2023-2024 spring capstone final report: <https://docs.google.com/document/d/1QNvqZRcIlr5oz7clWzOwtHOtSd97eKo5BvxzaM-GsSM/edit>

Github wiki: <https://github.com/Epsilon391/High-Frequency-Sampling-for-Circuit-Analysis>

STM32F103C8T6

To do:

* ~~Decide what I want to accomplish with this project~~
* ~~Decide what I want to measure~~
* ~~Decide how I'm going to measure it~~

10/04/2024:

* Reviewing 8/28/24 planning notes:
  + **Does it make sense to use STM chip?**
    - I think it does. I am starting to understand how to interact with it now and the ADC -> USART works pretty well how Alecea configured it
  + **Does the raspberry pi have ADC?**
    - “ADC on the Raspberry Pi which has a sampling rate that is too slow to sample the waveform precisely” - 2024 spring capstone final report
    - According to internet, rpi3 doesn’t have an onboard ADC, so that’s another reason to have the Blue Pill
  + **Design specifications: What do i want to accomplish?**
    - Condense system into one board
      * raspberry pi hat/shield
        + Is there a specific reason they did the comparison work on the pi instead of on any other computer?
    - Double ADC sampling rate? I feel like that could really add to this project
    - If i do the top 2 things, then the last main thing i’m not doing is creating a method of comparing the results and determining if the cap will fail soon
      * I need to make sure my board is able to be programmed so that people can integrate this
      * This processing done on the pi?
        + If yes, then my board’s main purpose is to apply the high pass filter, amplify the ripples, and use the STM’s ADC to UART.
    - **Decisions (goals will drive schematic design):**
      * **Focus on Hardware vs software**
        + Hardware: Make shield and improve ADC sampling rate
      * **Programming**
      * **Data analysis**
    - **Decide:**
      * **What i want to measure**
        + Keep it how it is by measuring the ripple voltage?
      * **How im going to analyze it**
        + Does this mean like deciding if the cap is close to failure or not?
      * **Analyze on or off processor**
        + I think off STM32 and on rpi3
      * **Focus on how to apply analysis on hardware**
        + What does this mean?
      * **How to make the hardware as small and efficient as possible**
  + **Schematic of old system**
    - **Gen bill of materials**
    - **Order all parts before PCB design**
    - **Dr scott wants mixer on schematic, low priority**
      * What was the mixer for again? Perhaps i could integrate it?
* Important stuff from 2024 spring capstone final report:
  + “After constructing the signal processing circuit we needed to select an ADC to sample the 0-2V, 50kHz signal at a sampling rate high enough to capture the shape of the waveform.”
  + “Additionally, capacitor failure causes changes on the order of 5 millivolts. Since the gain is around 13x, our ADC needed to differentiate between 66 millivolt intervals.”
  + “The ADC can be clocked at a maximum of 14MHz, and it has a resolution of 12 bits with a voltage range of ±3.3V. This yields a resolution of 1.6 millivolts.”
  + “Currently, the code developed by our team uses a singular ADC operating at 14 Mhz clock speed. This allows us to send 10 data values per period for a 50 kHz signal (1 Msps). The resulting shape is similar to that of our simulated version, but we believe that by utilizing both ADCs on the STM32, code could be developed to use both ADCs with offsets from one another to double the data points collected. We believe that 20 data points could create more accuracy in the shape of the waveform and make analyzing the waveform for failure easier.”
* Questions I have:
  + Why did they choose a corner frequency of specifically 800 Hz?
    - “This is done with 20 nF capacitor and a 10 kΩ resistor, yielding a cutoff frequency of 800 Hz.” - report
    - Is it because they just needed to get rid of DC offset which is 0 Hz?
    - Is it simply easier to use 20 nF cap and 10 kΩ resistor? Are these common component values? I know 10 kΩ resistor is pretty common.
  + I need to figure out a way to guarantee that the ideal experimental ripple voltage is the same amplitude as the ideal simulated ripple voltage. How? Lol.
    - I need to figure out how to check what the gain value of the amp is. The pot is causing trouble for me lowkey
      * Maybe i get the AD620 from the module and test to see if i can get everything working without the pots?
        + I think itd be good to keep the adjustability of the amp for scalability of the system
  + How important is it for me to implement a way for the measurements to be analyzed?

10/08/2024:

* Decide what I want to accomplish with this project
  + Make a functioning PCB/rpi hat
  + I think it’d be neat to figure out how to double the sample rate
  + \*\*Maybe make it seem closer to “live” readings by updating the graph every so many seconds?
* Decide what I want to measure
  + Should i not stick with the cap ripples?
* Decide how I'm going to measure it
* Today i looked into how i would go about doubling the ADC samplerate
  + So far nothing is jumping out at me on the internet about how to go about that
* Could it be interesting to make the STM32 continuously send data and continuously update the graph on the rpi?

10/09/2024 Meeting with Dr. Scott:

* Jlcpcb would fabricate pcb but id have to use their parts
  + <https://jlcpcb.com/>
  + Look into this first
  + Otherwise, blake rile is good with reflow oven if it’s top side only
* Mixer was for if i could make a poor man’s spectrum analyzer or at least have the functionality
  + Mixer and 20 MHz signal
  + Mix down higher frequency data so that this function works
  + Why not add mixer
  + Mixer is a single chip
    - Down converter
    - Made by mini-circuits
* Do schematic first, then generate bill of materials
  + Continuously check if parts are obsolete or out of stock
  + Schematic design in altium
* Would want to take apart blue pill
  + Look into how many layers, look into layout, see if i could just use the chip
  + Ideally, it’d be nice to see their layout and copy it into my circuit
  + Layout matters for high frequencies
  + \*dig into practicality of swapping layout over
* See if i can swap amp layout into my design as well, including pots
* Look into blue pill continuous sampling
  + Should have downtime when board is being fabricated
  + Would be valuable to project
* Learning altium
  + Look for tutorial “getting started in PCB design” by altium
    - Youtube probably
    - Dr. Scott read document and thought it was useful
  + Look into schematic creating
  + Be good with footprints and schematic symbols
  + Import footprint schematic symbols from digikey to altium
  + Make sure to make chip look like actual component instead of footprint block
* Ideally order board for fabrication before christmas
* I dont think altium is available on mac :|