H&D
*Life with less stress*

*Thesis project proposal*

# *Android application development for measuring the "Heart rate variability" (HRV) parameter using PPG technology.*

**Targets**

The main goal of this project is the development of an Android application. This application must be able to measure heart rate variability (HRV) using photoplethysmographic technology (PPG). The project includes the development of a data acquisition algorithm and its management algorithms, including the possibility of remote storage.

**Background**

Heart rate is defined as the average number of heart beats per minute. In reality, the time that passes between one heartbeat and another is not constant, but changes continuously. Each of us presents a natural variability of heart rate in response to factors such as the rhythm of breathing, emotional states, anxiety, stress, anger, relaxation, thoughts, etc. In a healthy heart, the heart rate responds quickly to all these factors, changing according to the situation so that the organism is able to adapt in the best possible way to the different needs that the environment continually submits to it. A healthy individual shows a good degree of heart rate variability which translates into a good degree of psychophysical adaptability to the different situations that may arise.

To measure HRV, continuous heart rate monitoring is required. The two main techniques used are ECG and PPG. ECG, which is considered the main technique, is a direct measurement based on the measurement of cardiac electrical activity. PPG is an indirect technique based on monitoring the volume fluctuations of blood vessels. ECG is a more precise but more expensive and invasive and less accessible technique, on the contrary PPG is less precise and more difficult to develop, but simpler and cheaper to use and can also be used by untrained users.

PPG needs a light source to illuminate the subcutaneous tissue and a photodetector with spectral characteristics corresponding to those of the light source. There are two basic configurations used in PPG: transmission mode, in which the perfused tissue (such as a finger or earlobe) is positioned between the source and the detector, and the reflection mode, where the two electronic components are positioned next to each other close to the skin. In both cases the detector registers small variations in the transmitted or reflected light respectively, caused by changes in the microcirculation. The main factors influencing the intensity of the detected light are the volume of blood and the movement of the walls of the blood vessels. The waveform detected by this measurement consists of several elements of different frequency and intensity, including an alternating current (AC) component and a direct current (DC) component. The AC component depends on the changes in blood volume in sync with the beating of the heart. The CC component results from the optical signals reflected or transmitted by the tissues of various nature. The base rate of the AC component varies with the heart rate and is superimposed on the DC reference. The CC component shows secondary changes related to phenomena such as breathing.

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**Project structure**

The steps required to create the Android application are shown below:

- Development of an algorithm that through the use of smartphone peripherals (LED and Camera) calculates the waveform in PPG;
- Processing of the waveform in PPG to derive the HRV;
- Data management and storage via remote database.