AN APPLICATION FOR REMOTE RESPIRATORY PATTERNS DETECTION IN POST-SURGERY PATIENTS

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Introduction

Remote monitoring of clinical parameters plays a key role in different situations like pandemic health emergencies and post-surgery conditions, where the patient is impeded in his/her movements [1]. Currently several devices are available to fulfill this task, however in recent years, the huge development of smartphone technologies has opened the possibility to adopt phone-embedded sensors [2]. In this context, the current project proposes a new smartphone application dedicated to the respiratory and chest kinematic monitoring of patients who underwent cardiovascular/oncological chest surgery. The developed app uses embedded IMU signals to infer the chest kinematics. Additionally, the application is also able to integrate ecographic imaging from Point-of-Care Ultrasound probes (POCUS) devices and blood oxygenation data from bluetooth pulseoximetrs. The collected data have been used for the training of an AI network in order to detect significant respiratory patterns.

Methods

Before developing the application, a first validation phase was carried out by comparing the measurements from the smartphone-embedded sensors with standalone IMUs. Five different positions were defined and tested, with two smartphone orientations for a total of ten configurations. The application was developed for the Android operative system. The application was programmed to be interfaced with a wearable pulse oximeter via bluetooth protocol. Additionally, the possibility to associate a set of POCUS ecographic acquisitions to each monitored case was given. The developed app was then distributed to a population of 100 healthy volunteers and 80 post-intervention patients who underwent cardiovascular/oncological chest surgery. A sample of population was also given a POCUS device. To evaluate its usability, the user was asked to give a score from 1 to 5 (best score). The signals were then stored in a database and fed as input to an AI neural network to determine differences between in terms of respiratory patterns.

Results

The validation revealed that both smartphone-embedded sensors and standalone IMUs have revealed the same performances in terms of measured range (Figure 1 a), except for vertically-oriented configurations, which produced artifacts. The application was successfully developed (Figure 1 b) and distributed to the users, producing a mean usability score of 4.25, to gather the data for the AI network.

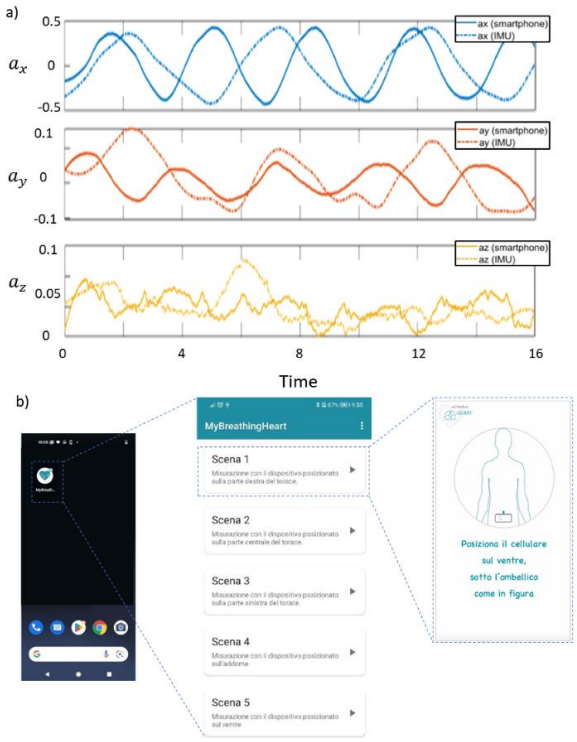

Figure 1: Example of signal validation (a) with Realization of the monitoring application (b).

Discussion and Conclusion

The current work demonstrates the successful validation and development of a smartphone application for respiratory dynamics recording. The workflow of monitoring was correctly validated to gather a significant population patient data.

References

1. Liao et al. ASCO. 39, 115-121, 2019.
2. Majumder and Deen. Sensors 19(9): 2164, 2019.

Acknowledgements

This work was supported by MyBreathingHeart project (J64G200038001).