Embedded Challenge Spring 2021
Term Project
The Pressure is On

Objective:

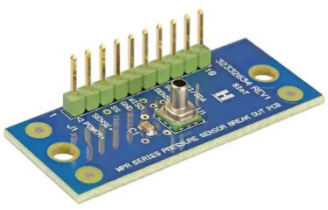
Embedded system design focuses on gathering useful data, processing that data, and providing a useful representation of information. In medicine, we often rely on professional observation to make biological measurements. However, we have recently seen the emergence of at-home mobile devices to help the patient monitor their own well being. These devices range from simple thermometers to at home ECG's like in the case of Cardia Mobile.

The objective of this semester's embedded challenge is to build a semiautomated blood pressure/HR measuring device. To accurately represent one's blood pressure, the device must be capable of measuring two measurements, mainly Systolic (high number) and Diastolic (low number) where both measurements are in units of mm Hg.

Automated systems use pressure transducers to convert pressure data into digital data that algorithm use to calculate the two values. This method is referred to the oscillometric method. Details on this process can be found here: https://www.nature.com/articles/s41371-019-0196-9

Building such a device requires several components.

1. A pressure sensor to translate pressure into digital data. We will use the Honeywell MPRLS0300YG00001BB, available at Mouser or Digikey. This is an I2C pressure sensor capable of measuring 0-300mmHg



2. Manually inflatable blood pressure cuff. Available on Amazon.

https://www.amazon.com/Dixie-Ems-Aneroid-Sphygmomanometer-Pressure/dp/B00RY3ASUS/ref=sr_1_10?dchild=1&keywords=blood+pressure+cuff&qid=1611595891&sr=8-10

3. Embedded Controller (Our STM32 Discovery board)
4. Miscellaneous parts
    a. F-F wire jumpers https://www.pololu.com/category/66/female-female-premium-jumper-wires
    b. Transition air tubing https://www.adafruit.com/product/4661
    c. Silicone adhesive/sealant (available at local shop)

The challenge involves the following procedure:

1. Put on the cuff
2. While measuring the pressure, increase the cuff pressure to 150mmHg
3. While continuously measuring the pressure, have the user open the pressure relief valve, causing the pressure to reduce about 4mmHg/sec. The system must provide notices if the release rate is too fast or too slow.
4. Record the data as the pressure drops to about 30mmHg. The data should be similar to the graph represented in https://www.nature.com/articles/s41371-019-0196-9. Use the algorithm described to calculate Heart Rate, Systolic, and Diastolic values.

Restrictions:

- This is an individual project to be done independently by each student.
- No other components may be used other than those specified above.
- The PlatformIO programming environment must be used.
- You will be allowed to use any drivers/HAL functions available through the IDE

Grading Criteria:

- 15% - Ability to successfully and continuously measure pressure values from the Honeywell sensor
- 10% - Ability to control deflation rate using measured data
- 15% - Ability to detect and quantify pulse oscillations
- 10% - Calculation of Heart Rate from oscillations
- 20% - Calculation of Diastolic and Systolic values from oscillations
- 10% - Ease of use/user interface
- 10% - Creativity
- 10% - Well written and organized code