Live Demonstration: Wireless Device for Clinical Pulse Wave Velocity Evaluations

(Article begins on next page)

Live Demonstration: Wireless Device for Clinical Pulse Wave Velocity Evaluations

A. Valerio*, I. Buraioli*, A. Sanginario*, D. Leone† , G. Mingrone† , A. Milan†, D. Demarchi*
* Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Torino, Italy
† Department of Internal Medicine, University of Torino – AOU Città della Salute e della Scienza di Torino, Torino, Italy
Email: irene.buraioli@polito.it

***Abstract*—This Live Demonstration presents a low-cost wireless integrated device for clinically evaluating Pulse Wave Velocity (PWV). The system comprises two pen-shaped probes with a high-precision MEMS force sensor on their tips and a base/recharge station. The two probes are placed on the femoral and carotid arterial sites and send the pulse wave signal to the base/recharge station via Bluetooth. A PC GUI displays the signals and calculates in real-time the PVW value. The visitors can see a real PWV measurement on a dedicated test subject or experience, in the first person, the arterial pulse assessment on their carotid after proper probe sterilization.**

***Index Terms*—Arterial stiffness, Arterial Pulse, Pulse Wave Velocity, Bluetooth, MEMS sensor, Tonometry.**

I. Introduction

Arterial stiffness is known to be strictly correlated with cardiovascular Diseases (CVDs) [1]. Thus it is become one of the most important classifiers for cardiovascular pathologies. Among different methods, arterial stiffness can be evaluated by measuring the velocity at which blood pulse propagates through the cardiovascular system, i.e. the Pulse Wave Velocity (PWV).The stiffer the blood vessel walls, the higher the PWV. Nowadays, several devices exist to assess the PWV but all of them are expensive and non-portable. Our research group developed a new device for the clinical assessment of PWV that overcomes cited issues [2]. This demo reproduced such device with an additional improvement: the two probes are now battery-powered and connected to the base station via Bluetooth instead of a wire. This feature makes our system even more portable and manageable.

II. Demonstration setup

The experimental setup is shown in Fig. 1. Two pen-shaped probes with a high-precision MEMS force sensor on their tips are placed on two different site of the subject's body (one of the authors): the neck and the groin. The two probes will send their data via Bluetooth to the base station. The base station, connected to a laptop via USB acts as data collector for the data streaming as well as a charging station for the two probes. A GUI displays continuously the two pulse waves and calculates the PWV parameter with a patented [3] real-time custom algorithm. The two probes are electronically synchronized as soon as they leave the base station, this ensure the accuracy of the measurement.

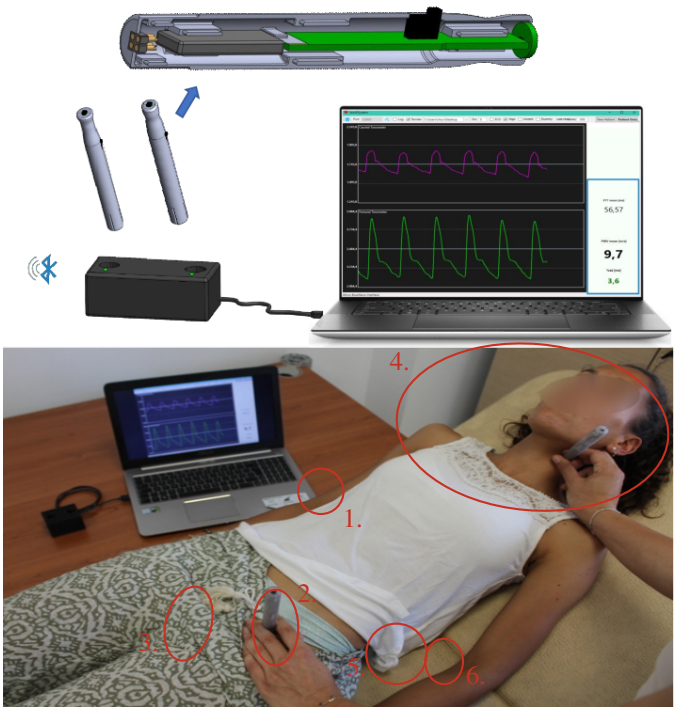

Fig. 1. System setup: 1) Bluetooth receiver; 2) Acquisition device on *Extensor Carpi Ulnaris*; 3) Acquisition device on *Palmaris Longus*; 4) System GUI while plotting ATC values; 5) Employed electrodes; 6) Involved PCB.

III. Visitor experience

Visitors can see how a real clinical PWV evaluation is performed by looking and interacting in real-time with the two conductors: the "physician" and the "patient" (two of the paper's authors). They will understand the practical issues and the benefits of the proposed device. Moreover, they can experience the measurement of their carotid site arterial pulse. The "physician" will place one probe on the visitor's neck displaying his PW in real-time. After every subject, the probe will be sterilized with an alcoholic solution to comply with COVID-19 safety regulations.

References

[1] E. Council, J. Redon, K. Narkiewicz, P. M. Nilsson, M. Burnier, M. Viigimaa, E. Ambrosioni, A. Coca, M. H. Olsen, and R. E. Schmieder,

"2013 esh/esc guidelines for the management of arterial hypertension," *European Heart Journal*, vol. 34, no. 28, pp. 2159–2219, 2013.

[2] I. Buraioli, D. Lena, A. Sanginario, D. Leone, G. Mingrone, A. Milan, and D. Demarchi, "A new noninvasive system for clinical pulse wave velocity assessment: The athos device," *IEEE Transactions on Biomedical Circuits and Systems*, vol. 15, no. 1, pp. 133–142, 2021.

[3] D. Demarchi, I. Buraioli, A. Milan, F. Veglio, and F. Vallelonga, "Method and system for real-time measurement of a sphygmic wave velocity," Nov. 2020, international patent - Priority number: 102020000027846.