So we developed a wireless pulse oximeter that measures SpO2, SpCO, and SpMET before displaying the measurements on a separate computer screen, in real-time. This will allow emergency medical teams more flexibility in the field compared to existing devices.

### Terminology

| SpO2 | Blood Oxygen Saturation, The proportion of oxygen carrying red blood cells. Normal levels are between 95% to 99%. |
| SpCO | Blood carbon monoxide saturation, high levels can indicate various diseases if too high (anything above 2%). |
| SpMET | Methemoglobin saturation, which can indicate various poisons. |

**Plethysmograph (Pleth) Waveform**
The raw absorption data that correlates to the blood pulsing through the artery, is used in pulse oximetry to find a heartbeat.

### Objective

- Current pulse oximeter designs either are too bulky to be used practically by paramedics or do not detect SpCO and SpMET, measurements that are standard in the medical field.
- So we developed a wireless pulse oximeter that measures SpO2, SpCO, and SpMET.
- Measurement and display of SpO2, SpMET, and Pleth waveform.
- Minimum sampling rate of 100 Hz
- Wireless communication between pulse oximeter device and display
- Sensor values held in characteristic and event handler put in place for updates
- Digital data filtering and processing script
- 3D printed housing that blocks most ambient light and holds sensor module in place

### Modules

- **AFE 4403** – an analog front end, from Texas Instruments, equipped for basic pulse oximetry. This chip houses a programmable timer module that controls an ADC, SPI, and a LED driver designed for two LEDs.
- **Custom Sensor Module** – since the AFE 4403 could only drive two LEDs, a custom PCB was made in order to control 3 LEDs with the AFE 4403’s LED driver.
- **HM-10 Bluetooth Module** – an Arduino controlled Bluetooth module that would transmit the ADC readings to our display.
- **Web Application Display** – receives ADC readings over Bluetooth from the HM-10 before computing and displaying the SpO2, SpMET, and the pleth waveform.

### Limitations

- Less effective on individuals with a darker skin tone and ineffective on patients lacking a normal pulse, such as patient’s with mechanical hearts.
- Less effective on patients with finger sizes that are extremes compared to the average finger size.
- Sensitive to physical disturbances.

### Current Progress

- Calculations for SpO2 confirmed by readings in the correct range for a healthy adult.
- AFE and Bluetooth modules integrated together to communicate measurements to web application.
- Custom PCB, for 3 LED peripheral sensor, integrated with AFE and used to take Pleth waveforms.
- 3D printed prototype for housing has been completed.

### Conclusion and Future Work

Though wireless communication complicates the pulse oximetry process, our work has shown that is possible:

- We can achieve a sampling rate of 100 Hz by operating at a baud rate of at least 19200.
- Post processing of data is time efficient.
- The key components for the device are small enough to be housed in an easy to apply cuff.

The next steps for this project will be:

- Adjust algorithm for 4 wavelengths and the calculation of SpMET
- Pulse oximeter testing setup
- Calibrate pulse oximeter to improve accuracy
- Design and implement a mobile power supply
- Post processing of data

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