

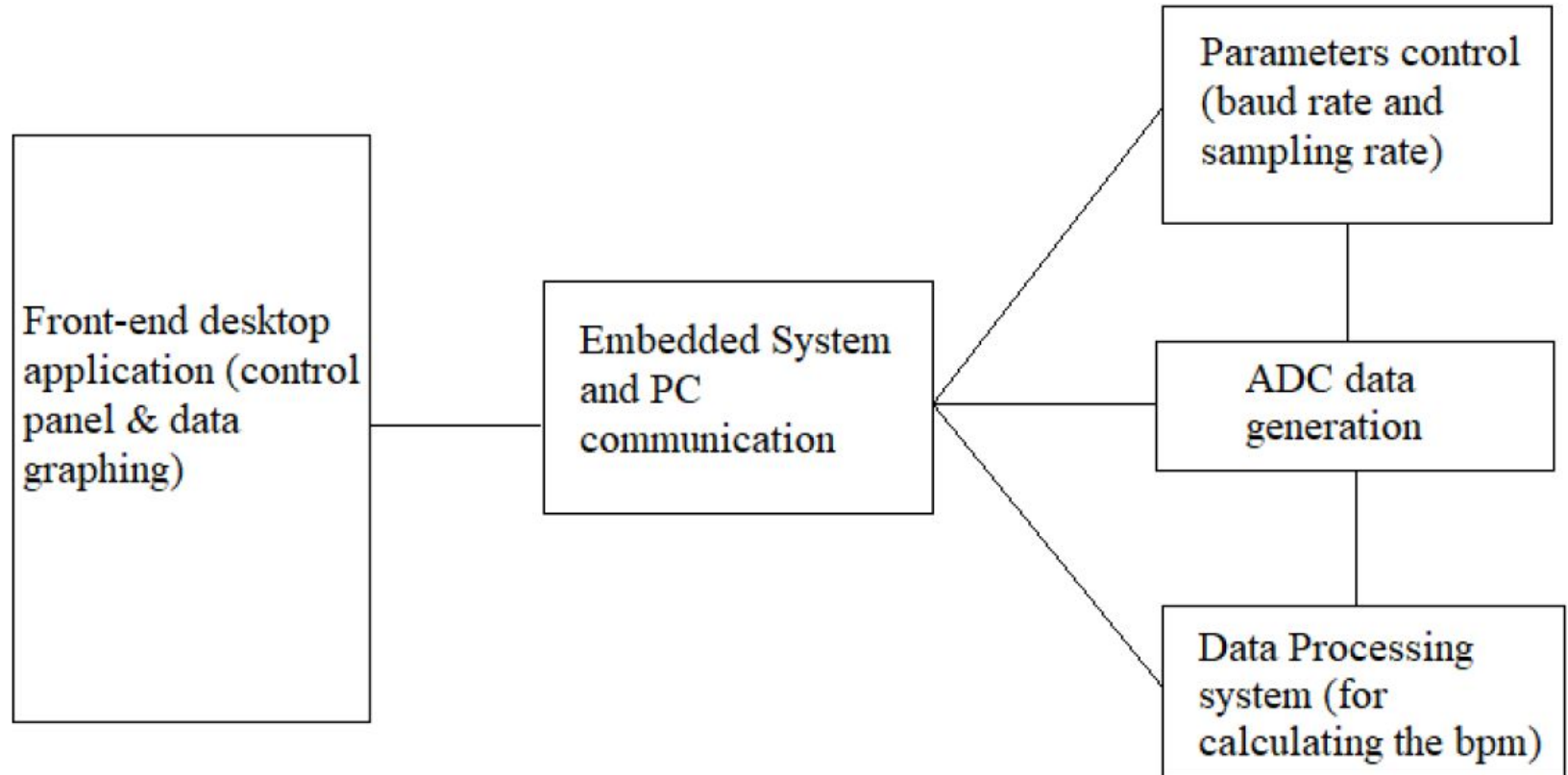
# Embedded Systems Project

## 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

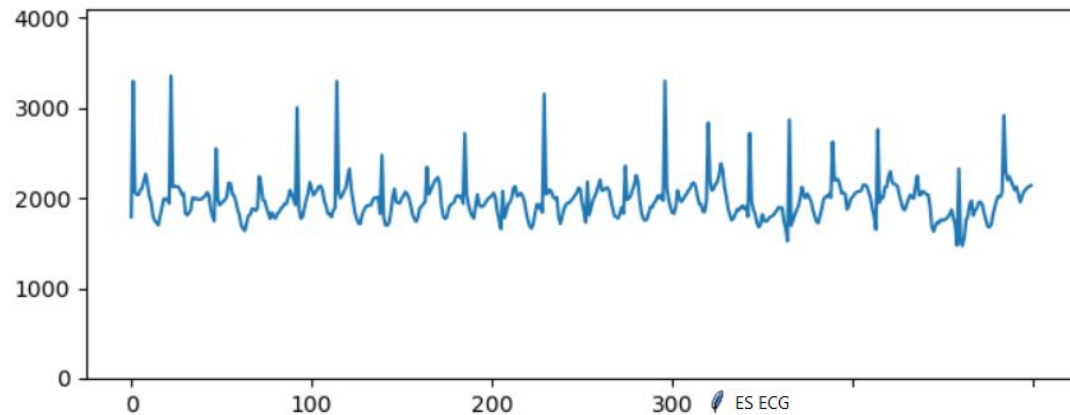
# Used Configurations

- 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)

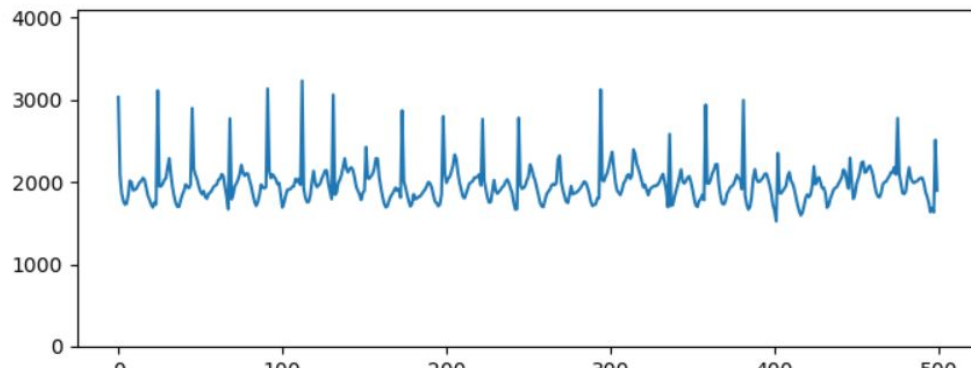
ES ECG

— □ ×



ES ECG

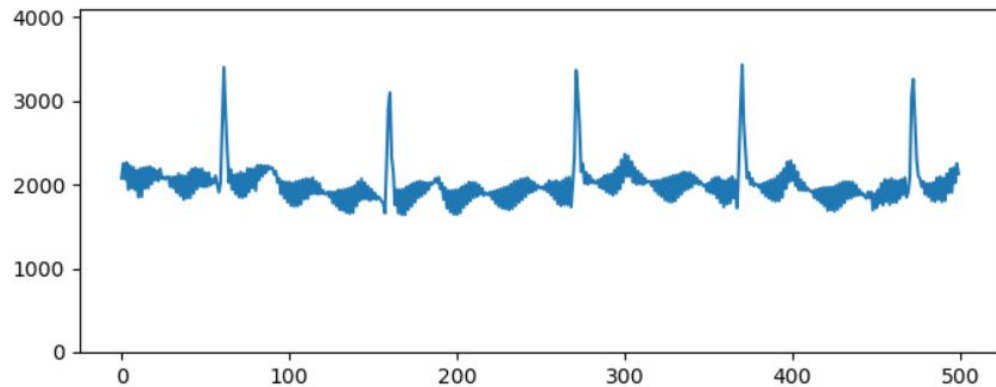
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# Screenshots (100sps)

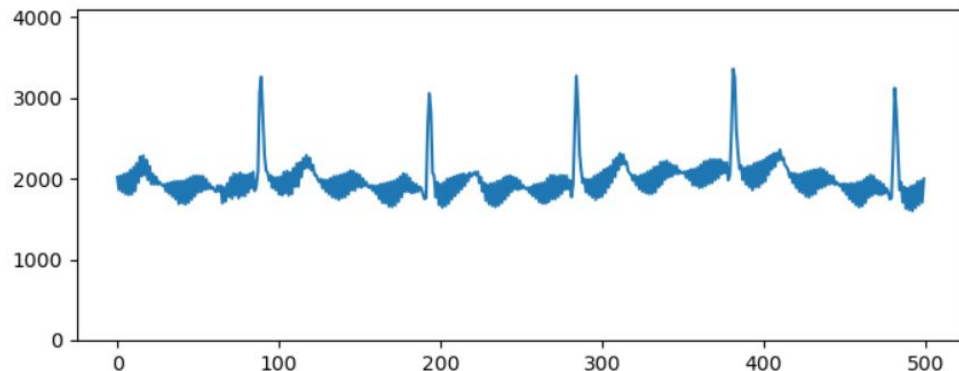
ES ECG

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ES ECG

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# 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  $\rightarrow 8\text{M} / (799+1) = 10,000$
- Sampling rate is set via setting the timer auto reload register

# CubeMX setting



File

Window

Help



Home > STM32F103C8Tx

ES-Project.ioc - Pinout & Configuration

GENERATE CODE

Pinout & Configuration

Clock Configuration

Project Manager

Tools

Additional Software

Pinout

Search

Categories A-Z

✓ ADC1  
ADC2  
CAN  
CRC  
DMA  
FATFS  
FREERTOS  
GPIO  
I2C1  
I2C2  
IWDG  
NVIC  
RCC  
RTC  
SPI1  
SPI2  
▲ SYS  
TIM1  
✓ TIM2  
TIM3  
TIM4  
✓ USART1  
USART2  
USART3  
USB  
USB\_DEVICE  
WWDG

TIM2 Mode and Configuration

Mode

Slave Mode   
Trigger Source   
Clock Source   
Channel1   
Channel2   
Channel3   
Channel4   
Combined Channels   
☐ Use ETR as Clearing Source  
☐ XOR activation  
☐ One Pulse Mode

Configuration

Reset Configuration

Parameter Settings User Constants NVIC Settings DMA Settings

Configure the below parameters :

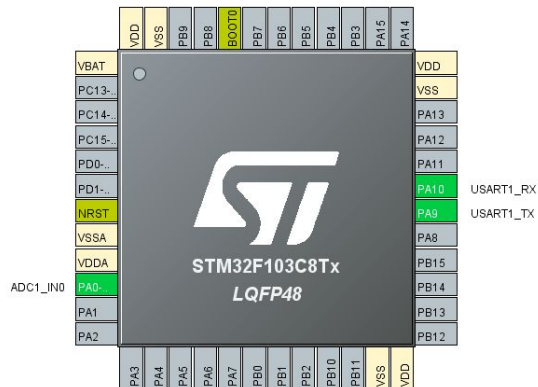
Search (Ctrl+F)

Counter Settings

Prescaler (PSC - 16 bits value) 799  
Counter Mode Up  
Counter Period (AutoReload Register - 16 bits val... 0  
Internal Clock Division (CKD) No Division  
auto-reload preload Disable  
Trigger Output (TRGO) Parameters  
Master/Slave Mode (MSM bit) Disable (Trigger input effect not delayed)  
Trigger Event Selection Reset (UG bit from TIMx\_EGR)

Pinout view

System view



# Desktop App Implementation

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

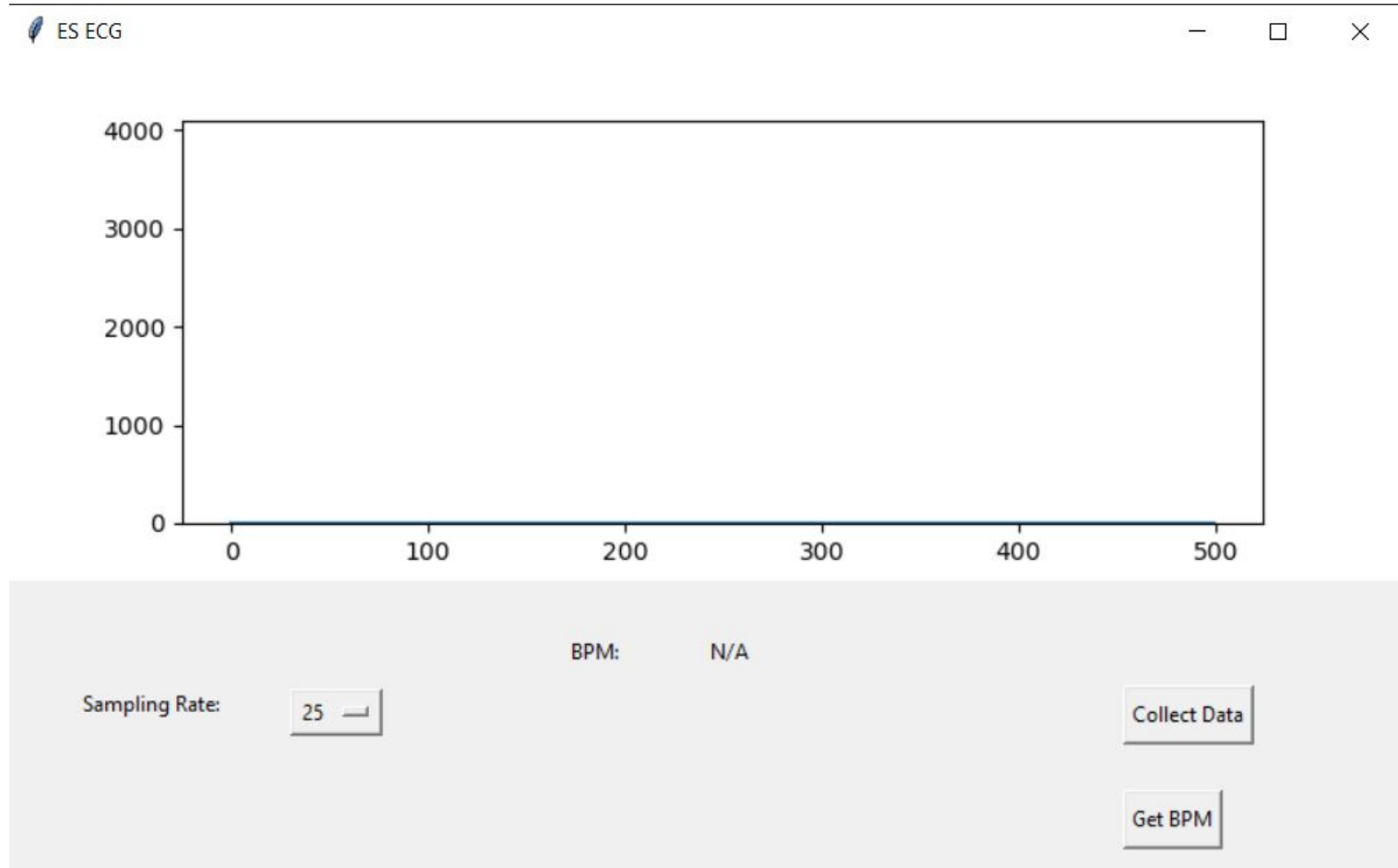
# Desktop App Implementation

- BPM is calculated on the front-end side
- The user 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

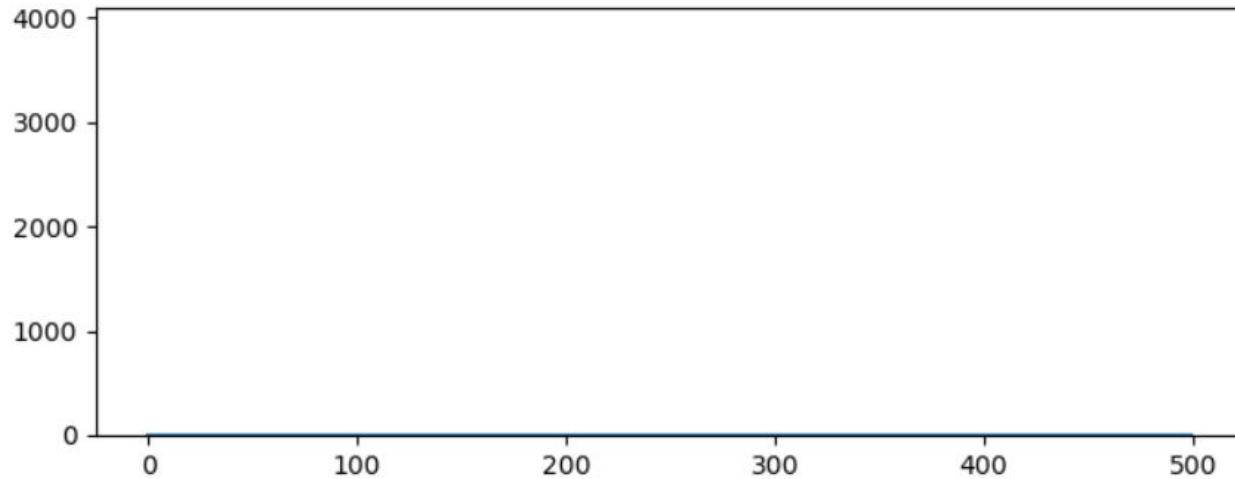
- Threading is used to maintain GUI usability along with plotting and serial communication

# GUI Screenshots



# GUI Screenshots

ES ECG



BPM: N/A

Sampling Rate:

25

25

50

100

200

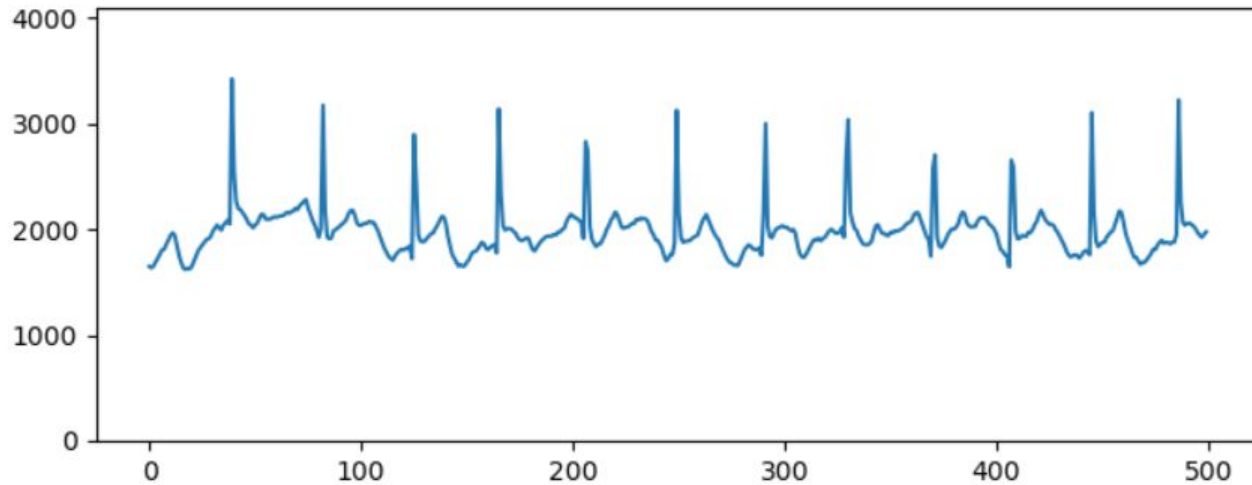
Collect Data

Get BPM

# GUI Screenshots

ES ECG

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BPM: N/A

Sampling Rate:

50

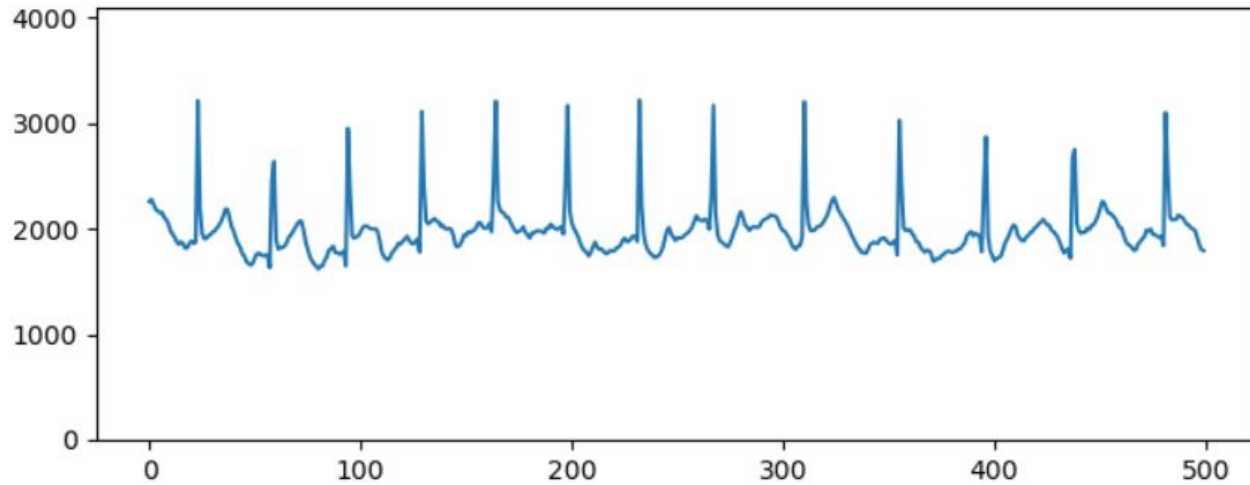
Collect Data

Get BPM



# GUI Screenshots

ES ECG



BPM: 81

Sampling Rate:

50

Collect Data

Get BPM

# 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