The VIs, or virtual instruments, is LabVIEW programs that imitate physical instruments.

A VI consists of a front panel, block diagram, and an icon that represents the program. The front panel is used to display controls and indicators for the user, and the block diagram contains the code for the VI. The icon, which is a visual representation of the VI, has connectors for program inputs and outputs. For developing different applications in LabVIEW there are different palettes such as tools palette, controls palette, and functions palette are used. LabVIEW is fully integrated for communication with hardware such as GPIB, RS-232, RS-485, and plug-in DAQ devices.

LabVIEW also has built-in features for connecting application to the Web using the LabVIEW Web Server and software standards such as TCP/IP networking and ActiveX. Using LabVIEW, we can create test and measurement, data acquisition, instrument control, data logging, measurement analysis, and report generation applications. We also can create stand-alone executables and shared libraries, likeDLLs, because LabVIEW is a true 32-bit compiler

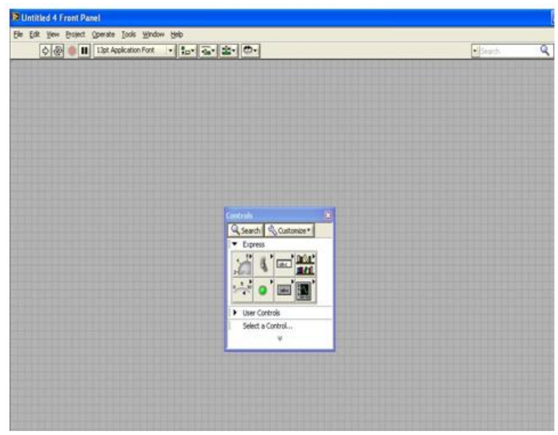

Fig 4 Blank Virtual Instruments

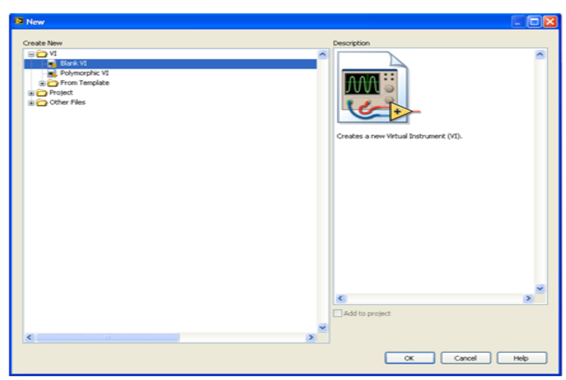

Fig 5 Virtual Instruments Template

7. RESULT ANALYSIS

Health Parameters	Normal Value	Unit
Heart Rate	60-72	Bpm (Beat per minute)
Respiration Rate	12-24	Bpm(Breath Per minute)
Body Temperature	37	Deg°C

Table 1. Parametric Values

Health Parameters	Obtained Value	Unit
Heart Rate	72	Bpm (Beat per minute)
Respiration Rate	24 (40 sec-Breath holding time)	Bpm(Breath Per minute)
Body Temperature	37	Deg°C

Table 2; Parametric Values For Normal Person

Health Parameters	Obtained Value	Unit
Heart Rate	108	Bpm (Beat per minute)
Respiration Rate	36 (10 Sec – Breath holding time)	Bpm(Breath Per minute)
Body Temperature	39	Deg°C

Table 3. Parametric Values for Abnormal Person

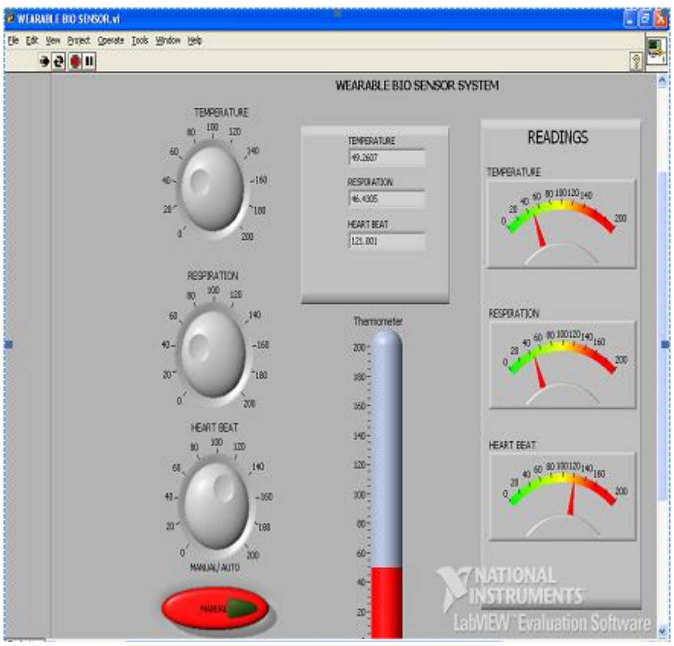

Fig 6 Simulation Results for Analysis of Parametric Values

8. SUMMARY AND CONCLUSION

The proposed system has a great impact on both patient monitoring by means of wireless It extends healthcare from the traditional clinic or hospital setting to the patient's home, enabling telecare without the prohibitive costs of retrofitting existing dwellings. Smart homecare benefits both the healthcare providers and their patients. For the providers, an automatic monitoring system is valuable for many reasons. Firstly, it frees human labor from 24/7 physical monitoring, reducing labor cost and increasing efficiency. Secondly, wearable sensor devices can sense even small changes in vital signals that humans might overlook, for example, heart rate and blood oxygen levels. Quickly notifying doctors of these changes may save human lives. Thirdly, the data collected from the wireless sensor network can be stored and integrated into a comprehensive health record of each patient, which helps physicians make more informed diagnoses. Eventually, the analyzing, diagnosis, treatment process may also be semi-automated, so a human physician can be assisted by an “electronic physician."

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