Live Demonstration: Real Time Imaging With Electrical Impedance Tomography

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Abstract—**This demo presents a high framerate (89 fps) electrical impedance tomography (EIT) system. It is a wearable, low-cost and non-invasive imaging system to continuously monitor regional lung ventilation for neonatal and SARS-CoV-2 patients. The system uses a 16-passive electrode belt around the chest to extract impedance changes as a result of lung ventilation.**

I. Introduction

Electrical Impedance Tomography (EIT) can create a dynamic image of impedance changes for application in lung function monitoring. Small constant AC current < 5mA rms are applied to the tissue and the boundary voltages are measured, which represents the impedance between them. Applying currents with frequencies as high as 10 MHz or as small as a few Hz can be used to distinguish between different tissue types. Although the spatial resolution of EIT is not as high as magnetic resonance imaging (MRI) and X-ray computed tomography (CT) systems. EIT systems have a greater temporal resolution > 100 frame a second. It is also radiation-free, which is idea for continuous lung function monitoring.

Demonstration type: Academia

II. Demonstration Setup

Fig. 1. shows the proposed EIT system [1-3], which comprises the following components:

- **A saline tank with a moving object:** simulating changes (volume) of the lungs.
- **Central hub:** Shown in Fig. 2, controls the 16 passive electrodes on the belt, according to the block diagrams in Fig. 1.
- **Computer:** Used to display the captured clinical parameters.

III. Visitor Expeirience

The demonstration would allow visitors to visualise and get familiar with real-time EIT images of dynamic changes of impedance as an object is moved in a saline solution.

TABLE I. EIT System Specification

No. of Electrodes	Frame Rate	Freq. (kHz)	Supply Vol.	Power Cons.	Current Amp. (mA)
16	89fps	125-1000	±12, 5	1.7W	Up to 5

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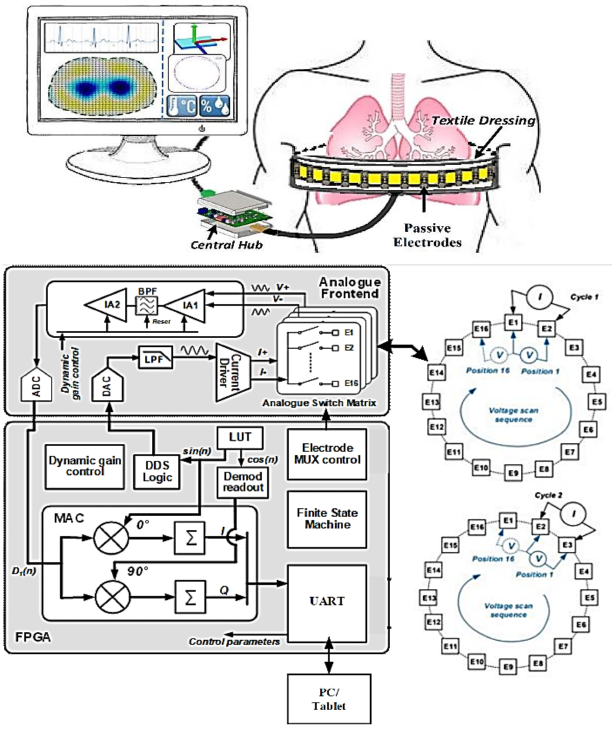

Fig. 1. Wearble EIT belt and central hub [1-2].

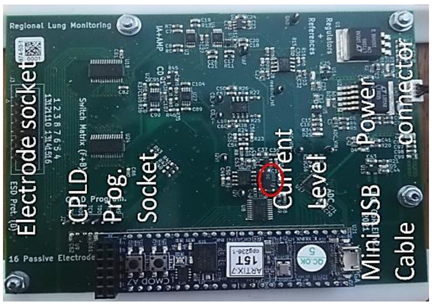

Fig. 2. EIT central hub

Earlier Publications

[1] M. Rahal., D. Jiang, Y. Wu, A. Bardill, R. Bayford, A. Demosthenous, "High frame rate electrical impedance tomography system for monitoring of regional lung ventilation", Annu. Int. Conf. IEEE Eng. Med. Biol. Soc., pp. 2487-2490, 2022. https://pubmed.ncbi.nlm.nih.gov/36085910/

[2] Y. Wu, D. Jiang, A. Bardill, S. De Gelidi, R. Bayford, A. Demosthenous, "A high frame rate wearable EIT System using active electrode ASICs for Lung respiration and heart rate monitoring", IEEE Trans. Circuits Sys. I Regular Papers, Vol. 65, No. 11. pp. 3810-3820, 2018. https://ieeexplore.ieee.org/document/8438537

[3] Y. Wu, D. Jiang, A. Bardill, R. Bayford, A. Demosthenous, "A 122 fps, 1MHz Bandwdith multi-frequency wearable EIT belt featuring novel active electrode architecture for neonatal thorax vital signs monitoring", IEEE Trans. Biomed. Circuits Syst., Vol. 13 No. 5, pp. 927-937, 2019. https://pubmed.ncbi.nlm.nih.gov/3128351.