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Biomedical data transmission with wireless communication: A review

A.P. THAKARE[1] and B.M. SHELKE (TATTE)[2]

[1]Department of Electronics and Telecommunication, Sipna's College of Engeenering and Technology, Amravati - 444 605 (India).

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ABSTRACT

Wireless biomedical sensing is a technique that measures physiological signals of humans or animals from a distance without a wire connection. Its basic components are sensor/transducer, transmitter, and receiver with a radio frequency wave as the most widely adopted transmission medium. The theory of wireless communication with an enhanced biomedical aspect is presented. The current status and future trends of this field are also discussed. In this a paper different manner of wireless monitoring of biomedical data are present. System is based on wearable sensor devices using wireless data transfer to send measured biomedical parameters to a central computer/server at hospital. The remote biomedical measurement system consists of several subsystems like biomedical monitoring sensors, wireless transfer of measured data, slave module, master module, central data base system and appropriate applications and automatic analyze, user interface software module and very important, hardware protected access realized by smart card. This system is suitable for continuous patients monitoring and gives possibilities to increase health care and safety of life.

Key words: Sensor/transducer; Radio wave; Wireless biomedical sensing, Monitoring of vital parameters

INTRODUCTION

The monitoring of vital parameters is an every-day thing in medicine. Despite the increased improvement in measurement and display methods, the devices haven't been able to keep up with the development of technical possibilities. Especially in the areas of intensive care and emergency services[1], the connecting cables from the sensors to the corresponding instruments often hinder the medical care or cause a time delay. Transportation of critically ill patients requires adequate planning and monitoring during transport[2-3]. Uninterrupted wireless monitoring facilitates intrahospital patient transport. Wireless monitoring replaces cables and reduces the potential risk for adverse events related to disconnection. Other weak points of wired sensors include the frequent separation of the cables from the sensors, the limited cable length, and the time that's lost in attaching all the cables to the sensors and instruments[4-5]. This problem should not be underestimated, as it's been conformed over and over in medical emergency situations. The most important innovation in this paper is logically the monitoring of vital parameters without connecting cables, but also the possibility of visualizing the vital parameters on a commercial central computer.

Objectives and goals

One of the goals of the project is to install

a permanent transmitter on the patient at the beginning of the treatment, which multiplexes and amplifies the measurements of the sensors on his body. These amplified measurements are digitalized by the transmitter and are sent to the receiver, which could be any of a wide variety of devices. The goal of this work was to optimally realize the wireless transmission of vital parameters in realtime to a commercial central computer. The most important criteria in transmitting medical measurements by radio is the robustness of the radio connection and the data security. The radio connection must be guaranteed in a specified framework and false measurements must never occur in the transmission. It is also to be observed that medical measurements are personal data of the patient, and the privacy of the patient should be protected from unauthorized third parties.

MATERIAL AND METHODS

Requirements for Wireless Medical Sensors

Wireless medical sensors should satisfy the main requirements such as *wearability*, *reliability*, and *security*.

Wearability

To achieve non-invasive and unobtrusive continuous health monitoring, wireless medical sensors should be lightweight and small. The size and weight of sensors is predominantly determined by the size and weight of batteries. But then, a battery's capacity is directly proportional to its size. We can expect that further technology advances in miniaturization of integrated circuits and batteries will help designers to improve medical sensor wearability and the user's level of comfort.

Reliable communication

Reliable communication in wearable wireless body area network (WWBAN) is of utmost importance for medical applications that rely on WWBANs. The communication requirements of different medical sensors vary with required sampling rates, from less than 1 Hz to 1000 Hz. One approach to improve reliability is to move beyond telemetry by performing on-sensor signal processing. For example, instead of transferring raw data from an ECG sensor, we can perform feature extraction on the sensor, and transfer only information about an event. In addition to reducing heavy demands for the communication channel, the reduced communication requirements save on total energy expenditures, and consequently increase battery life. A careful trade-off between communication and computation is crucial for optimal system design.

Security

Another important issue is overall system security. The problem of security arises at all three tiers of a WWBAN-based telemedical system. At the lowest level, wireless medical sensors must meet privacy requirements mandated by the law for all medical devices and must guarantee data integrity. Though key establishment, authentication, and data integrity are challenging tasks in resource constrained medical sensors, a relatively small number of nodes in a typical WWBAN and short communication ranges make these tasks achievable.

Transmission

One of the most important components of our device is the wireless transmission of the digital heart signal, blood pressure, and body temp. to a computer, which can then process the information. The microcontroller handled the tasks of data conversion, wireless transmission, as well as providing the ability of simple preprocessing such as waveform averaging or rectification. The low-power nature of this microcontroller affords the benefit of battery operation and hence, patient isolation of the system. Finally, a single-chip receiver,

which compatible with the RF transmitter of the microcontroller, was used to implement a compact interface with the host computer.

DISCUSSION

Wireless technology also is battery driven, thus suitable for pre-hospital patient monitoring. Traditional patient monitors are expensive and operate on proprietary platforms, producing analog signals. Processing of digital signals is of great interest in the point of care clinical setting. The wireless biomedical sensor prototype represents a low-cost, reliable and flexible alternative to traditional signal transmission and data processing.

Increases accuracy of clinical alarms

A recent study found that the use of the Lead Wear Disposable product in place of traditional lead wires on the same patients resulted in improvement of alarm accuracy from 46% with traditional wires to 92% with Lead Wear Disposable. This dramatic improvement in accuracy (and reduction in false alarms) is attributed to the elimination of artifact caused by lead wires rubbing together, poor transmission signal in lead wires, and a reduction in lead off alarms due to untethering the patient from the bedside monitor. Lead Wear Disposable, in conjunction with the wireless system, eliminates these issues inherent in traditional lead wire configurations.

Increases nurse productivity

A study conducted by the Lewin Group to assess the burden of lead wire management on health care providers concluded that nurses spend 40 minutes per day, per patient, dealing with lead wires. This included responding to false alarms, untangling lead wires, and attaching and detaching lead wires to patients. When asked what other duties they would perform with potential time savings offered by a wireless system, nurses indicated they would provide more patient care, complete chart work, spend more time tracking administered medications, perform more patient education, and spend more time talking to families.

Decreases infection risk from reusable ECG wires:

In a clinical study conducted at the University of Wisconsin, 77% of ECG telemetry leads that were cleaned by standard hospital methods were found to be contaminated with one or more antibiotic-resistant pathogens. These pathogens enter the blood stream through open wounds. Post surgical patients being monitored for cardiac irregularities are at risk of being exposed to contaminated lead wires. Given that it is single patient use, our Lead Wear Disposable product reduces the risk of transmission of dangerous pathogens from one patient to another.

CONCLUSION

Wireless transmission of blood pressure data, Body temp. and ECG signals are stable, accurate and simple method with a potential for developing new and cost-effective procedures, and to replace traditional monitoring solutions based on cables. It is beneficial for the large hospitals situated in the large cities to use this system. Also the overload of the doctors can be reduced up to large extent and their precious time can be utilized for the some good cause. Also since there are no human factors for the monitoring and recording purpose the errors can be eliminated and accuracy will be increased. And thus overall efficiency of the concern hospital will be increased.

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