Development of a low-cost interactive prototype for acquisition and visualization of biosignals

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In 2020, approximately one billion people lived with at least one mental health condition such as depression, anxiety, or stress [1]. Stress is known for aggravating symptoms of depression and anxiety, besides affecting the proper functioning of human body systems, including the cardiac and nervous systems, among others [2]. Biosignal acquisition systems play a fundamental role in clinical treatments and experimental testing for these conditions. However, most of these systems are not open source, which makes it difficult to modify them for developing new methods of clinical assessment and treatment [3].

PROJECT PROPOSAL

This work proposes the development of a low-cost prototype for acquisition and visualization of a patient's biosignals for educational and research institutions.

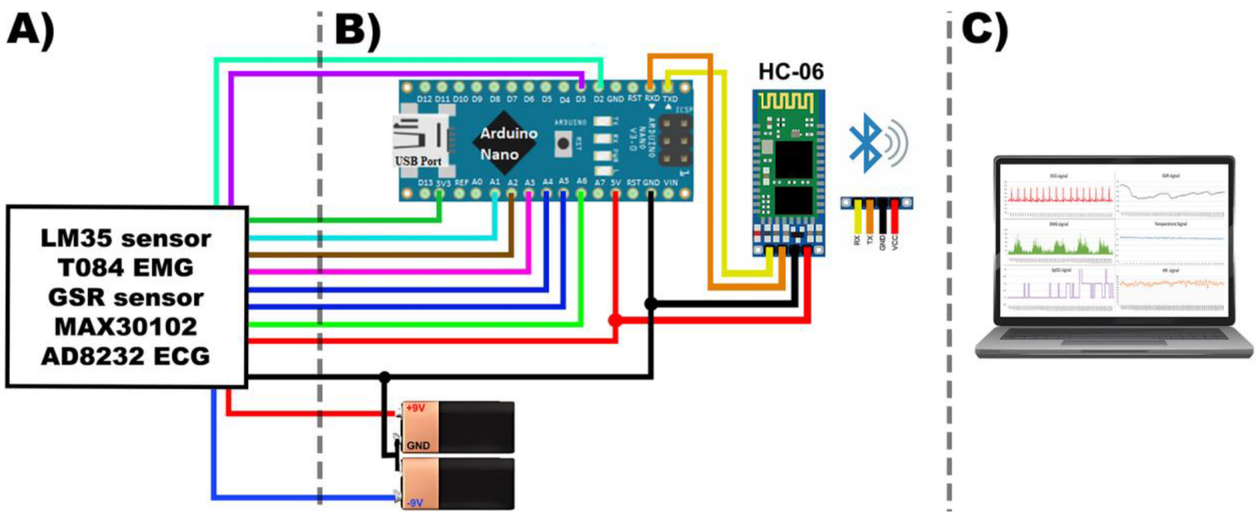

Fig. 1. Biosignal acquisition system connection diagram.

METHODOLOGY

The prototype was developed using a modular design. All modules were evaluated in three stages of operation:

A) Analog stage. The biosignal is recorded by means of a sensor or Analog Front End (AFE) connection plates.
B) Digital stage. The signal is recorded at a specific sampling rate for each biosignal using an Arduino Nano board.
C) Data transmission stage. The data is transmitted wirelessly to a computer via an HC-06 module.

Body temperature LM35

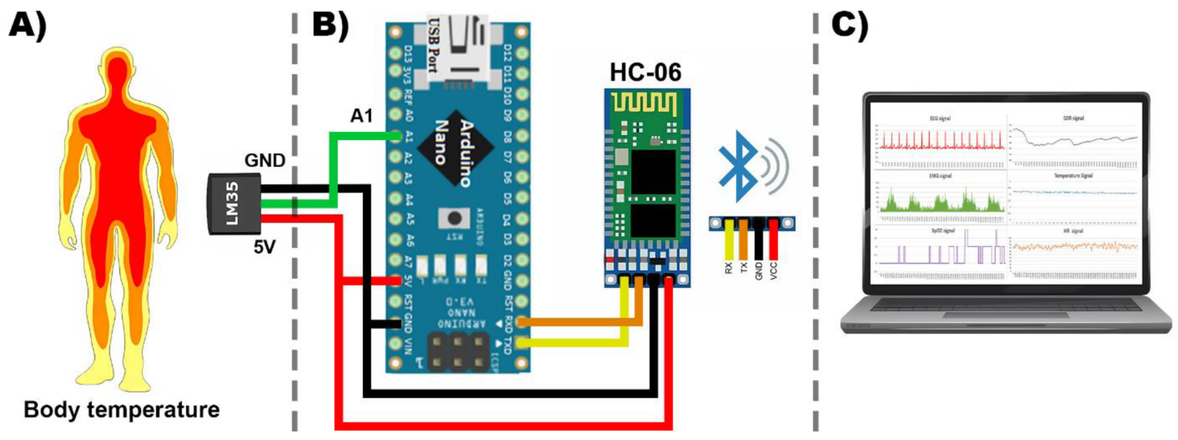

Fig. 2. Body temperature module diagram.

AD8232 ECG circuit

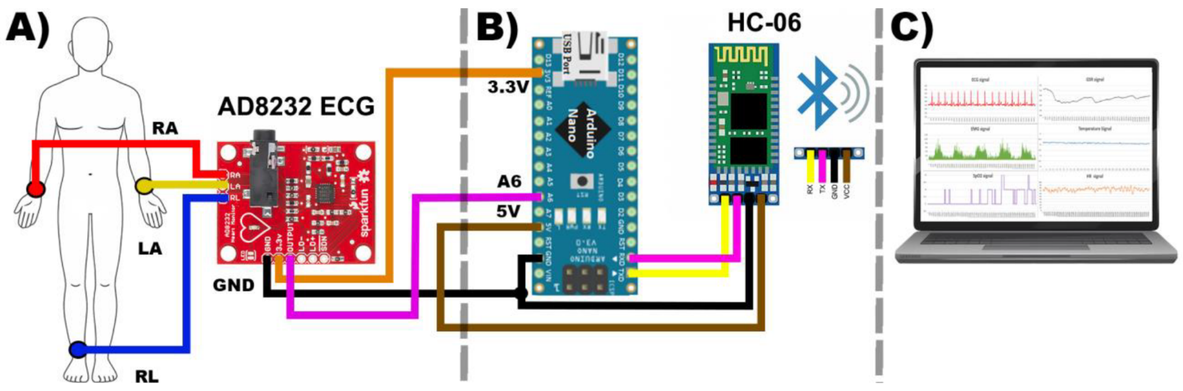

Fig. 3. ECG acquisition module diagram.

EMG Muscle T084 board

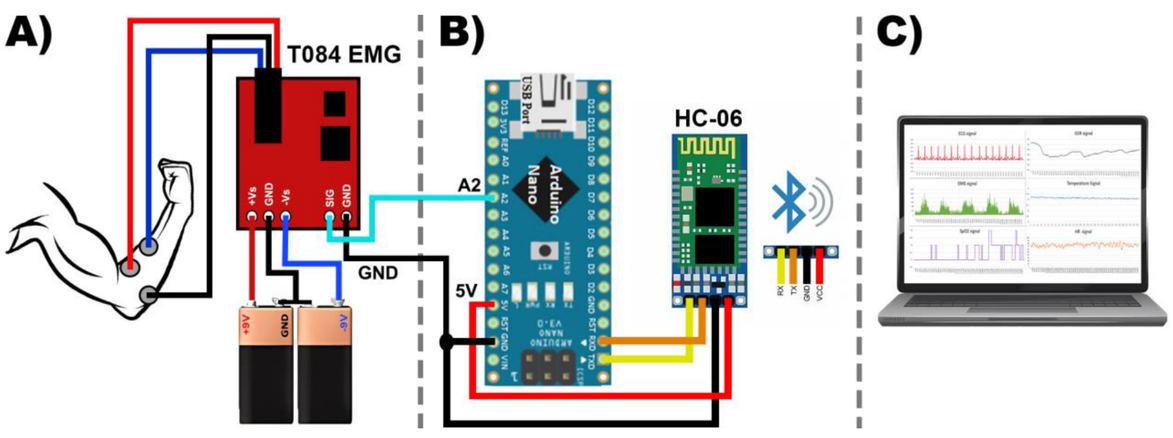

Fig. 4. EMG acquisition module diagram.

MAX30102 heart rate pulsioximeter.

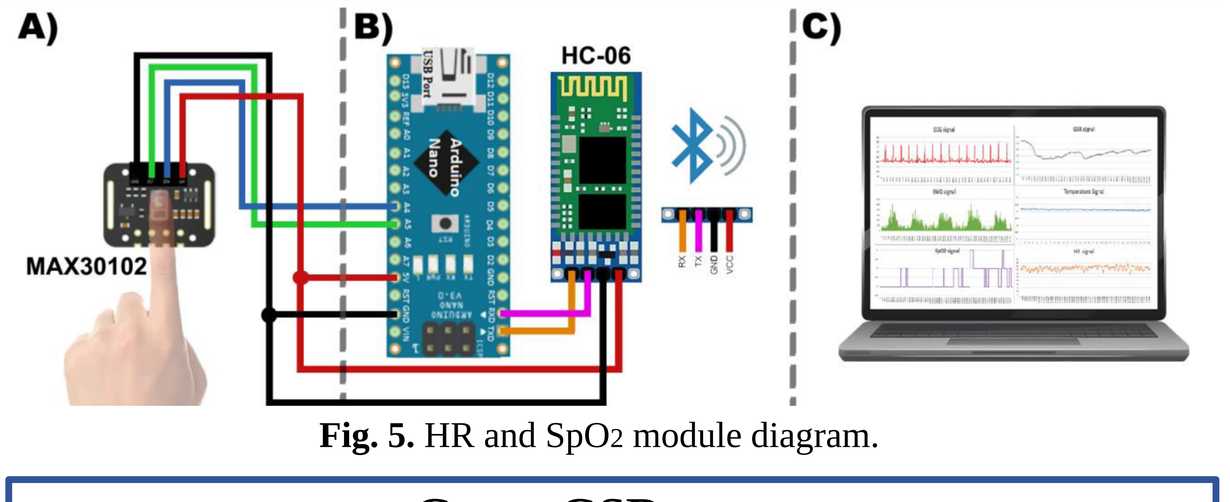

Fig. 5. HR and SpO_2 module diagram.

Grove GSR sensor

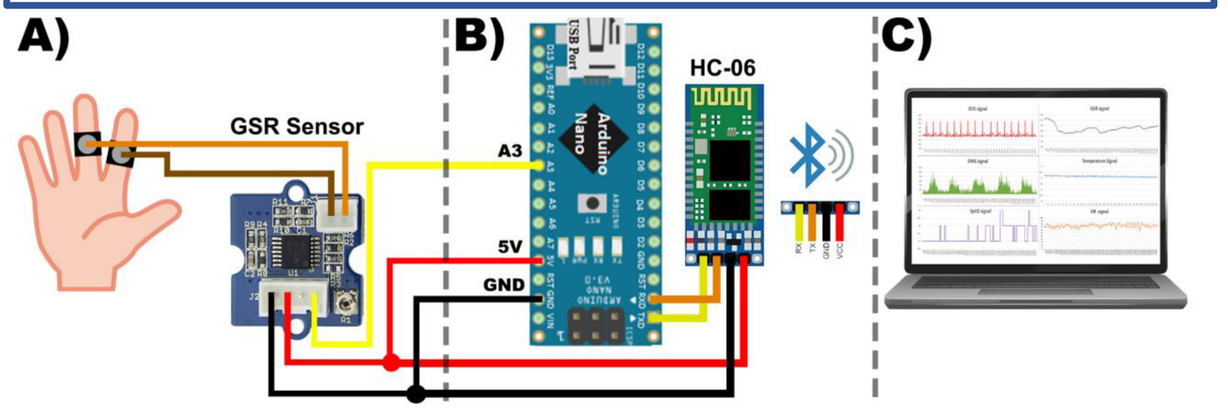

Fig. 6. GSR acquisition circuit module.

RESULTS

All acquired biosignals show a morphology appropriate to a signals of standard conditions reported in the literature. The prototype is able to transmitting data at 2380 samples per second with a baud rate of 1M bauds through the USB serial port to PC, and can transmit 1250 data per second using the HC-06 Bluetooth module.

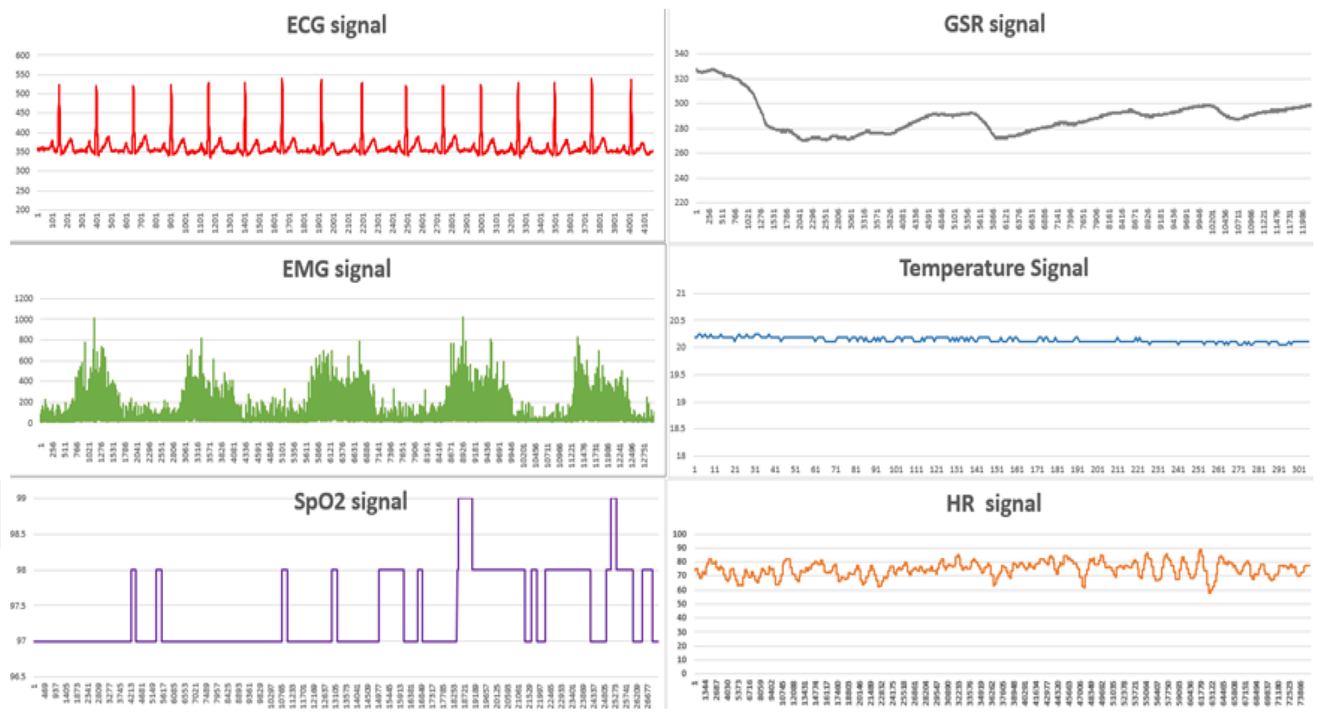

Fig. 7. Biosignals acquired by the prototype.

CONCLUSION

The low-cost prototype developed allows the acquisition of biosignals could provide to educational and research institutions the access to these technologies. This prototype uses AFEs available on the market, while maintaining a development cost below 70 USD. Future work will focus on the development of a printed circuit board (PCB) that integrates all sensors and microcontroller, which could further reduce the prototype's cost.

REFERENCES

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