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A Web-based Data Management System for Ubiquitous Bio-signal Data Monitoring

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Abstract

For the successful ubiquitous healthcare, the biological signal data should be easily assessed and properly maintained. This paper describes a system for the web-based data management. It consists of a device interface, an HL7 gateway, a data upload control, a central repository, and a web server. We use MFER standard for encoding medical waveforms and HL7 for transferring data. For the easy assessment and management of data, the user-specific web services were designed.

Keywords:

computer systems, system integration, internet, MFER

Introduction

Recent advances in the ubiquitous computing technology make it possible to measure bio-signal data anywhere, anytime. For the early diagnosis, treatment, and prevention, the measured data should be easily accessed and properly maintained. This paper demonstrates a web-based data management system which encodes the bio-signal data using MFER standard, wraps them in HL7 messages, transfer the messages, and stores them in the central database.

The Ubiquitous House (U-house) Project is a long-term project funded by Korean Science and Engineering Foundation. The goal of the project is to develop ubiquitous telemonitoring systems, bio-sensors, and a central database system. All of the bio–signals such as EKG and EEG are supposed to be monitored unconsciously during the daily life in the U-house. In order to collect the measured data from the U-house regardless of various monitoring devices, we have developed a web-based data management system.

Methods

Currently six types of biological signal data (ECG, blood pressure, glucose, temperature, weight) are monitored and collected from the U-house. The web-based data management system consists of the five components.

Device interface: For the communication of the waveform data (ECG, EEG etc.), we use the MFER[1] (Medical waveform description Format Encoding Rule) standard specialized in encoding medical waveforms. We developed MFER DLLs to support fast and easy implement for other developers.

HL7 gateway: After receiving waveform data, the HL7 gateway automatically generates HL7 (Health Level 7) messages. An HL7 message contains the patient information and the metadata for the waveform. HL7 gateway sends the messages to the central repository.

Data upload control: The role of the web-based data upload control is to provide a robust method for uploading waveform data. We designed a client-side ActiveX control which consists of the three key components: an MFER parser, a file compressor, and a transfer module. The MFER parser gets the header information of the encoded files. Then it hands over the information to the file compressor and the transfer module. Files are compressed by the file compressor. Finally the transfer module uploads files to the repository.

Central repository: The central repository contains the integrated biological signal data. For MFER files, we only stored header information (e.g., the number of channels, sampling rate, etc) and file pointers in the database.

Web server: Three kinds of web services were designed for three different user groups (doctors, patients, and system administrators). Doctors can review all of the measured data of his/her patients. Patients (subjects) can review their own bio-signal data and add new data. System administrators can check file transfer errors and establish new connections between the new devices and the waveform device interface.

Results and discussion

The first generation of the data management system was developed in 2003. For the second generation of the data management system, we have designed a more robust data upload module. We used Microsoft Internet Information Server 5.0 as a web server, and Active Server Page (ASP) and scripting languages. Microsoft SQL Server 2000 is used as the database management system of the central repository.

1 Available at: http://ecg.heart.or.jp/Jp/Index.htm

We expect that the proposed system can be a promising model for the ubiquitous health care environment.

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