Electrical sensors to monitor skin impedance

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Objective

The objective of this MSc project is to develop a sensor capable of measuring skin dehydration. The sensor is based on the measurement of the skin's electrical impedance.

The sensor together with an optical based sensor for dehydration will be miniaturized and implemented into the frames of an eyeglass.

The final goal is to develop a wearable skin dehydration sensor. Fig. 1 shows a conceptual view of the wearable device.

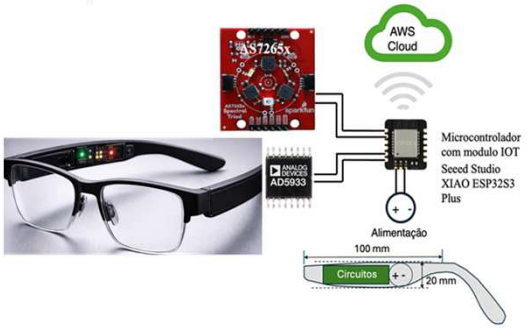

Fig. 1. Conceptual diagram show the goal of the project. The impedance measuring circuit will be incorporated into the frames of eyeglass together with optical sensors.

Experimental set-up

The sensor relies on the integrated circuit AD5933 which is the main core of the ADMX2001B (from Analog Devices). This is an impedance analyzer, with a measurement range of 0.2 Hz to 10 MHz.

The electrical sensor will be combined with the optical spectrometer AS7265x. This will allow us to combine optical and electrical measurements.

Gold electrodes are used to establish electrical contact with the skin.

Fig. 2 shows a photograph of the experimental set-up developed to evaluate the performance of the sensors.

The samples used to study dehydration are *ex-vivo* tissues, namely dermatomes of pork ear.

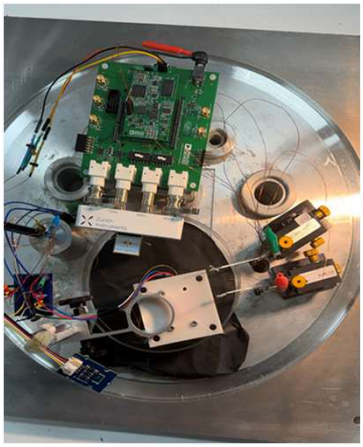

Fig. 2. Photograph of the experimental arrangement mounted to evaluate the dehydration of pork ear dermatomes.

Methodology

The experimental set-up will monitor the loss of water (dehydration) by measuring in real time the weight of the tissue being tested.

The electrical impedance of pork dermatome samples will be monitored over a broad frequency rande (10 Hz – 10 MHz) and correlated with the weight loss.

Dehydration will be induced by controlling the ambient atmosphere (temperature and humidity). The corresponding sensor response will be recorded as a function of time.

The performance of the system using *ex-vivo* tissues will be evaluated into and optimized towards the miniaturization and final integration into the eyeglass frames.

Preliminary data

Preliminary data shows that the skin capacitance decreases following a linear dependence with time. This time dependence correlates with the loss of water measured directly by the weight loss of the biological tissues. (see Fig. 3a and 3b)

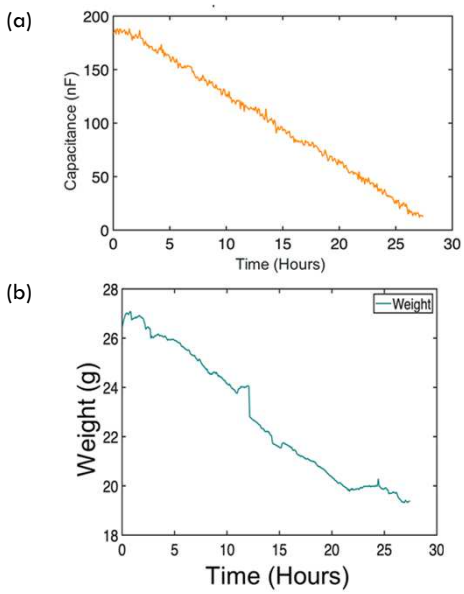

Fig. 3. (a) Time dependence of the skin capacitance. (b) Time dependence of the weight of the tissue. Measurements were carried out in a dermatome of a pork ear 2 mm thick.

Acknowledgements

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