Embedded Systems Project

Heart Monitor

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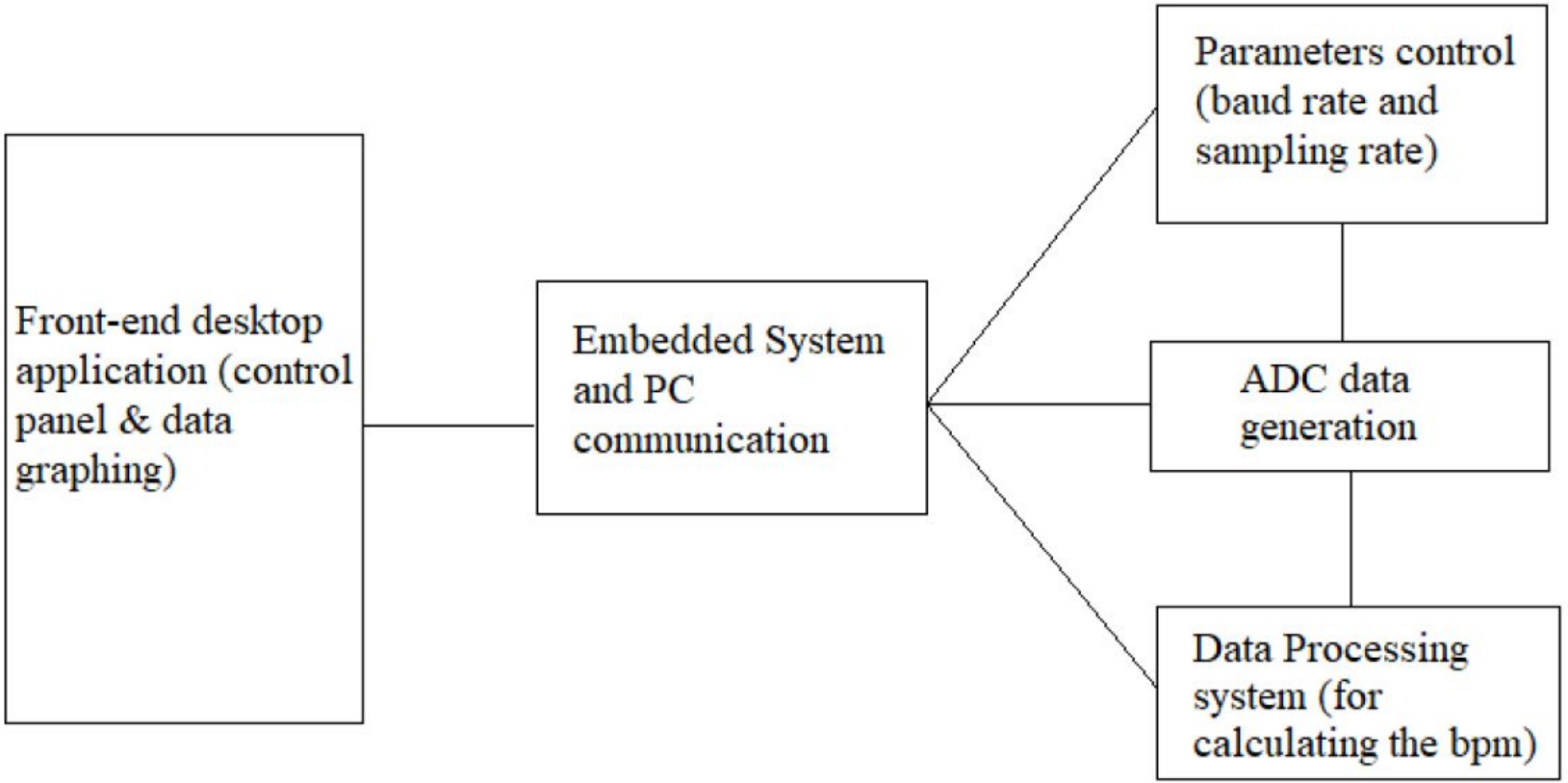
System Architecture



Current Progress

1- Complete back-end

2- GUI with the ability to
- Request 1 min worth of data
- Calculate bpm
- set the sampling rate (25, 50, 100, 200)

Communication Protocol

Commands are sent to the MCU via UART as 1-character ASCII string that represents a number from the following (0, 1, 2, 4, 8).

Commands Encoding:

“0”: Collect 1-min worth of data
Other values: Setting sampling rate as a multiple of 25s

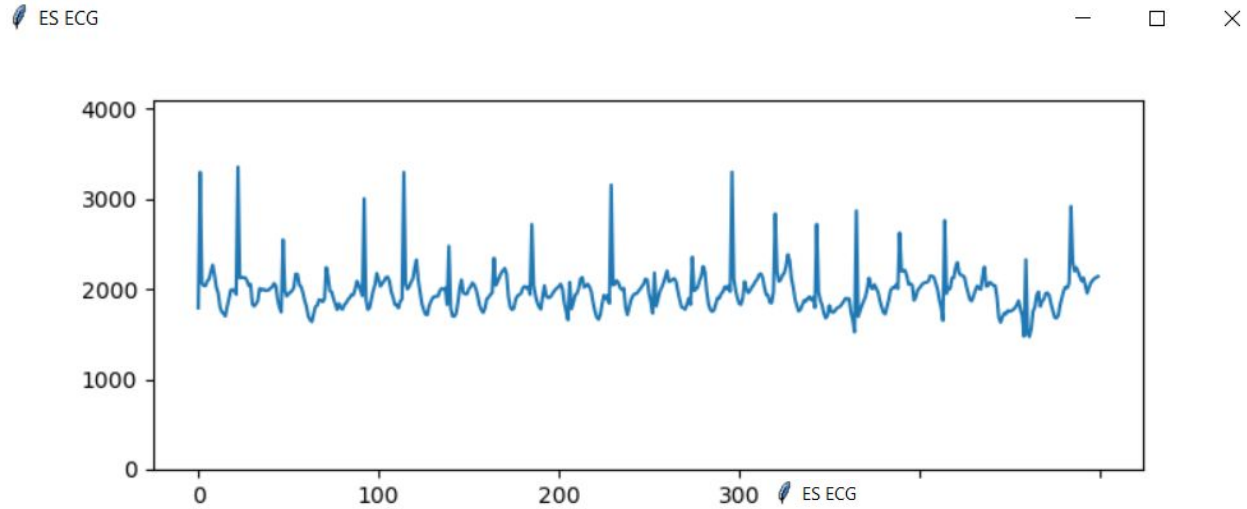
Assumptions/Decisions

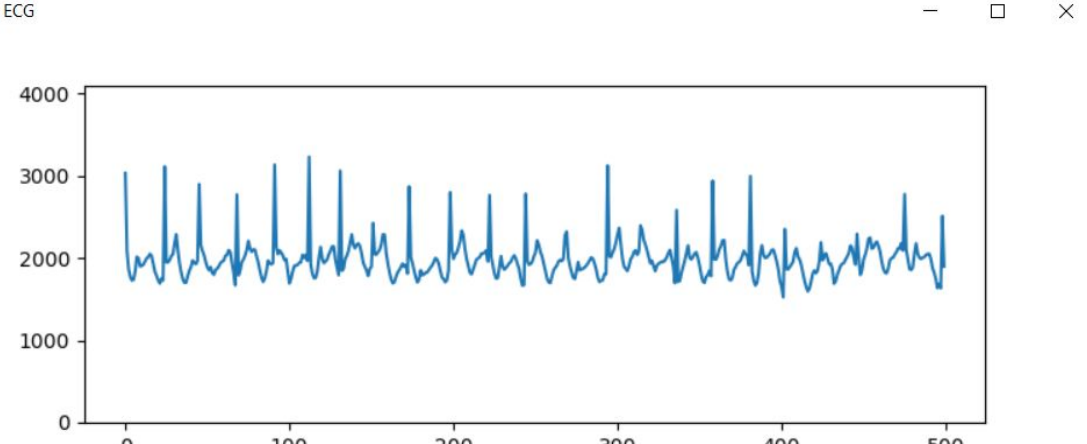
- ECG plot only shows the last 500 samples, the x-axis is the sample number
- All buttons are disabled during plotting
- Plotting time is not necessarily 1 min as it depends on the processing time. However, plotted data is for exactly 1 min

Used Configurations

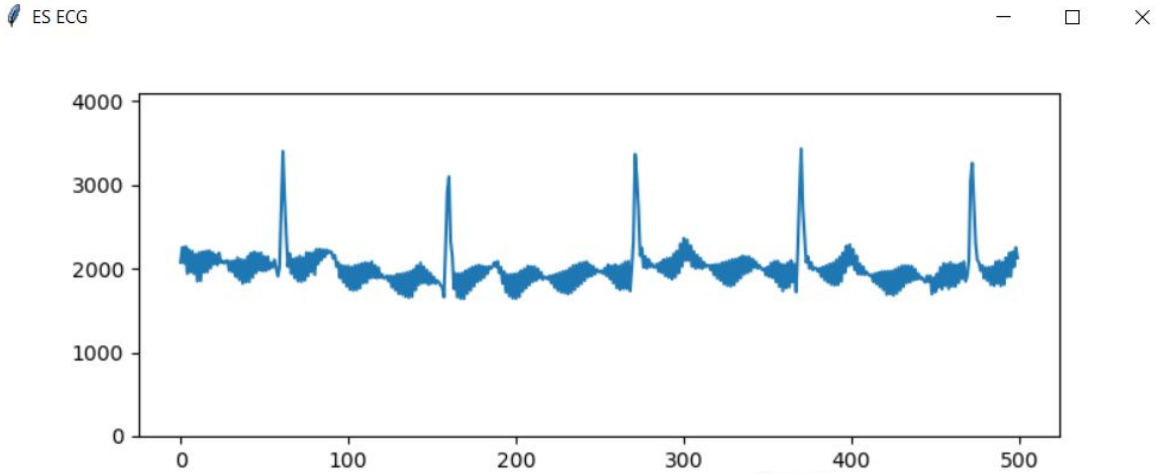
- System clock is set to 8MHz
- Timer clock is set to 8MHz
- ADC clock is set to 4MHz
- Baudrate = 115200
- Analog to Digital conversion is initiated via timer interrupt
- Transmitting is done in conversion complete callback

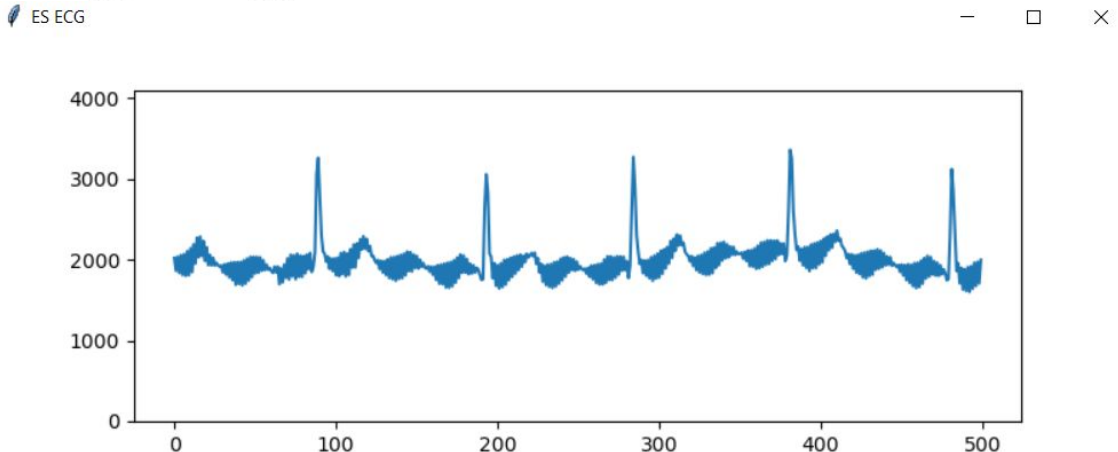
Screenshots (25sps)





Screenshots (100sps)

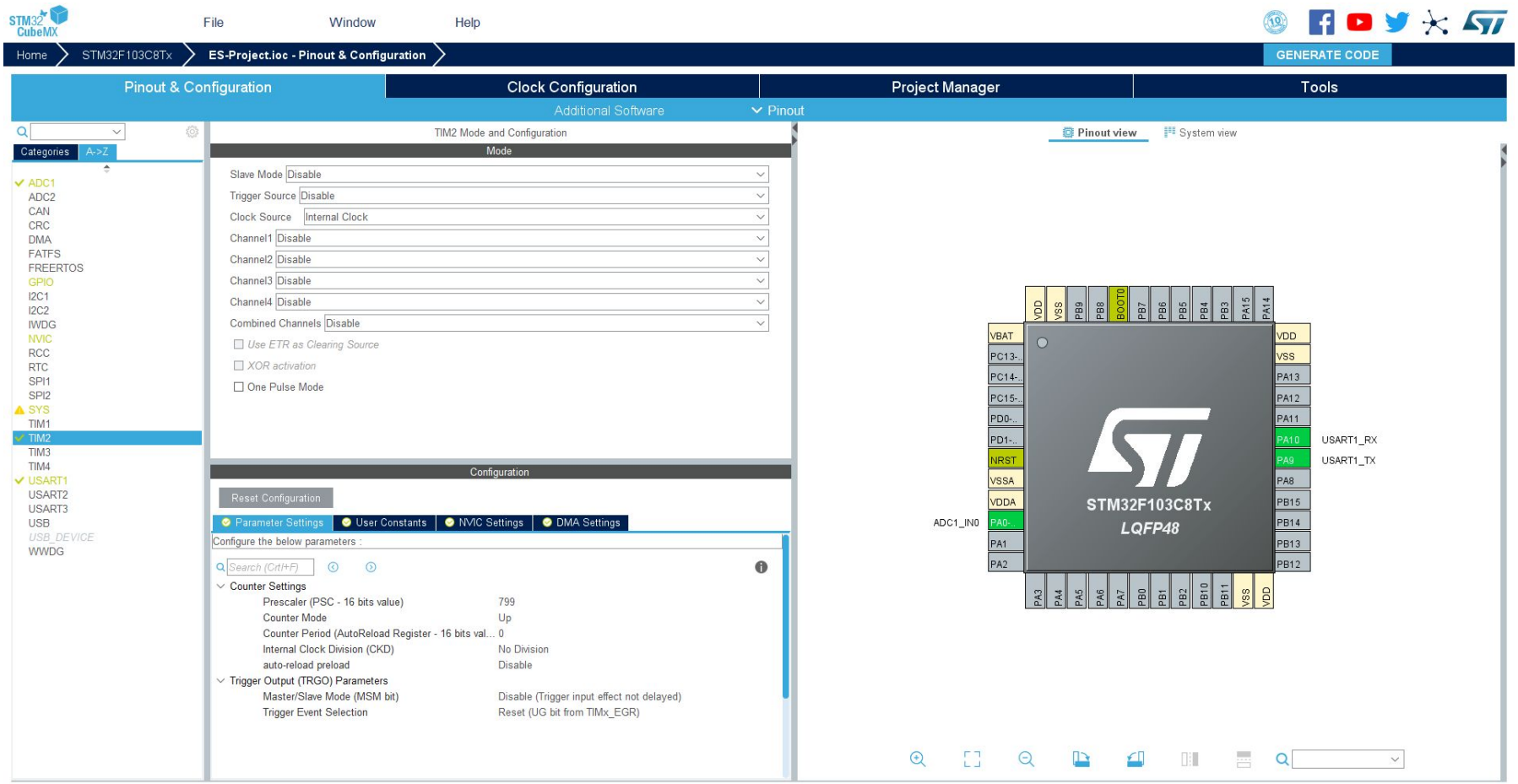




MCU Driver Implementation

- Simple binary state machine to start/stop transmitting
- Timer interrupts to start ADC conversion
- ADC continuous conversion is disabled
- Transmission triggered from ADC conversion complete
- Agreed on command encoding used to set the sampling rate
- Prescaler is set to 799 → 8M / (799+1) = 10,000
- Sampling rate is set via setting the timer auto reload register

CubeMX setting



Desktop App Implementation

- Developed using Python
- Used matplotlib for plotting
- pySerial for serial communication
- Tkinter for GUI

Desktop App Implementation

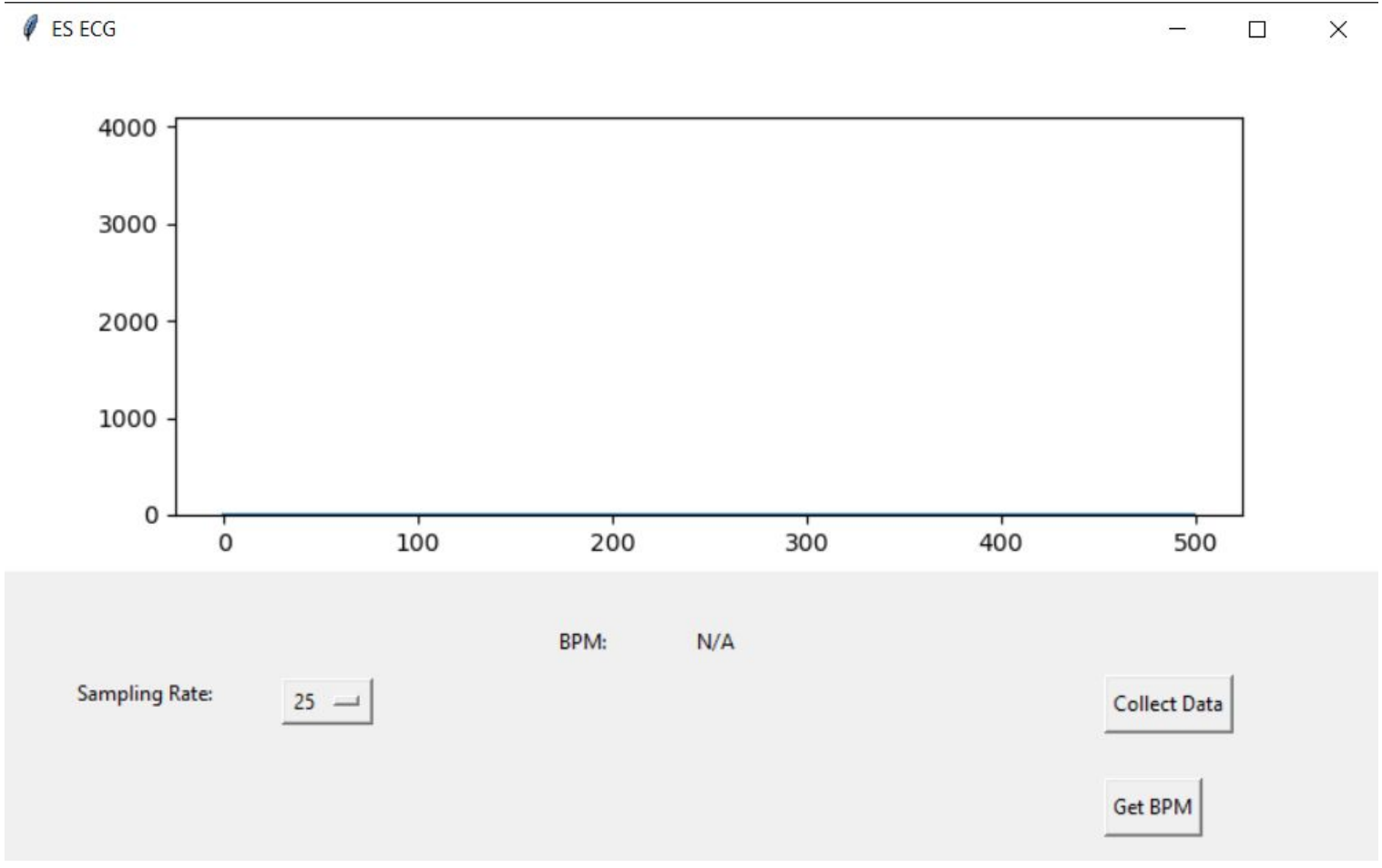
- BPM is calculated on the front-end side
- The used has to request 1 min worth of data before being able to request calculating the BPM

- BPM is calculated via passing a specific threshold, 1.85v or ADC output of 2300

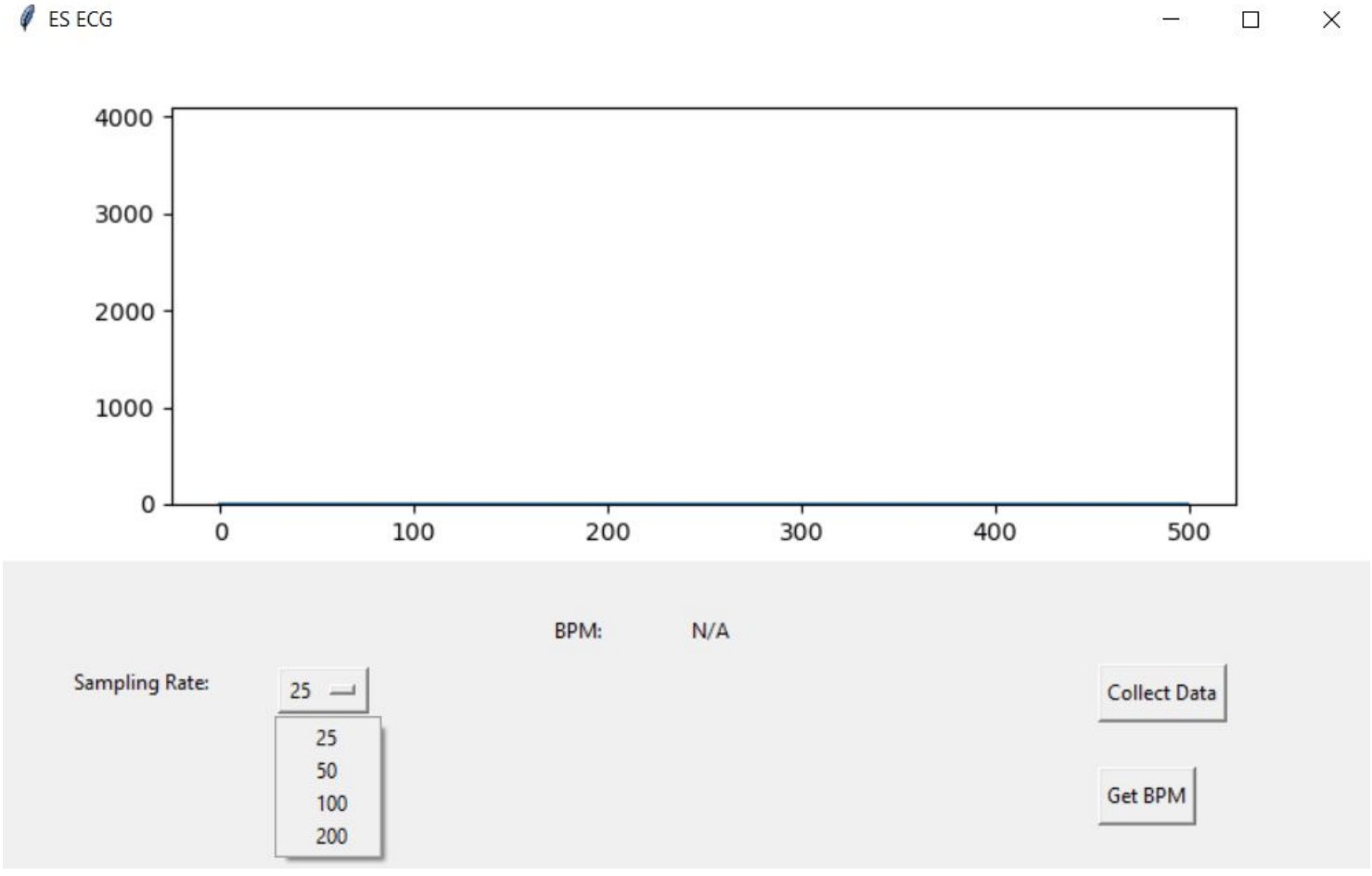
Desktop App Implementation

- Threading is used to maintain GUI usability along with plotting and serial communication

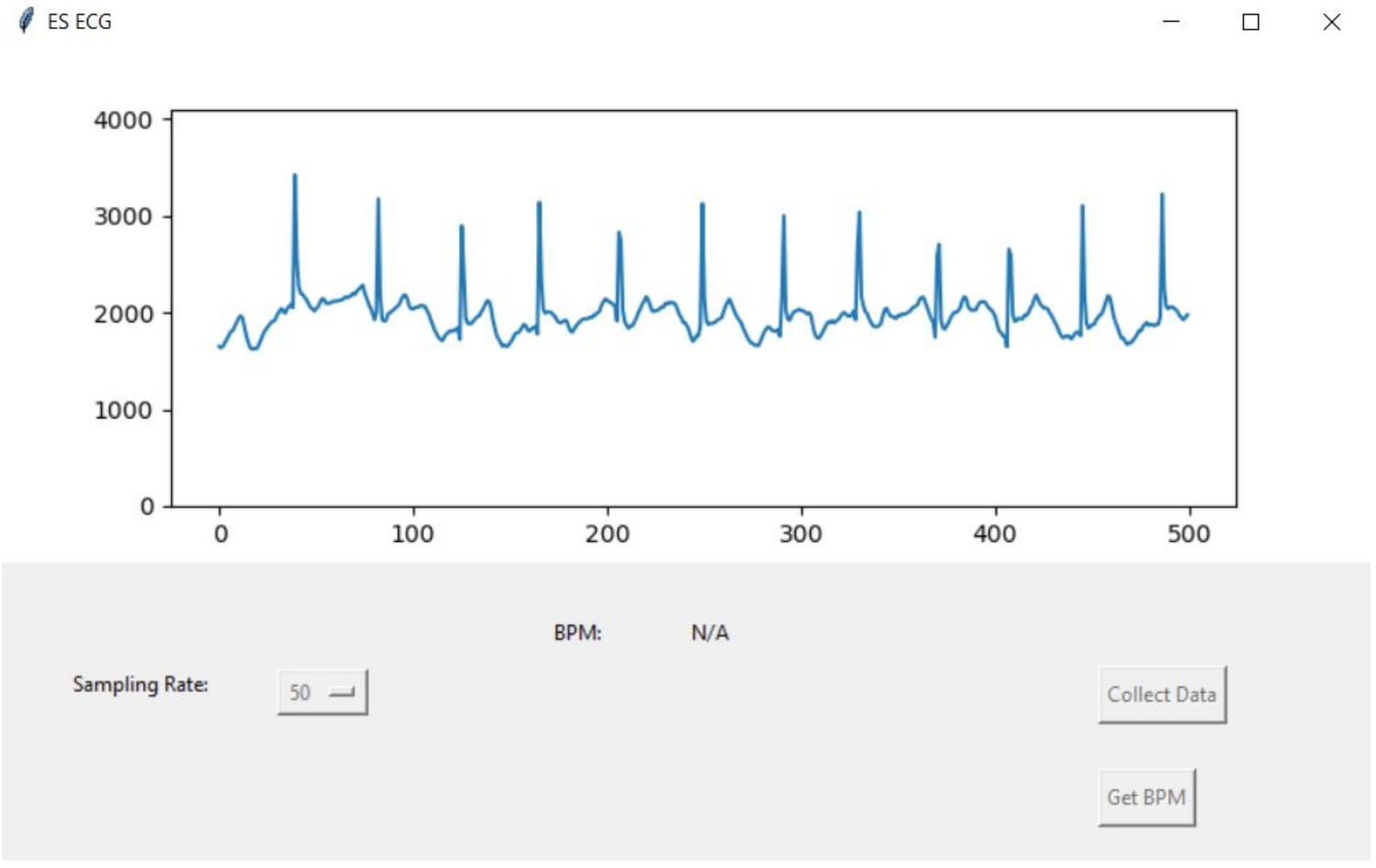
GUI Screenshots



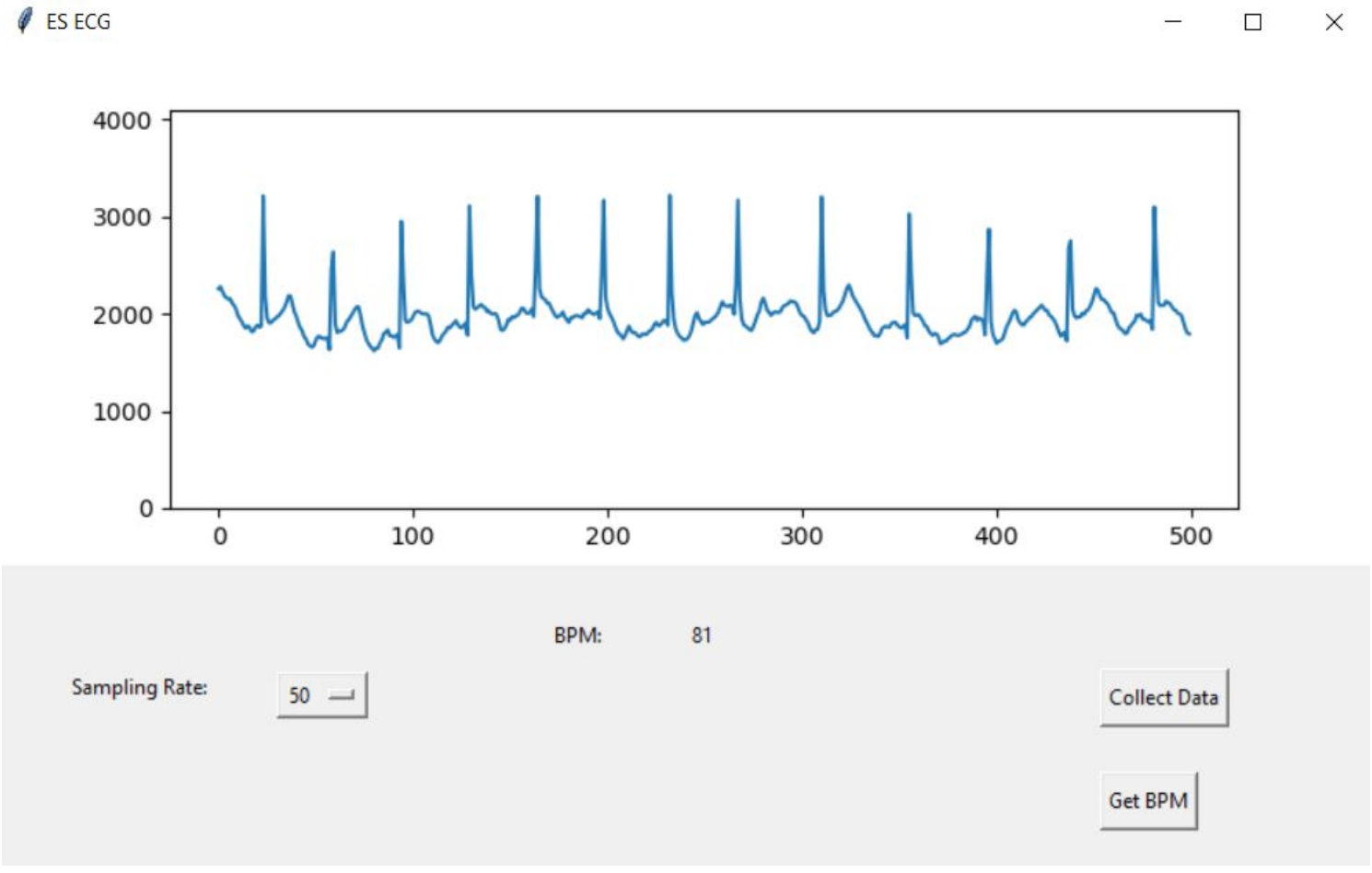
GUI Screenshots



GUI Screenshots



GUI Screenshots



Future Increments

- Pass the sensor signal through a low-pass filter to eliminate the high frequency noise.
- Transform the x-axis to be time based
- Add compatibility for multiple ports
- Add functionality to change the baudrate