285352 - CONVERTING PULSE OXIMETER TONE OUTPUT TO PLAY MUSICAL INSTRUMENTS VIA MUSICAL INSTRUMENT DIGITAL INTERFACE (MIDI)

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Introduction

Medical instruments such as pulse oximeters use sound to convey important information to personnel in the operating room. These sounds are a useful way of communicating continuously, however, multiple devices outputting simultaneously can create a distracting, and difficult to distinguish, cacophony of sound. Multiple Instrument Digital Interface (MIDI) is a standard communication protocol used in the music industry. It allows for interfacing multiple devices together and for the use of powerful software tools to control these devices. To utilize the advantage of MIDI in the operating room, an adapter for a clinical Masimo Radical 7 pulse oximeter was developed in order to convert the pulse rate and SPO2 data to MIDI format. The result is the ability to connect the pulse oximeter to any music recording software directly and is the first step towards integrating an audio standard for all devices in the operating room.

Methods

The design of this novel device was exempt REB approval. A novel device termed the “Pulse Oximeter-to-MIDI Output” (POMO) was developed. The device consists of an Arduino Mega, RS232 Shield a MIDI-to-USB converter, a custom circuit, and 3D printed case. The ASCII data from a Masimo Radical 7 is transmitted via RS-232 from the RS-232 port on the pulse-oximeter to the Arduino shield. This data is then transmitted to the Arduino which has been programmed to convert the information into a corresponding pitch and tempo. This pitch and tempo are then used to create MIDI commands that are transmitted via a MIDI-to-USB converter to a computer running GarageBand. A case for the device was developed using rapid-prototyping additive manufacturing techniques. The case contains a light emitting diode (LED) which echoes the patient’s pulse rate along with a toggle button which switches the device between a single note and chord mode.

Results

The device was successful in interfacing a Masimo pulse oximeter with GarageBand (Figure 1). When connected to GarageBand, the user can, select from a multitude of musical instruments (e.g. piano, guitar) to play at each pulse. As designed, the pitch of the sound corresponds to the SPO2 value (high pitch for high SPO2 and vice versa), while the tempo corresponds directly to the measured pulse rate. In preliminary testing and simulated environment, we were able to achieve high fidelity pitch and tempo

changes which responded in real-time to changes in the physiological data.

Conclusion A device to provide MIDI interfacing to a clinical Masimo pulse oximeter was developed. Such a device demonstrates the feasibility, and potential advantages, of integrating MIDI into the operating room to reduce excessive noise and provide a standard for collecting data from multiple sound-emitting devices. Further studies are required to assess the utility of this in the clinical environment.

References:

1. Santamore, David C; Cleaver, Thomas G. Journal of Clinical Monitoring and Computing; Dordrecht18.2(Apr 2004): 89-92.

Figure 1: POMO Device outputting saturation tone in classical piano in real-time from pulse-oximeter to GarageBand

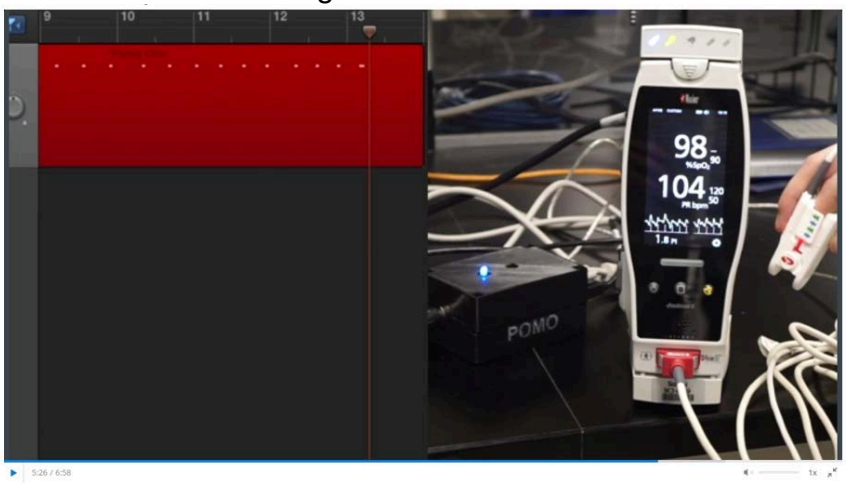

Figure 1: POMO Device outputting in real-time from pulse-oximeter to GarageBand

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