Biotelemetry Based Wireless Patient Monitoring System

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ABSTRACT
Health care systems are struggling to meet the requirements of the elderly population. These systems need to be more advanced with the advent of new technologies. This paper aims at providing immediate care to the serious patients in case of the emergency. The proposed system measures and monitors heart rate and pulse rate of the patient from a distance, that is, wirelessly. Wireless technologies such as WiFi, WLAN, Bluetooth and Zigbee provide options for design of proposed system. The concept of biotelemetry that permits the transfer of information from an inaccessible source to a monitoring station is utilized. The proposed system is designed using hardware-software co-design technique, taking use of wideband FM transmitter and receiver as hardware and Visual Basic programming model as software counterpart. Such a system reduces health care costs and improves quality of life of the patients in addition also provides risk coverage.

KEYWORDS
Plethysmograph, LED, telepresence

INTRODUCTION
Biotelemetry refers to the utilization of telecommunication technology for medical diagnosis, treatment, and patient care [1-2]. Recent technological advances have enabled the introduction of a broad range of telemedicine applications, such as tele-radiology [3-5], tele-consultation [6], tele-surgery [7], remote patient-monitoring [8-10] and health-care records management [11] that are supported by computer networks and wireless communication. In these studies, wireless transmission technologies such as satellite links, GSM, GPRS have been used for data communication. The use of satellite communications has been demonstrated [12-16], but it requires expensive equipment, dedicated links and skilled operators. Mobile cellular networks like GSM, GPRS are realized at low cost worldwide, but these technologies have low bandwidth [17-19]. Furthermore, special transmitters and receivers had been designed for every study. These devices use special signal sense, coding and transmission technologies; hence transmitter signals can be achieved by only compatible receivers. These technologies, whose coding and transmission techniques aren’t accepted widely, aren’t standardized and advanced significantly. This situation causes incompatibility, low bandwidth, low security problems [1-5]. Biotelemetry offers the realization of new remote sensing units and local communication links able to fulfill the demand of telemedicine for multiparametric, reliable data acquisition systems, with a minimum encumbrance to the patient. Bidirectional communication channels will be of normal use to obtain telepresence and could be exploited to improve the potentialities and the operability of the biotelemetry units by: a) Setting from remote their functional parameters according to the physician request; b) Providing the patient with a feedback about the success of the connection; c) Allowing the validity of testing the whole monitoring system from remote.

Our primary focus in the paper is to measure and monitor crucial patient parameters in almost real time. We aim to measure the heart rate and pulse rate and simultaneously transmit it to the monitoring station. We assume minimum propagation delay and ideally it should be zero. In our paper, we have used hardware and software approach. In the hardware section we have used heart rate sensor and a respiration rate sensor, FM receiver and transmitter. FM transmitter typically consists of respiration rate sensor, heart rate sensor, amplifier mixer, modulator and the receiver section consists of the LC Tune Circuit, RC Filter, Amplifier, Power Amplifier, DTMF to BCD Converter, Buffer And PC Parallel Port Interface. Heat rate sensor is used to measure radio vascular pulse wave that is found throughout the human body. The device that detects the signal is called as plethysmograph. A plethysmograph consists of an infrared LED which illuminates the tissue and a light sensitive detector that detects the amount of light transmitted from the tissue.

PRELIMINARIES
Biotelemetry is a vital constituent in the field of medical sciences. It entails remote measurement of biological parameters. Transmission of physiological data from point of generation to the point of reception can take many forms. Biotelemetry, using wireless diagnosis, can monitor electronically the symptoms and movements of patients. This development has opened up avenues for medical diagnosis and treatment. It enables monitoring of activity levels in patients suffering from heart troubles, asthma, pain, Alzheimer’s disease, mood disorders, cardiovascular problems, accidents, etc. A patient’s response and reaction to drugs can also be investigated for treatment. Radio telemetry transmits biological data using various radio transmission techniques. No wires are required to be attached to the patient’s body. The patient just carries a bracelet-sized transmitter that enables monitoring of the patients symptoms. Carrier modulation, physiological data encoding, frequency and time division multiplexing blocking
oscillator or Endoradiosonde receivers and antennas for Biotelemetry, power sources and transcutaneous power transfer are discussed in this paper. We have used the concept of biotelemetry in our system. It has the objective of measuring biological or physical relevant quantities at a distance. Being varying magnitude, distance is a relative concept in the case of implanted devices. It may be simply space between the inside and outside of the body. Biotelemetry typically comprises of Sensors appropriate for the particular signals to be monitored. Battery powered patient transmitters and a radio antenna and receiver, a display unit capable of concurrently presenting information from multiple patients.

MODEL
The proposed model consists on the hardware part a FM transmitter and receiver and on the software part VB is used for creating GUI.

Transmitter consists of following parts:
Respiration rate sensor: we have used a microphone to measure the exhalation of CO₂ by the subject of immersing the sensor at the noise and sensing the air pressure. Microphone converts sound waves into electrical energy. Microphone uses the diaphragm for energy conversion, which vibrates when it is struck by the sound waves. When diaphragm vibrates it causes other components of the microwave to vibrate as well.
Heart rate sensor: It is used to measure an individual heart rate through PPG type sensor. Whenever heart beats, blood pulses are supplied to the body through the tissues. The optical density of the tissue changes as the pulses passes. The PPG circuit uses a high intensity red LED as the emitter and the photo sensor as the collector. The patient’s finger is placed between the two.
Amplifier: The amplification of signal is done by the power amplifier which provides signal amplification up to 10 volts.
Mixer: It mixes the amplified output at several Hz frequencies with local oscillator frequency to generate intermediate frequency of 455 kHz.

Modulator: The intermediate frequency is modulated on carrier wave generated by carrier wave oscillator and is sent to the antenna for transmission.

Receiver consists of following parts:
LC Tune Circuit: It tunes the receiver with the same frequency as that of the transmitter.
RC Filter: It filters out unwanted noise signal which are received along with the original signals.
Amplifier: It amplifies the signal to the appropriate amplitude for transmission. Signal amplification of up to 10v is done.
DTMF to BCD Converter: it is a FSK decoder which converts received DTMF signals into BCD format which decides whether the received signal is heart rate or the respiration rate by observing the output.
Buffer: It performs the work of digital amplifier and a driver circuit to interface output with that of the pc parallel port.
PC Parallel Port Interface: Output is interfaced with the parallel port of the personal computer on the screen of which obtained results i.e. heart and respiration rate are displayed.

CONCLUSION
A Biotelemetry system developed using IEEE 802.11b WLAN technology, a WebNet and a WebRJS-PIC adapter card. This multichannel system is able to transmit measured oxygen saturation, blood pressure, body temperature and heart rate values of a patient to any recipient. The proposed system has two major advantages different from traditional systems. Because of small dimensions and low weight of the transmitter unit, this unit gives only a little disturbance to patients. This
system is low cost, useful and improvable. Furthermore, it operates wirelessly.

FUTURE SCOPE
We will try to extend the applications of the system developed by us. It will be helpful in diagnosis of more diseases. We will try to encompass more biomedical parameters for so that wider arena of diseases can be covered. We will convert into a full fledged diagnostic device rather than for emergency circumstances only.

REFERENCES