

EXTRACTING HEART RATE AND RESPIRATION RATE USING A CELL PHONE CAMERA

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OBJECTIVES

- This study investigates the feasibility of extracting heart rate (HR) and breathing rate (BR) using a cell phone camera in a non-invasive way without the need of external sensors and such that it is independent of ambient lighting condition.
- Develop a mobile application that can estimate HR and BR in real-time.

BENEFITS

Implementing a smartphone application to monitor HR and BR that does not require external sensors will provide a cheap and accessible solution for self-assessment health care. Monitoring these physiological signals is important because it could help subject detect and prevent abnormal respiratory rates and other issues that may lead to cardiac arrest, stroke and chronic obstructive pulmonary diseases. This application can therefore potentially benefit a large population as source of physiological measurements.

METHOD

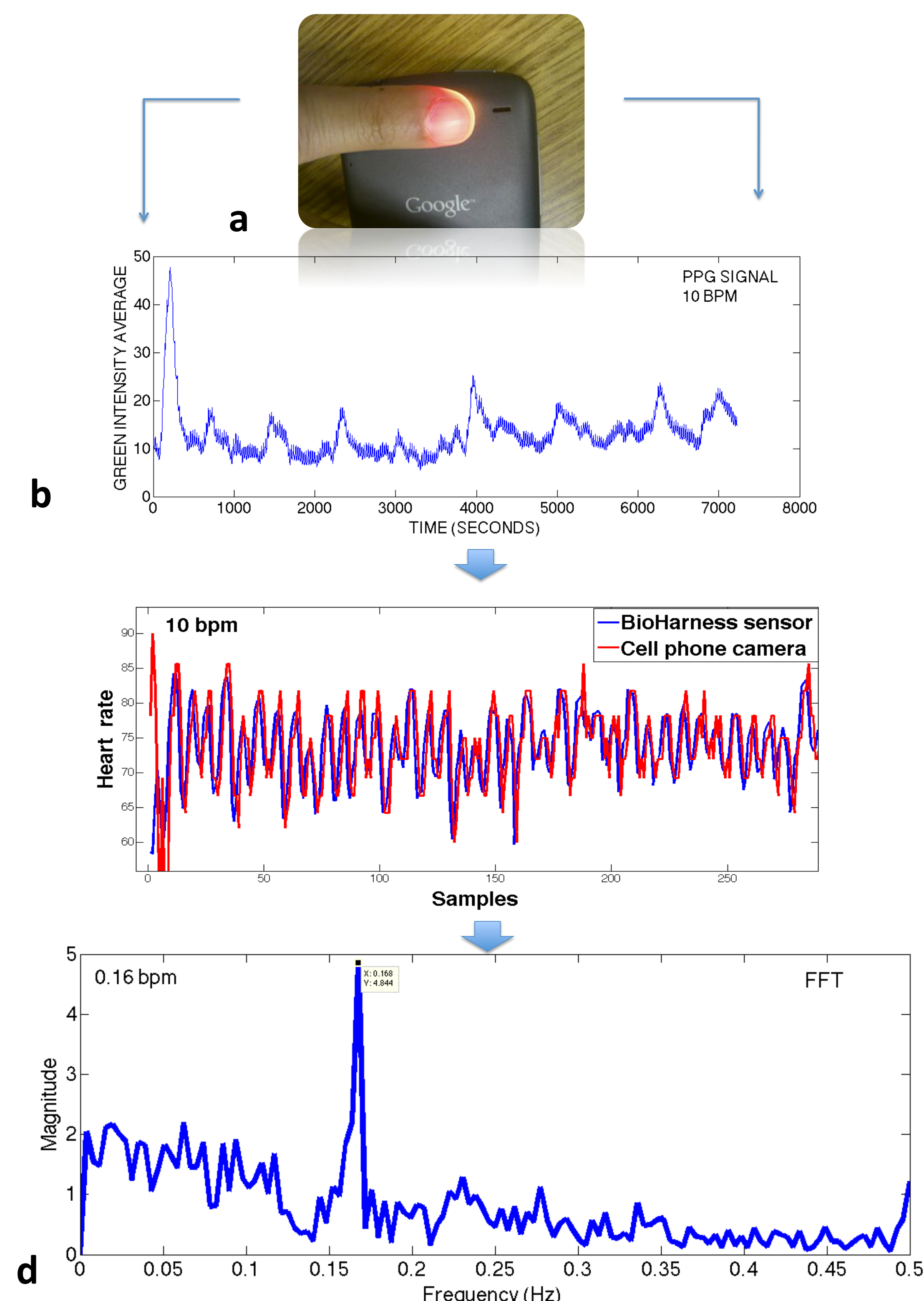


Figure 1. Represents the HR and BR procedure. (a) smartphone recording. (b) Photoplethysmography and Respiration Sinus Arrhythmia signals. (c) correlation between commercial sensor measurements and the HR estimation from the iPhone camera recordings at 10 bpm. (d) Represents the FFT plots of heart rate signal. The harmonic peak corresponded to the respective Breathing frequency, in which the sample was collected.

HR & BR ESTIMATOR APPLICATION

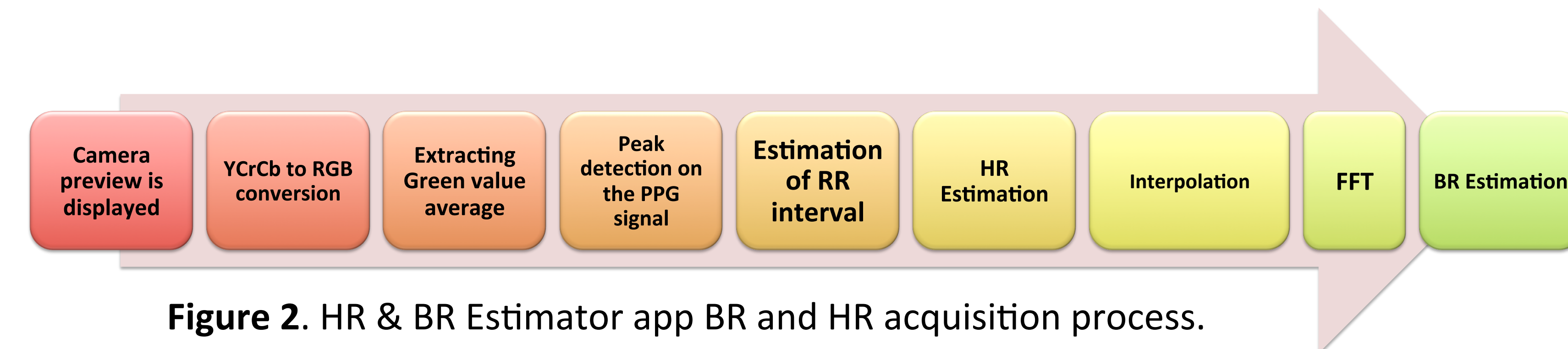


Figure 2. HR & BR Estimator app BR and HR acquisition process.

HEART RATE ESTIMATION

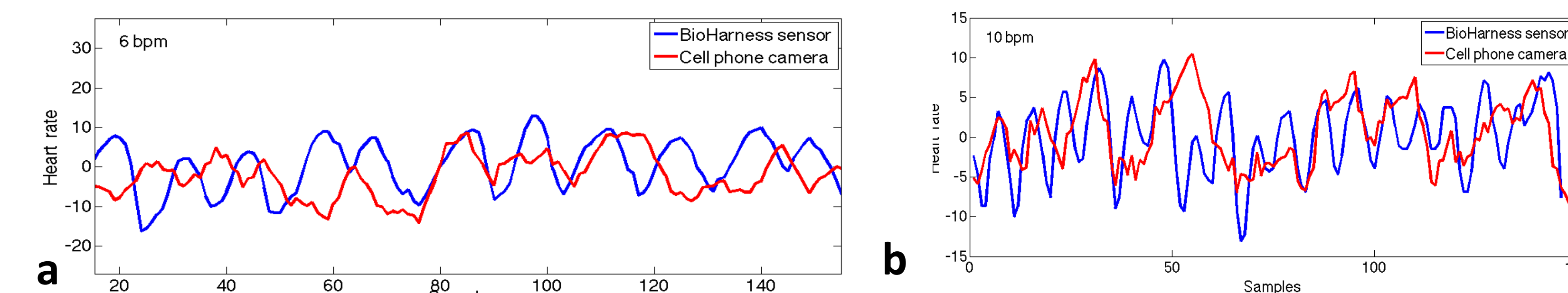


Figure 3. The similarity in the HR signal from the HR & BR app (red) and the commercial sensor (blue) under two controlled breathing patterns. (a) 6 bpm and (b) 10 bpm

RESULTS

Statistics	Heart rate estimation			
	Offline processing		HR & BR Estimator app	
	6 bpm	10 bpm	6 bpm	10 bpm
RMSE	2.89	1.36	8.71	5.35
ME	0.06	1.07	2.39	0.68
STDE	2.90	0.85	8.40	5.33
Correlation coefficients	0.92	0.96	0.02	0.32

Table 1. Shows the statistical error results from the three controlled settings recorded with the iPhone camera and the HR & BR estimator. The Standard deviation error (STDE), Mean error (ME), Root mean square error (RMSE) and Correlation coefficients were computed.