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Data Article

Simultaneously acquired data from contactless and wearable devices for direct and indirect heart-rate measurement



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ABSTRACT

The proposed dataset provides a complete set of simultaneously acquired data from contactless and wearable devices for direct and indirect heart-rate measurement. Data were acquired on a total of 20 healthy white Caucasian subjects wearing no makeup (10 males and 10 females; age: 22.50 ± 1.57 years; height: 173 ± 10 cm; weight: 62.80 ± 9.52 kg) and consisted of: i) videos of the subject's face acquired by a RGB-D (Red, Green, Blue and Depth) camera (Microsoft Kinect v2), which is a contactless device; ii) electrocardiographic (ECG) recordings acquired by a clinical Holter ECG recorder (Global Instrumentation's M12R Holter), which is a wearable device; and iii) heart-rate measurements acquired from a commercial smartwatch (Moto 360 smartwatch by Motorola), which is also a wearable device. ECG recordings were processed to extract the R-peaks position and obtain a reference indirect measurement of the heart rate. A direct measurement of the heart rate was provided by the commercial smartwatch. The dataset here presented could be useful to develop new algorithms for heart-rate detection from contactless devices and to validate contactless heart-rate estimation in comparison to reference heart rate from

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clinical wearable devices and to heart rate from commercial wearable devices.

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Specifications Table

Subject	Biomedical, Electrical and Electronic Engineering
Specific subject area	Contactless and wearable devices for heart-rate measurement
Type of data	Videos (.avi) Matlab data files (.mat) Text files (.txt)
How data were acquired	RGB-D Camera (Kinect v2, Microsoft) Clinical Holter ECG recorder (M12A, Global Instrumentation) Smartwatch (Moto 360, Motorola)
Data format	Raw and processed
Parameters for data collection	Data were acquired on a total of 20 healthy white Caucasian subjects (10 males and 10 females; age: 22.50 ± 1.57 years; height: 173 ± 10 cm; weight: 62.80 ± 9.52 kg) wearing no makeup and consisted of videos of the subject's face, electrocardiographic (ECG) recordings and heart-rate measurements.
Description of data collection	During the test, illuminance of the room was kept constant; the subject was sitting on a chair in front of a Microsoft Kinect v2 RGB-D camera (1-m distance) and worn two different wearable devices: a Global Instrumentation's M12R Holter ECG recorder and a Moto 360 smartwatch by Motorola. A single test lasted 40 s during which the three measurement devices acquired data simultaneously. Five test repetitions, each characterized by its illuminance value, were performed for each subject.
Data source location	Department of Information Engineering, Università Politecnica delle Marche, Ancona, Italy
Data accessibility	Data is publicly available on Mendeley data public repository. Link: https://data.mendeley.com/datasets/rryh4gbp7g/draft?a=a8c34b20-a718-4623-824d-ade44eb29173 https://doi.org/10.17632/rryh4gbp7g.1
Related research article	Elsevier credentials are needed to download data. Ennio Gambi, Angela Agostinelli, Alberto Belli, Laura Burattini, Enea Cippitelli, Sandro Fioretti, Paola Pierleoni, Manola Ricciuti, Agnese Sbrollini, and Susanna Spinsante Heart Rate Detection Using Microsoft Kinect: Validation and Comparison to Wearable Devices Sensors 2017, 17 (8) 10.3390/s17081776 [1]

Value of the data

- Data are useful to support development of algorithms for heart-rate measurement from videos of human face acquired using contactless devices.
- Researchers and algorithms developers can benefit from these data to validate the output of their algorithms against heart rate measured by clinical and commercial wearable sensors.
- Further experiments could involve subjects of different ethnicities, wearing different makeup under different light conditions.
- Additional value of these data consists in the simultaneous acquisition of data from different type of devices.

1. Data

This article provides a dataset for direct and indirect heart-rate measurement organized in three main folders: *Data*, *DemographicFeatures* and *LightConditions*. *Data* contains a folder for each subject (S_n , where $n = 1, 2, \dots, 20$ indicates the subject). Inside each subject's folder, there are three subfolders containing data simultaneously acquired with a contactless RGB-D camera (*R*), a clinical wearable

Holter ECG recorder (*H*), and a commercial wearable Smartwatch (*S*) for indirect (*R* and *H*) and direct heart-rate measurement. *R* subfolder contains videos (RGB color: three channels with 256 pixel levels each; frame rate: 30 fps; frame size: 492x276 pixels) of the subject's face called *Sn_m.avi*, where $m = 1, 2, \dots, 5$ indicates the test repetition. *H* subfolder contains MATLAB files called *Sn_m.mat* relative to the standard 12 lead electrocardiogram (ECG) organized in a MATLAB structure having fourteen fields: *H.Rpeaks* (*R*-peaks position vector; samples); *H.sf* (sampling frequency; Hz); *H.I* to *H.III* (leads I to III; μV); *H.V1* to *H.V6* (leads V1 to V6; μV); *H.aVR* (lead aVR; μV); *H.aVF* (lead aVF; μV); and *H.aVL* (lead aVL; μV). *S* subfolder contains a text file called *Sn.txt* composed of five rows, each representing the heart-rate value (bpm) provided by the smartwatch for each test repetition. *DemographicFeatures* contains a text file (*DemographicFeatures.txt*) with the demographic characteristics of all the subjects involved: gender, age, weight, height, smoking and fitness status. *LightConditions* contains a text file called *Ln.txt*, composed of five rows each representing the illuminance value (*lx*) during each test repetition.

2. Experimental design, materials, and methods

The experiment was performed on 20 healthy white Caucasian subjects wearing no makeup (age: 22.50 ± 1.57 years; height: 173 ± 10 cm; weight: 62.80 ± 9.52 kg) and was carried out in accordance with the Declaration of Helsinki. Each subject signed an informed written consent before participating. During the test, illuminance of the room was kept constant; the subject was sitting on a chair in front of a Microsoft Kinect v2 RGB-D camera (1-m distance) and worn two different wearable devices: a Global Instrumentation's M12R Holter ECG recorder [2] and a Moto 360 smartwatch by Motorola. A single test lasted 40 s during which the three measurement devices acquired data simultaneously. Five test repetitions, each characterized by its illuminance value, were performed for each subject.

RGB videos (256 levels) of the subject were acquired with a frame rate of 30 fps through the Complete Viewer v2.0 capture software [3]. Size of the video frames, originally equal to 1920x1080 pixels, was reduced to 492x276 pixels to contain only the subject's face identified by a MATLAB face-detection algorithm [4]. Eyes were obscured to avoid identification of the subject.

Standard 12 leads ECG signals (μV) were acquired using ten electrodes placed on the body surface of the subject according to the Mason-Likar configuration [5]. Signals, originally sampled at 1 kHz, were down-sampled at 200 Hz. *R*-peaks positions (samples) were extracted using the Pan and Tompkins algorithm [6] applied to aVR lead.

Heart-rate measurement (in bpm) was provided by the LG Pulse app, analyzing the photoplethysmographic signal [7] acquired by the commercial smartwatch.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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