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Low Cost Electrocardiogram and Easy Manipulation

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Abstract

This work presents the prototype of an low cost electrocardiogram (ECG) and easy manipulation. The acquisition is made by an integrated signal conditioning block for ECG that receives the signal through electrodes attached to the patient, filters, amplifies the signal output and sends it to the microcontroller. The visualization is done by means of an interface that has a touch screen. Thus, it is expected a better aid in the early diagnosis of cardiovascular diseases.

Introduction

World Health Organization indicates that, each year, 17.3 million people die worldwide from cardiovascular disease [1]. In this context, the interest in noninvasive analysis techniques for the diagnosis of arrhythmias, such as the electrocardiogram (ECG), is increasing. a. The ECG market has several devices, for example Ecafix, Prince-180B, Ecafix, Win cardio, EX-03, TEB, Cardio care, ECG-600G among others. All these appliances have been sold in large scale. However, none of these devices is open license, that is, it is not possible to add or even modify any item on the devices, be it hardware or software. In addition, few of these devices rank critical points on the ECG signal [2]. The impossibility of adding or modifying functions in the ECG motivated the development of a device (Hardware and Software) capable of classifying critical points in the ECG signal.

Device's Development

The microcontroller used at this work was 8-bits Atmega328/P. The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noise conditions, such as those created by motion or remote electrode placement. The real time signals are shown in a touch screen display, this display has a simple interface, so the user can start, restart or stop the heart beat acquirement, besides the device calibration. This interface was done through the free software Nextion Editor, developed by same display manufacturer [3]. To storage collected data is was needed to use a micro SD reader. The communication between the microcontroller and module is established through SPI protocol. The device feeding is done by a 9V battery; this tension is converted to 5V and 3.3V by a simple voltage regulator circuit. To indicate R peaks, it was used a buzzer, a low-cost sound indicator based on piezoelectric. Figure 1 shows the device prototype. To maximize handling and avoid possible flaws on protoboard connections a printed circuit board was elaborated containing all needed components in a single module, this PCO was developed on the online low cost small objects and high-quality prototyping platform Easy EDA (Figure 2).

Results and Discussion

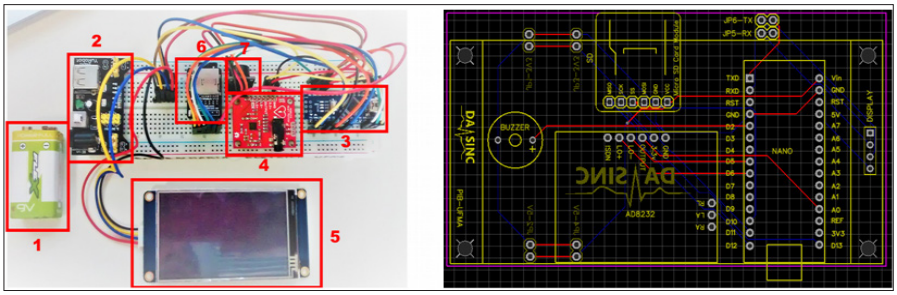

Figure 1: Low cost ECG – a) printed circuit board 1-Battery, 2-Voltage Regulator, 3-Arduino Nano(ATmega328 / P), 4-AD8232 Shield, 5-Touch Screen, 6-Module SD Card, 7-Buzzer. b) Printed circuit board.

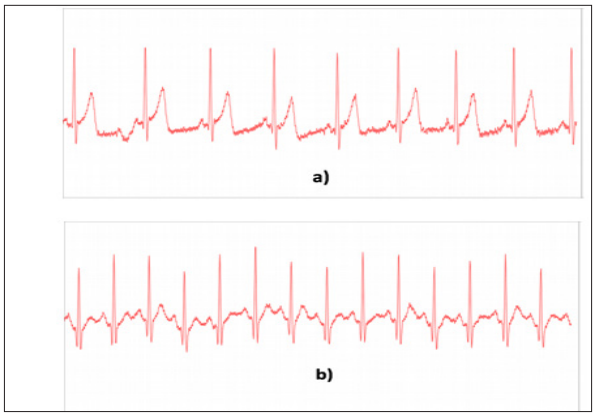

Figure 2: Test patient. a) Patient test at rest. b) Patient test after physical activity.

Assisted by Processing software executed in a computer connected to the Arduino it was possible to show in real time the ECG acquire done before and after physical exercises. Observing the data acquired before and after physical activity it was possible to visualize the heart beat variation through the graphics, screen, buzzer and ECG's signal amplitude. Moreover, the records are saved in a memory card, working like a database and can even be processed and analyzed for a possible heart diseases diagnosis [4]. The Hardware proposed is easy reproduction due its low cost, about $90 and its components high accessibility. The sample rate was evaluated as far as 1032 samples per second in an 8 bits resolution. The user interaction is through a 3.2 inches (Nextion) LCD touch screen [5].

Conclusion

This work main contribution was to implement a low-cost device easily handled for any user, which is considerably important for an early heart diseases diagnosis.

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