Assignment 1

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Hardware 1 - Health technology

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Scope

The objective of the project is to build a heart rate detection and analysis system. We will be working with new machines, devices and aspects that will get increasingly more familiar as the course advances.

The data gathered from the optical sensor will be sent to the cloud for analysis. Then the data of the analysis will be shown to the end user. The *heart* of the project is to work with different software and hardware to combine their strengths to build a heart rate monitor. Core problems presented are to emphasize hardware and software integrations on different levels.

Device

Its operating principles

The optical sensor has an LED which is used to transmit light to the body tissue. The light is reflected and then optical sensor converts the reflected light signal into voltage.

This analog signal can be then converted into a digital signal with the help of the AD-converter in the Raspberry Pi Pico. When the Raspberry Pi Pico completes processing PPG (Photoplethysmography) signals using algorithms to calculate IBI (inter-beats-per-intervals).

The OLED display will output readable data to the end user regarding their heart beat and other information like HRV (heart rate variability) and stress index. Once the data is presented to the end user it will be wirelessly be sent to a WIFI base and Linux server which in turn will send the data to Kubios Cloud HRV analysis service for a more detailed and enhanced analytics.

Device and its components

Key components in this device include the pulse sensor, the OLED display, wireless connection to Linux server and WIFI. These components working together ensures a user-friendly experience.

The pulse sensor is crucial for gathering reliable data to be processed and read. In contrast, the OLED display is responsible for presenting all relevant data to the user in an intuitive manner.

The wireless data transmission feature allows the device to function beyond its physical limitations, with the integration of Linux and Kubios Cloud significantly enhancing its capabilities.

Application

Final device is intended to be used by the students or individuals wanting to know their or their subjects HRV, recovery and stress index. The device is intended for use in home, office, or professional settings.

Development tools

Ulab, **T**honny IDE, **W**okwi, **K**ubios Cloud are among the development tools being used in the project.

Thonny is an IDE that suits our need to program Raspberry Pi Pico well. It can run MicroPython and is a special IDE with special focus on embedded systems.

Ulab helps us with mathematical problems and algorithm with it having tools for simplifying advanced algorithm development.

Wokwi is an environment that allows us to simulate Raspberry Pi and Arduino. The platform simulates the required hardware in a software environment, allowing for comprehensive testing and learning experiences.

Kubios Cloud takes our IBI(inter-beat-interval) data and then is able to return HRV(heart rate variability) analysis and stress analysis to our device. Kubios Cloud is a cloud service that uses REST API to send us the data back.