University of Pennsylvania
Department of Electrical and System Engineering
Medical Devices Lab

ESE3400, Fall 2022	Project: ECG Monitor	Wednesday, Nov. 16

Presentation/Demo Due: Tuesday, December 6, 11:59PM
Report Due: Monday, December 12, 11:59PM

Design Problem: Design an ECG Monitor and Heart Rate Detection with Wireless Communication. You will use the knowledge you've gained in the Labs to put together your custom designed signal conditioning board with the Arduino nRF52 Board to acquire a noisy ECG signal from the heart rate simulator and report the heart rate as well as display the ECG signal. This may require digital filtering using python in real time and will require setting up low energy bluetooth communication to interact with a computer, tablet or other mobile device.

Functionality Specifications:

- Acquire signal from TechPatient ECG Simulator (noisy and non-noisy – compare performance of both)

- Signal Conditioning: Amplify and bandpass filter signal for ADC input

- Use ADC on Arduino nRF52 Feather Board to digitize signal

- Write python code to perform any signal processing (eg, filtering, upsampling, R-R detection, etc.) to detect heart rate of ECG

- Visulaize ECG signal in whatever way you want (Eg. wired serial connection, Bluetooth stream, serial plotter, etc.)

- Use low energy Bluetooth on Arduino nRF52 Feather Board to display heart rate on mobile device

Presentation/Demo on 12/6 in Lab:

- Create a 10-minute presentation describing your design operation

- Describe the performance limitations (eg, input amplitude limits, noise limits, HB limits, mobility and power limitations etc.)

- Include how you verified operation of each piece of the project as listed above

- Include any problems/difficulties you ran into and how you solved them

- Show demo of your device working

Report due 12/12: Your report should be a single, stand-alone document and should include a full design description such that your device can be repeated by anyone who reads the report. You will submit your report in Canvas by the due date. Any late submissions may be subject to a late penalty. Things you might include are listed below:

- Device functionality description and motivation
- Schematics, PCB design, and simulation for the signal conditioning design
- Full system description including any wiring between custom PCB and Arduino nRF52 Feather board
- Description of and DSP systems designed including commented python code
- Wireless communication operation and setup including any relevant python code
- Design process writeup including design choices made and trouble shooting
- Conclusion of design functionality with design limitations
- Learning outcomes and future work

Extra Credit: Best written report will get extra credit.