Co-funded by the European Union

Report on the implementation of the exercise: Lab #1: Design of an Electrocardiogram (ECG) circuit (Student Group no. 2)

CONN'COR, Project No. 2024-1-FR01-KA220-HED-000250882
WP3: Development of new and modernization of existing selected courses as examples of teachers' collaboration
Activity 3.2: Development of the course Home Compatible Labworks

Lab work duration: 2h00

Implementation date: 23.05.2025

Name of the students:

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Supervisor of this project:

- Assist. Prof. Jarosław Forenc, PhD Eng.

1. Project Objective

The objective of this project was to build a complete system for observing the ECG waveform based on the provided instructions and to identify any elements of the task that were difficult or unclear.

2. Project Implementation

The project was conducted by a two-person team of second-semester students in Electronics and Telecommunications at the Laboratory of Electrical Measurement, Faculty of Electrical Engineering, Bialystok University of Technology (room WE-215). The students were provided with the following instruments and components:

- a PC with Digilent WaveForms software installed,
- an Analog Discovery 3 module with a 5 V power supply,
- a breadboard,
- operational amplifiers, resistors, capacitors,
- ECG electrodes (Tiga-Med Electrodes),
- connecting wires.

3. Student Comments

During the project, the students provided the following remarks regarding specific parts of the laboratory task instructions they had received.

Introduction

(no remarks)

Experimental ECG

(no remarks)

1. First order high-pass filter

It would be better if this chapter were placed after the amplifier, because problems may arise during its construction, and the presence of the filter could make them more difficult to identify and fix.

"I recommend the following values: R = 1 MΩ and C = 1 µF. It leads to fc = 0.15 Hz."

This comment, as well as the following ones, greatly facilitated the construction of the device.

2. Instrumentation amplifier

2.1 What is the advantage of the instrumentation amplifier for a sensor which can be assimilated to a voltage source?

(no remarks)

2.2 Calculate the expression of the output signal Vout and dimension the resistors of this circuit for a gain in the range [7-100]

We used a gain of 200 (10+20), and everything worked correctly. Moreover, even without changing the V/div setting in WaveForms, it was clear that a signal was present, which reduces the risk of students mistaking a low-amplitude signal for noise. Using the ready-made formula from the notes significantly sped up the construction of the device. Finding it independently could have taken a lot of time. An even greater help would be indicating which part is responsible for the gain in each segment of the amplifier. It would also be useful to add a hint about the order of magnitude the resistors should have, as this may not be obvious to those with less experience.

2.3 Cable the circuit on the breadboard with the component OP482 and observe the output with waveforms delivered by the Analog Discovery Card. Call the supervisor to show this result.

(no remarks)

3. Notch filter

(no remarks)

4. Observe your ECG

It is worth paying attention to the way the electrodes are connected to the amplifier circuit (the labels on the jack-to-terminal adapter were not correct for our application). In our case, the red electrode turned out to be the ground electrode, which needed to be connected to the leg. When we initially connected it to the chest, we did not receive any signal.

5. Low-pass filter

(no remarks)

4. Final remarks

The students concluded that the allocated time (2 hours) was sufficient, as they successfully built and tested the circuit within this period.

5. Photos taken during the project implementation

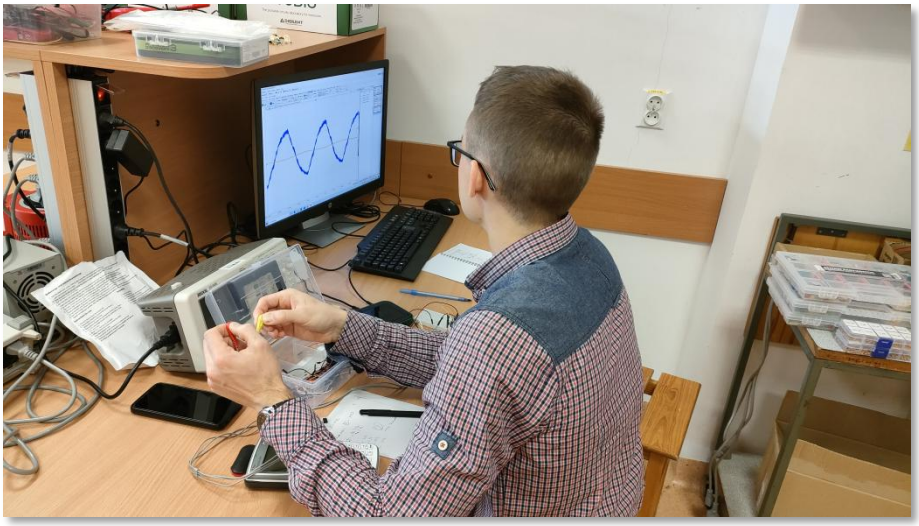

Fig. 1. Preliminary tests

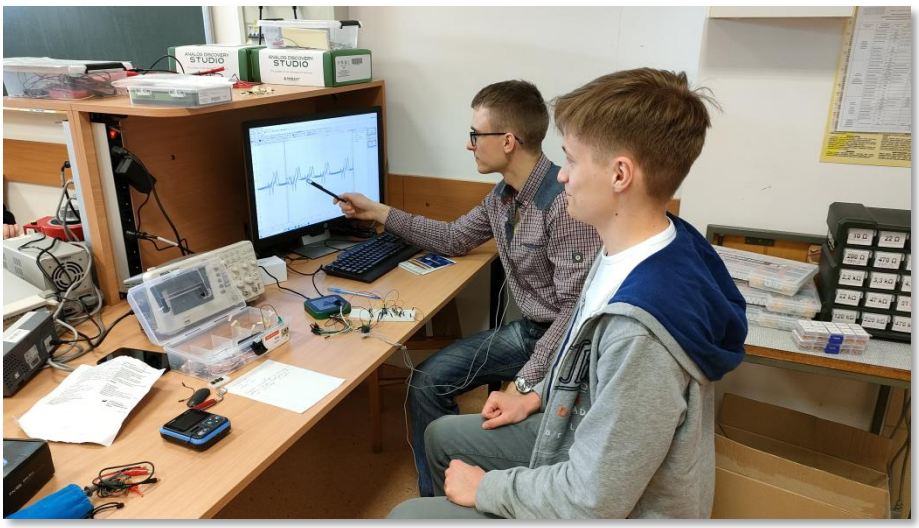

Fig. 2. Final tests of the finished system

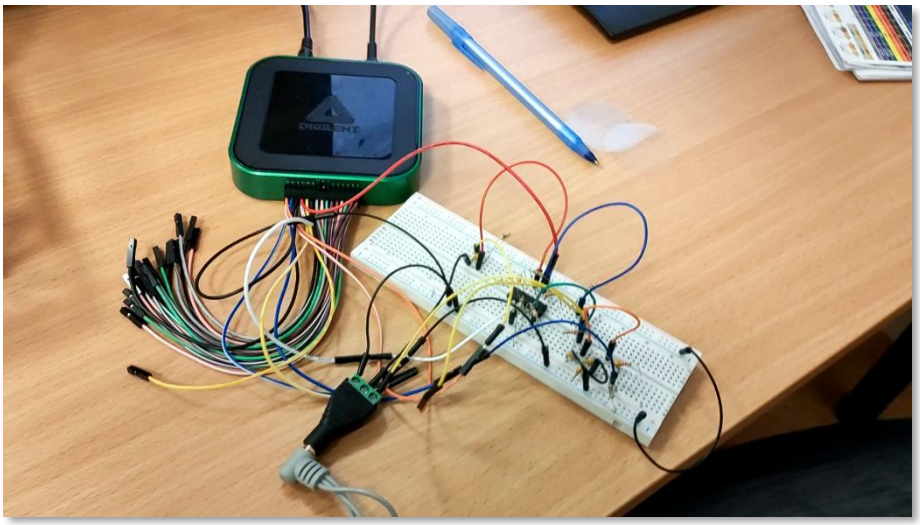

Fig. 3. System for observing the ECG waveform

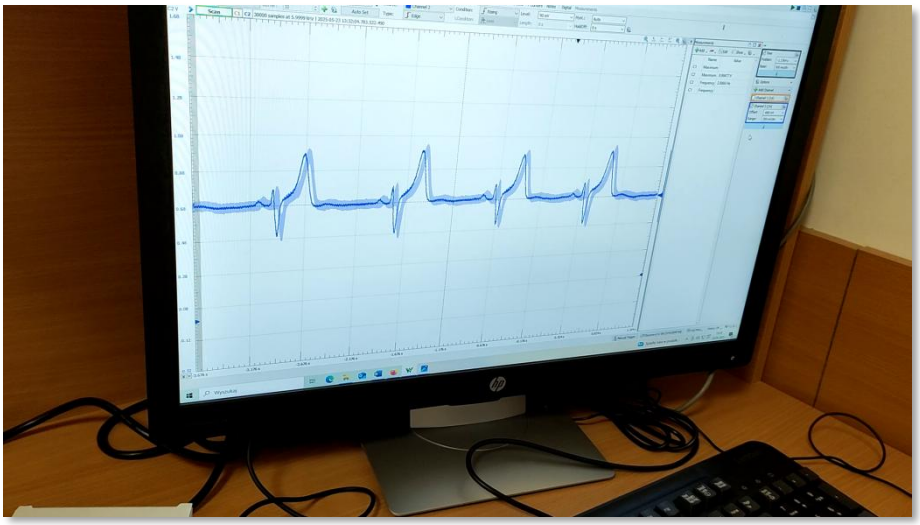

Fig. 4. The obtained ECG waveform