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A biotelemetric system for human ECG measurements

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Abstract

The use of telemedicine capabilities to therapy chronically ill patients is becoming more and more clinically relevant and economically cost effective. This paper presents own designed a prototype telemedicine system which provides human electrocardiogram (ECG) signals transferring via a mobile phone. System also covers the management of electronic records of patient and access to databases on the hospital side. The parts of system include an ECG amplifier, a communicator for data transferring and automated software which can receive and monitor ECG data.

Keywords: ECG; Telemedicine; Biomedical electronics

1. Introduction

As the population of aged people increase, close and continuous monitoring becomes important. Real time, continuous monitoring would allow not only for emergency detection of an abrupt change of the patient health condition but also for long-term assessment to establish the right dose and timing of medication [1]. For this aim, many researches have been carried out over many years on the development of methods for the radio frequency (RF) telemetry of biosignals. A well applied technology improves efficiency and effectiveness, lowering costs, saving time, and increasing direct attention to elderly, those with varied handicaps patients in the process of recovery [2]. The means of quite sophisticated telecommunication systems, we can make the global aim of providing all individuals with access to advanced communication, information and control systems that improve their life conditions. The availability of telemedicine is dependent on a large degree on telecommunication and on high bandwidth; the field is concerned with advanced telecommunication equipment and standards, methods of increasing effective bandwidth and network performance. The security, confidentiality, reliability and government legislation are important aspects in these areas.

This paper presents a design of prototype microcontroller based transmission system capable

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of real-time cardiovascular monitoring via mobile phone system. The designed system includes an ECG data acquisition module, a communicator for transferring the ECG data and automated software which can record and monitor the received data on the hospital side.

2. Background of ECG transmitting and monitoring via mobile phone system

Human electrocardiogram transmitting has been particularly useful for monitoring cardiovascular system's conditions. Nowadays, infrastructure of internet and mobile phone systems has opened a new transmission medium which establishes access to many data base at very low costs. With the means of intelligent agents, monitoring and therapy sessions can be greatly enhanced and cost lowered. Real-time ECG transmission via mobile phone system has been important in order to provide direct access to doctors in remote area to coronary care unit patient monitoring and to check patient's conditions at combat zone or rural area. This paper describes a complete prototype real-time ECG telemonitoring which is given as in Fig. 1.

The function of each one of the components of the proposed transmission system and details will be described in the following sections.

3. Data acquisition module (DAM)

This system was designed taking into consideration the requirements of nonclinical conditions. Namely, it has some properties, including low noisy signal acquisition hardware, user friendly using and low power supply cost. A common front-end in biopotential measurements is a dc-coupled fully differential amplifier followed by a difference amplifier, as in the classical three opamp instrumentation amplifier [3]. The front-end amplifier was built around the Burr–Brown INA128 instrumentation amplifier, driven right leg, and guard driving circuits, simple controlled gain. The overall gain is set to 1000. For DC power supply, we use 9 V batteries. Fig. 2 shows a sample of recorded ECG output standard derivation (Lead I) by proposed system.

The digital section comprises the following subsections; the data converter (ADC0804), control unit (Microcontroller 8051) and interface chip (MAX 232). 8 bit parallel A/D converter was employed. The sampling rate can be set to 250 samples per second.

4. Sampling and transferring module

In this module, Philips ADC0804 microcontroller (MC), and MAX 232 interface are chosen. The connection rate of the MC with mobile phone is 19,200 bps. Since we have used Siemens C55 mobile phone, standard-baud-rate was set to 9600. MAX 232 interface chip performs a proper connection between mobile phone data terminal with RS-232 standard and MC. The sampling and transferring units are shown in Fig. 3.

After opening the system, MC sends an instruction which consists of a phone number to mobile

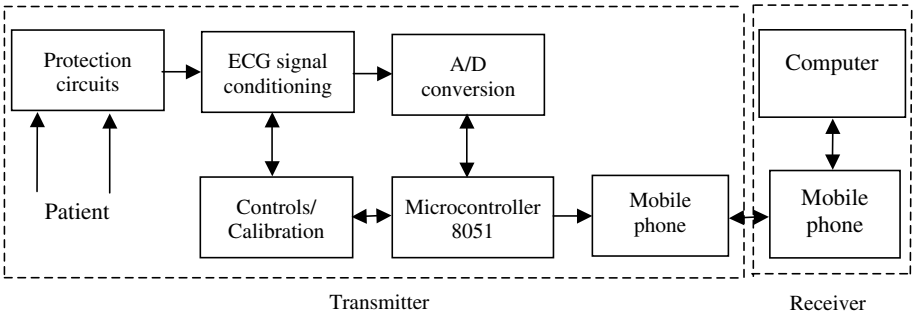

Fig. 1. Block diagram of telemonitoring system.