Introduction

The Safe-X project aims to design a device to accurately predict when an intubated patient can be safely extubated. This will be achieved by using emg sensors to monitor muscle activity in the neck. The sensor data will be sent to an embedded system to be processed and classified. Along with accurately being able to predict patient status, the device must also display the EMG waves to give the user more information.

Selected Final Concept

Criteria	Component Referenced
EMG Sensor	8 Lead, Wired
Signal Processing Algorithm	Fast Fourier Transform (FFT)
Machine Learning Algorithm	Support Vector Machines
Embedded System	Raspberry Pi-4
Display	LCD Screen
Power & Battery	USB-C Cable

For the Final Selected concept for signal processing algorithm we choose a Fast Fourier Transform(FFT). The fourier is the best fit for our design in order to process the signal that comes from the EMG sensor(8 Lead, Wired), then to the signal processing (FFT), last to the Embedded System (Raspberry Pi-4).

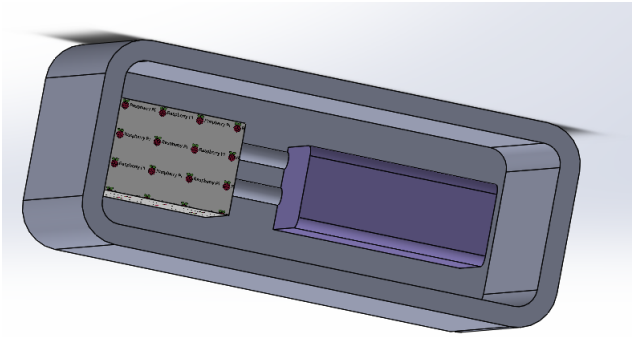
For the Final Selected concept for Power & Battery we choose to have a USB- C Cable, part of the customer needs is that device has to be portable. The device must not shut down in the hospital. Big advantage of any room in the hospital is there is a 120v ac power outlet that can keep the device powered on to be able to monitor the patient.

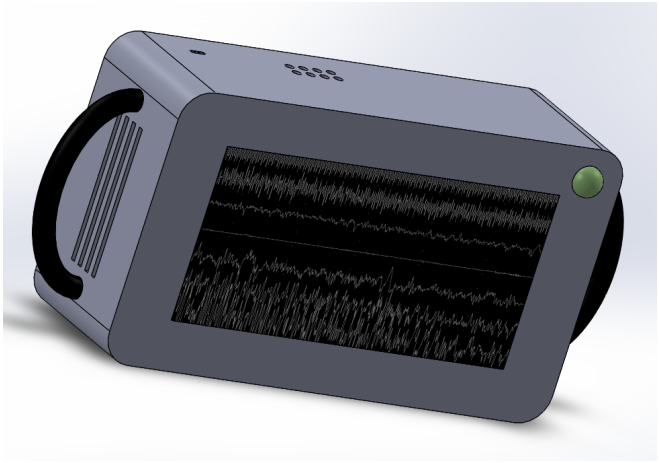
Preliminary Design

The EMG sensor will read in emg signals and output a processed analog signal to the embedded system. The selected EMG sensor has a USB port that can be used to directly connect to the embedded system.

The embedded system will take the analog emg signals and output to the LCD screen. In order to take in the analog emg signals, it will be connected to the sensor via a USB cable. Additionally, the embedded system has two micro HDMI ports in order to output to a display. The LCD will display the processed signals from the embedded system, along with indicating if the patient is safe to extubate. The LCD will be connected to the embedded system using an HDMI cable.

In our functional Decomposition we included a separate block for a Signal Processing Unit, which is not entirely necessary as a separate block as the EMG sensor will read the signals, and process them into an analog signal that will be sent to the embedded system.





Pictured is the rough preliminary 3D model of our design. The inside view shows a Raspberry Pi being connected to an EMG sensor, while the outside view has the EMG sensor readings being displayed on screen, with an LED indicator letting users know if it's safe to extubate a patient.

Summary

The major components of our design include our selected EMG sensor and our choice of embedded system. We have chosen an 8-Lead Wired EMG sensor due to the amount of signals that we will be reading and the price limitations on our budget. We have already acquired a Raspberry Pi thanks to Mayo Clinic providing one. This Pi has all the hardware requirements we will need, and can run our software with no issue. These components will be stored in a custom made and printed chassis that will have vents for cooling, handles on the side for transportation, and ports to allow for usb-c power and the 8-leads of the EMG sensor. Along with the Raspberry Pi and the EMG Sensor, the chassis will store a 15.9” LCD Screen that will display the EMG sensor readings.