

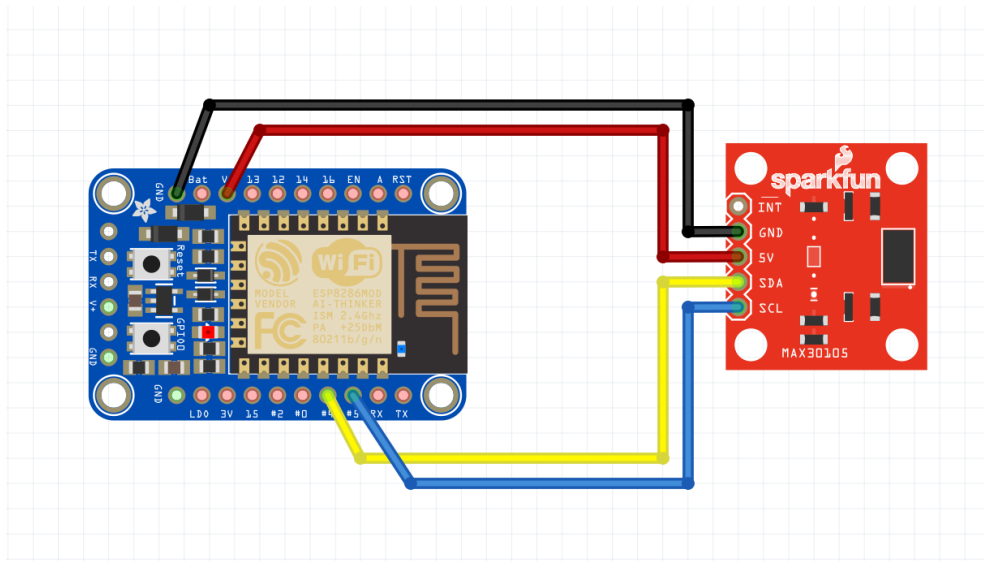
## Monitoring System for patients' health in the Emergency Department of Hospitals

The project is about the design of a system for monitoring biomedical values measured from patients in the Emergency Department of Hospitals. The system consists of two main parts, a device and a web application. The device's role is to collect vital signals, process them in order to export the bioparameters, heart rate (HR) and oxygen saturation in blood (SpO<sub>2</sub>) and finally send them remotely to our web server. The web application receives those values, store them in a database and demonstrates them in several ways due to the purpose of monitoring. A further explanation of these two parts is given below.

### Device:

The device includes:

- The optical PPG sensor MAX30105
- The Wi-Fi microcontroller Adafruit Huzzah ESP8266 breakout



As mentioned this device collects biomedical parameters from body and especially from finger with steady pressure. This is done by measuring the absorption of Red and Infrared light from blood cells and tissues through a photodetector and after that, by the calculation of HR and SpO<sub>2</sub> from the collected signals. Finally, the ESP8266 connects to a local network and sends the bioparameters to the application via MQTT Protocol.

The programming of the Device is done in Arduino IDE.

The main steps of the algorithm are:

- Initialization of MAX30105 and ESP8266
- Connection to Wi-Fi
- Connection to MQTT broker
- Collection of 100 Infrared and 100 Red samples
- 21-point moving average filter to remove noise
- HR calculation:
  - Detection of the consecutive peaks
  - For every pair of peaks detected calculation of beats per minute through the type:  $BPM = F_s * 60 / d$ , where  $F_s$ : sample frequency,  $d$ : time between two consecutive peaks
  - Calculation of HR as the average of BPMs
- SpO<sub>2</sub> calculation
  - Calculation of the DC component from IR and Red values as the average value
  - Calculation of the AC component from IR and Red values as the difference between maximum and minimum value.
  - Calculation of parameter  $R = (AC_R / DC_R) / (AC_{IR} / DC_{IR})$
  - Calculation of  $SpO_2 = -45.060 * R * R + 30.354 * R + 94.845$
- Publish ID of device, HR and SpO<sub>2</sub> to topics IR\_Data, HR\_Data, SpO2\_Data through MQTT protocol

### **Web application:**

The web application is a MERN application (MongoDB, Express.js, React.js, Node.js)

Especially the server was developed in Node.js with the framework Express.js and MongoDB was used to store our collected data.

The UI was made with React.js and includes a table, which contains the current values of all devices and gets updated in real-time, graphs and some other stuff that you can discover on your own.

Feel free to use anything you might find useful! Thank you:)