An Automated Device for Recording Peripheral Arterial Waveform

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Introduction: The aim of the study was to develop an automated device for recording peripheral arterial pulse wave, in order to assess cardiovascular health. Current golden standard non-invasive method is radial artery applanation tonometry which requires a trained operator. Recent studies have shown that Photoplethysmography (PPG) is a viable technique to measure peripheral pressure waveform.

Methods: We developed a small motorized device that can measure pulse waveform from the finger. The device targets the distal transverse palmar arch (DTPA) artery using infrared wavelength PPG. The artery is compressed to mean arterial pressure (MAP) where the PPG amplitude reaches its maximum value. Arterial waveform was recorded for 15 seconds and then averaged for pulse wave analysis. The resulting waveform is calibrated with systolic and diastolic pressure readings acquired via standard brachial cuff ($SBP = 126 \pm 13\, mmHg$, $DBP = 73 \pm 8\, mmHg$).

Results: Measurements were taken from healthy subjects (n=8) using the developed device. The heart rate (HR) detection was performed using a custom algorithm for evaluating the performance of the device. HR detection was successful ($TRP = 100\%$, $PPV = 100\%$) in all subjects. The high detection rate is partly attributed to high quality signals. The averaged pulse waveform was extracted successfully from all subjects. Augmentation index (AIx) was calculated for signals that showed a clear inflection point ($AIx = 85 \pm 8.5\,\%$). Pulse morphology during different compressing levels was studied and it was verified that maximal pulse amplitude is found by setting the compressing pressure equal to MAP.

Conclusion: The device was able to record high quality blood pressure calibrated arterial waveforms, detect beat-to-beat heart rate allowing the assessment of the full radial waveform profile. The averaged pulse waveform could potentially be further used to derive stroke volume (SV) and cardiac output (CO) or transformed into aortic pressure waveform using a Generalized Transfer Function (GTF).

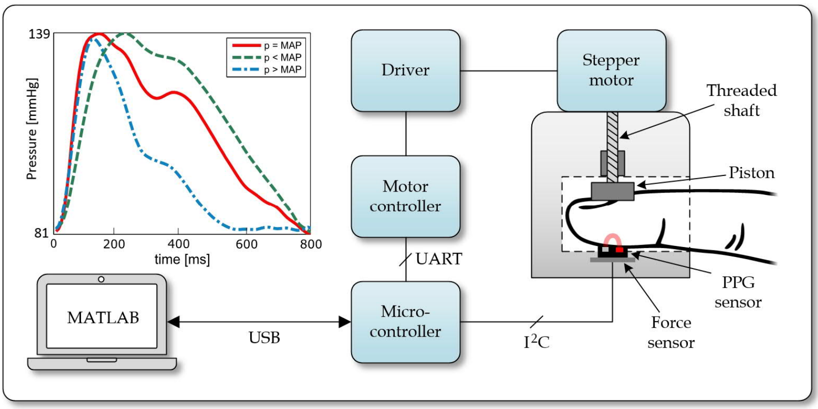

Figure 1: System diagram and pulse morphology analysis using different compression levels.