Documentation - Heart Monitoring Project

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1 What is the problem?

According to the World Health Organization, cardiovascular diseases are most likely the number one cause of death globally, taking an estimated 17.9 million lives each year. More than four out of five CVD deaths are due to heart attacks and strokes, and one third of these deaths occur prematurely in people under 70 years of age. Therefore, this is the best time to improve our knowledge and understanding of your heart health. Regular monitoring will reduce our risk of heart and circulatory disease and it is also a great start to improving our overall health.

2 The environment in which device will work.

Our product is designed to integrate with the C programming environment. We are using Raspberry Pi Pico 2040 WH and MAX30100 sensor. We also have Python application where you can watch the results of your measurement.

3 Minimum functionality/design assumptions. CONCEPT

- Data processing and storage collected from sensors: heart pulse (minimum)
- Oxygen saturation
- electrocardiography
- accelerometer -> measuring distance traveled, measuring burnt calories during training.
- Calculating relative fat mass, daily energy expenditure, heart rate variability -> measuring intervals between your heartbeats that slightly fluctuates.
- Communication via WiFi and Bluetooth

4 Solutions from the market (pros, cons, cost of the device and maintenance).

There are many devices such as pulseoximeters or wrist bands that are calculating heart rate and oxygen saturation. The advantage of our device is price. Our device costs about 45zł which is twice cheap as pulseoximeter. Their price starts from 80-100 zl and wrist bands price starts from around 200 zl. We assume that because of cheap sensor we might get a bit less accurate results than solutions you can find on market. Another advantage will be the wrist band which is more comfortable than simple pulseoximeter. More expensive devices that you can find on the market may have greater functionality.

5 Our idea (comparison with the competition).

Our idea is to make a low-cost either wristband, that might have worse precision than the products that already exist on the market, but it will still be within the margin of error. Our product might be less convenience in terms of the size, but still more comfortable than the simplest pulseoximeters on the market. It will be affordable for most people due to low cost of production. It will has the application that will compute you heart rate and oxygen saturation. you can also see the measurement in real time on graphs. After putting your basic information such as age, gender, weight, height you will be able to compare whether your results are normal for your parameters.

6 Project description

A pulse oximeter is an electronic device used to measure blood oxygen saturation, known as saturation. Another additional parameter measured by the pulse oximeter is the heart rate, also known as the pulse (pulse rate in bpm). Photoplethysmography (PPG) is a technique for measuring changes in the amount of light absorbed or reflected by body tissues, especially the skin. In a medical context,

it is often used to monitor changes in blood flow. Light penetrates through tissue (such as the skin) and is absorbed by hemoglobin in red blood cells. As blood flows through blood vessels, the amount of light absorbed by hemoglobin changes, which can be recorded using appropriate sensors. Typically, red light (at a wavelength of 650nm) and infrared light (at a wavelength of 940 nm) are used, as they penetrate the skin better. Based on differences in radiation absorption by hemoglobin, using a constant absorption coefficient, we calculate the degree of oxygen saturation of hemoglobin, which is expressed as a percentage.

7 Diagram, schematics, behavioral model, view of application

Figure 1: Connection Diagram

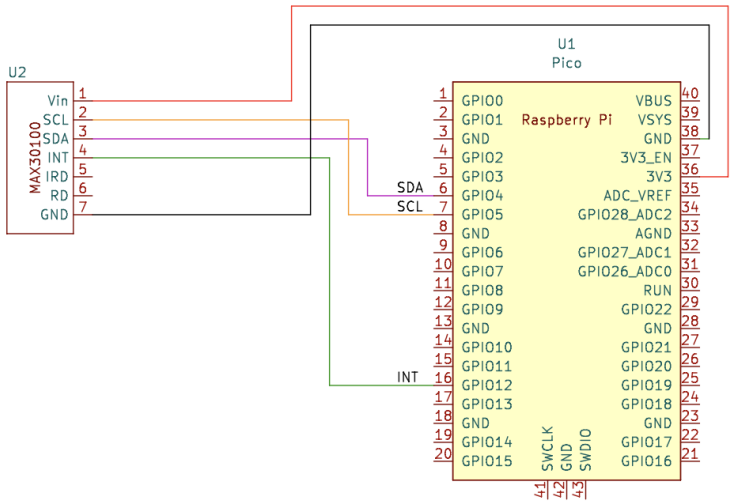


Figure 2: Diagram of concept

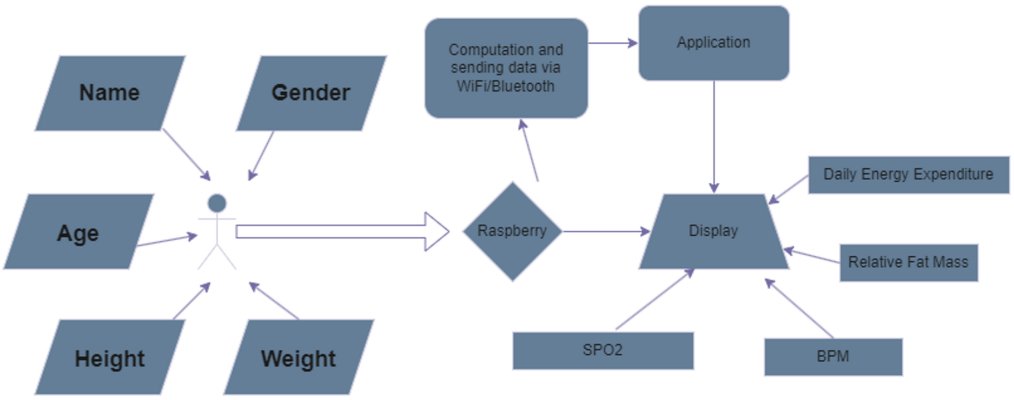
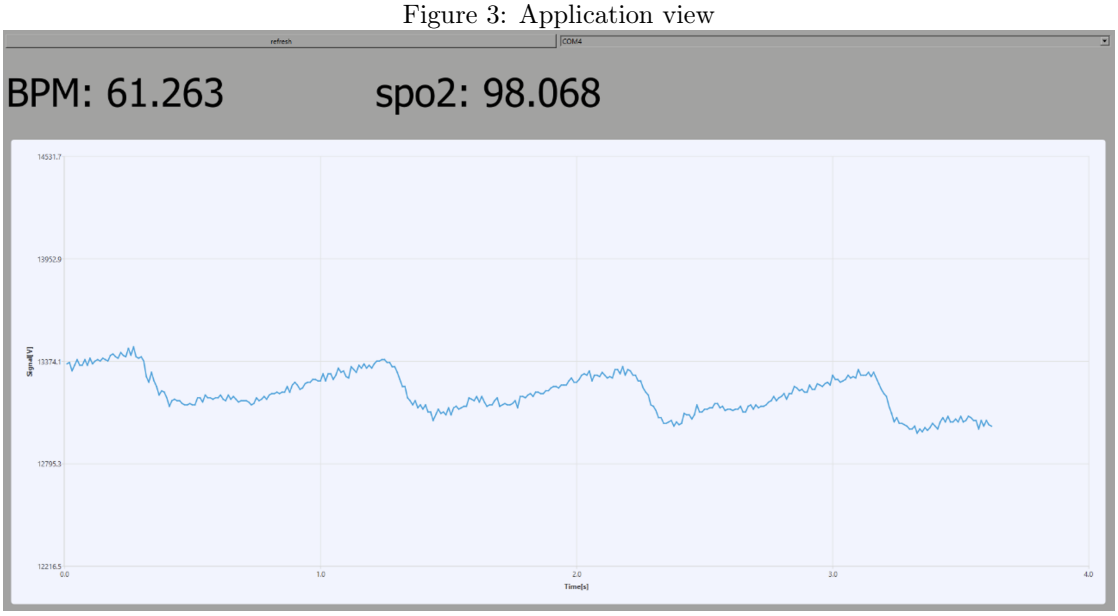


Figure 3: Application view



8 Prototype (proof of concept)

Figure 4: Prototype

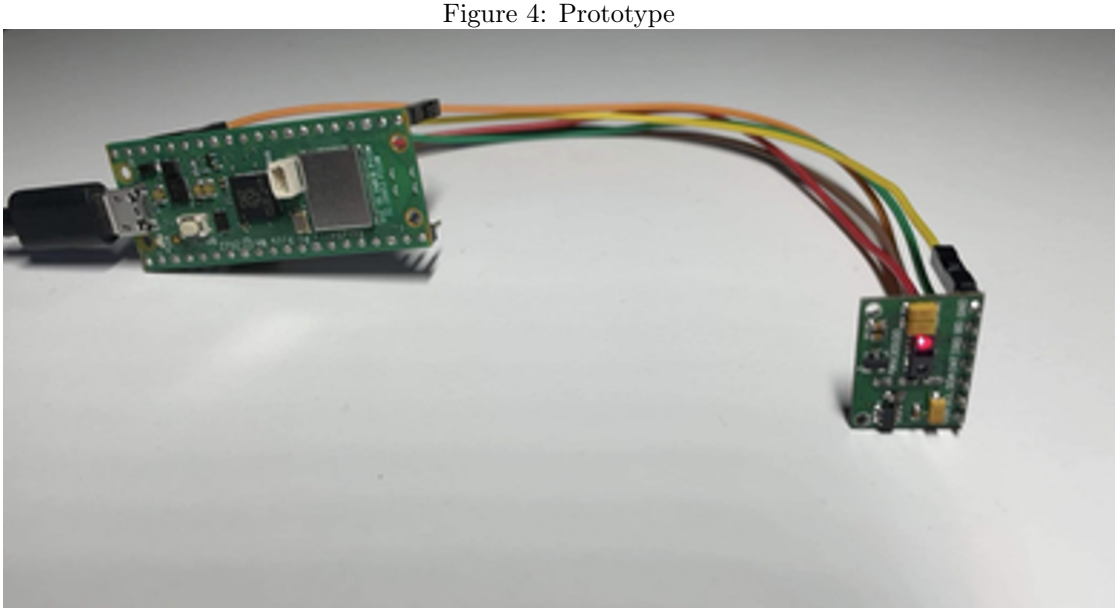


Figure 5: Behavioral model of prototype