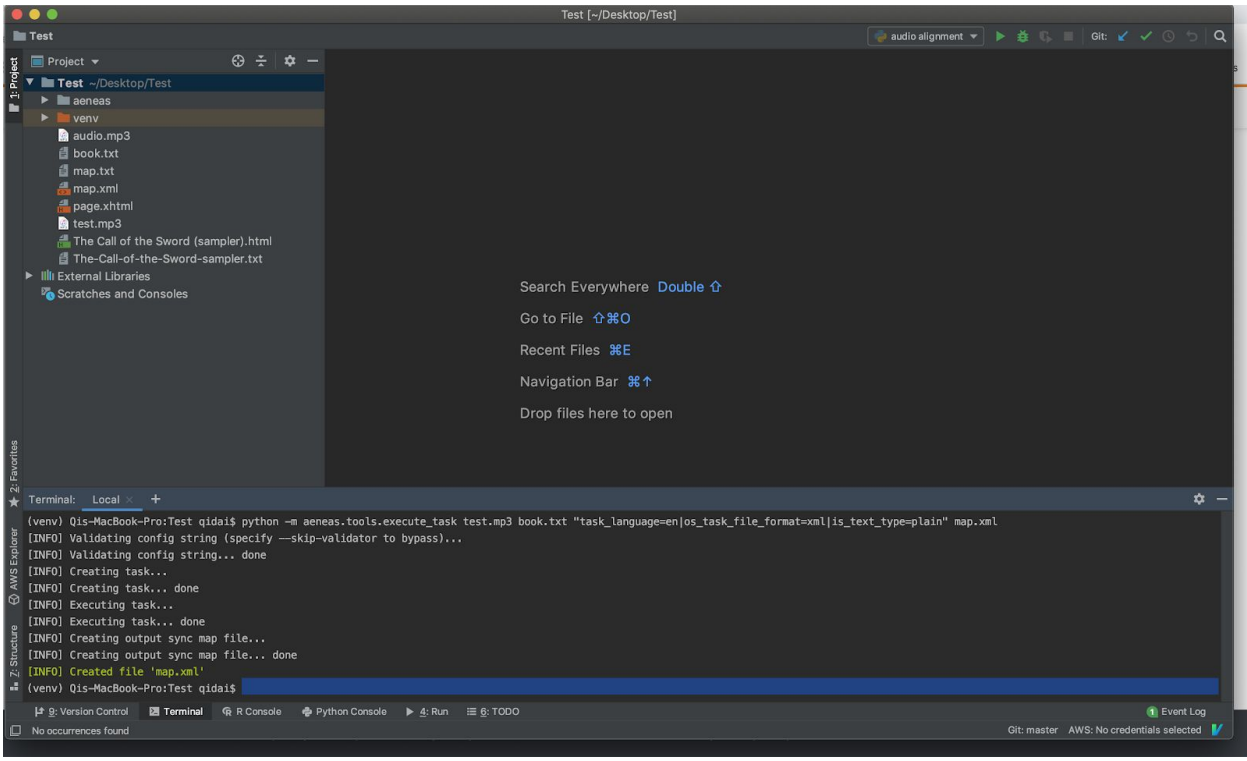
Week 4

Main tasks completed for the week:

- Updated block diagram and subsystem design document
- Researched more on the audio and ext synchronization method in the aeneas library in Python and downloaded on Pycharm
    - Successfully generated audio-text-alignment using this library and output a mapping file with all ids for each fragment in .xml format, the parsing is by line(phrases separated by comma), the input format is .txt and .mp3
    - The process time for audio parsing the whole ebook I selected is around 40 sec
    - according to my experiment, using a sorted plain .txt (with all lines separated by comma) or using .xhtml will work better in mapping it; while using unsorted plain .txt, the map file will randomly mapped it using blanks and paragraphs.



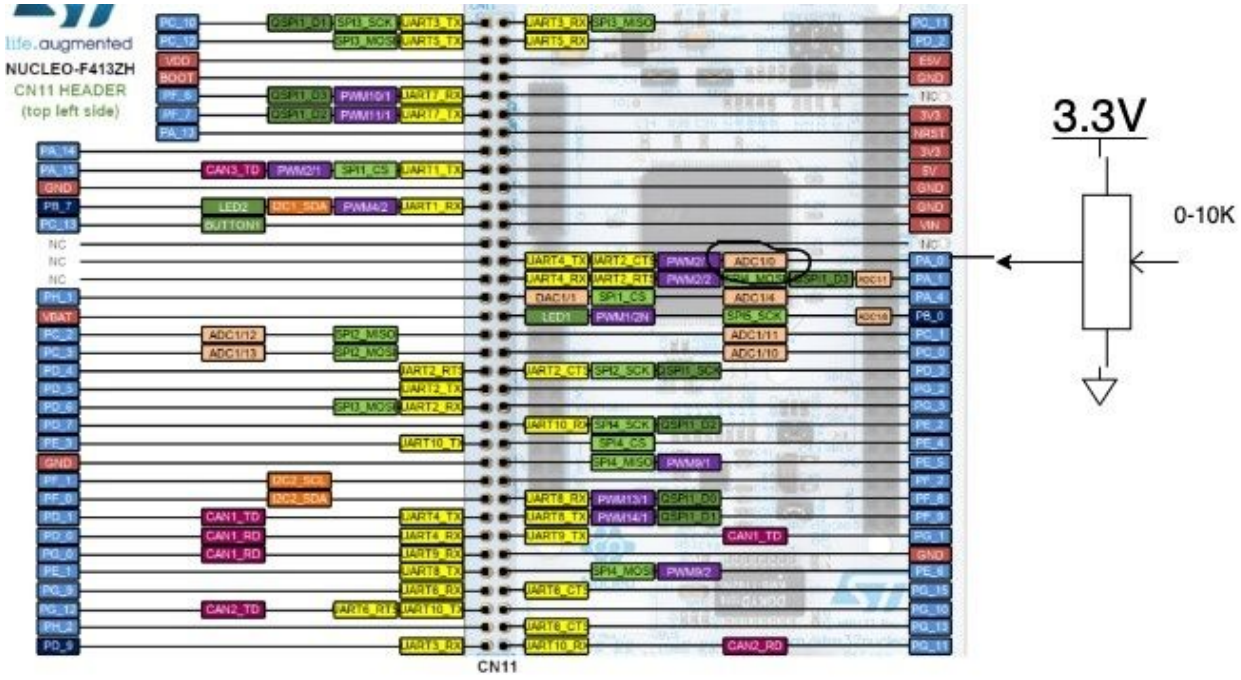
map.xml

map.xml 〉 No Selection

```xml
<?xml version='1.0' encoding='UTF-8'?>
<map>
  <fragment id="f000001" begin="0.000" end="0.600">
    <line>Prologue</line>
    <children/>
  </fragment>
  <fragment id="f000002" begin="0.600" end="0.640">
    <line></line>
    <children/>
  </fragment>
  <fragment id="f000003" begin="0.640" end="2.720">
    <line>In the ninth hour of the Last Battle,</line>
    <children/>
  </fragment>
  <fragment id="f000004" begin="2.720" end="3.440">
    <line>Sumeral,</line>
    <children/>
  </fragment>
  <fragment id="f000005" begin="3.440" end="6.560">
    <line>warring with Ethriss in ways beyond the knowledge of men,</line>
    <children/>
  </fragment>
  <fragment id="f000006" begin="6.560" end="10.480">
    <line>gazed upon the pitiless slaughter being wrought by the two great armies and,</line>
    <children/>
  </fragment>
  <fragment id="f000007" begin="10.480" end="11.240">
    <line>wearying of it,</line>
    <children/>
  </fragment>
  <fragment id="f000008" begin="11.240" end="16.120">
    <line>was overwhelmed with a desire to seize at one stroke His final victory.</line>
    <children/>
  </fragment>
  <fragment id="f000009" begin="16.120" end="16.120">
    <line></line>
    <children/>
  </fragment>
  <fragment id="f000010" begin="16.120" end="20.040">
    <line>Then He left the high vantage where His Uhriel held at bay the Guardians,</line>
    <children/>
  </fragment>
  <fragment id="f000011" begin="20.040" end="27.760">
    <line>and with silver sword and golden axe cut a shining path of gore to the heart of the fray where stood the mortal frame of His
        enemy.</line>
    <children/>
  </fragment>
</map>
```

- Learned how to find the correct registers and pins for my subsystem (ex: find RCC→ RCC AHB1 peripheral clock enable→look for ADC) on https://www.st.com/content/ccc/resource/technical/document/reference_manual/group0/81/ea/88/1f/97/9e/4a/d0/DM00305666/files/DM00305666.pdf/jcr:content/translations/en.DM00305666.pdf

- Updated schematic



Goal for next week:

- Prepare for manager meeting
- Research a way to connect divider in c with audio parsing in python

Research note:

Analog to Digital Conversion

https://www.mccdaq.com/PDFs/specs/Analog-to-Digital.pdf

Thoughts:

Some definitions:

ADC: converts a analog voltage to binary number(1s/0s) and then to a base 10 digital number

MSB: the farthest bit to the left

A helpful diagram to understand how ADC works:

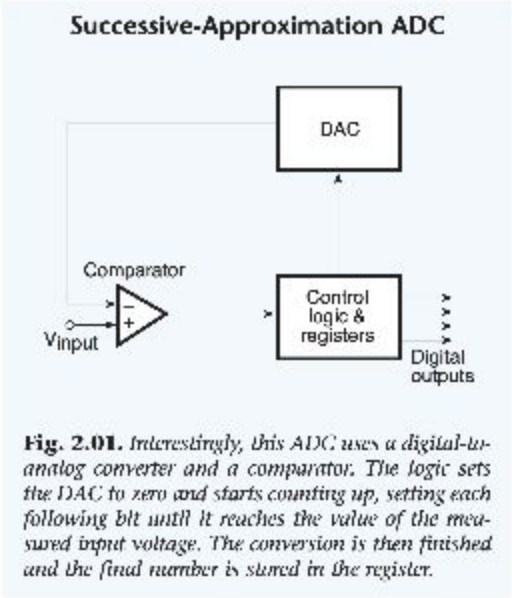


Fig. 2.01. *Interestingly, this ADC uses a digital-to-analog converter and a comparator. The logic sets the DAC to zero and starts counting up, setting each following bit until it reaches the value of the measured input voltage. The conversion is then finished and the final number is stored in the register.*

The ADC on our controller is 12 bit (2^12 = 4096 resolution), which means that the voltage will be converted to a 12 bit digital number by successively comparing each digit until getting the closest voltage and then it would be assigned to certain speed for both the display divider and the audio divider.

The RCC basically set up the cycle of conversion time (sampling time), like how frequently the machine sample the voltage and convert it digitally.

Vsys = 3.3V

Resolution/System Voltage = ADC reading/Analog Voltage Measured

Conversion time (Tc) = N*Tclk(depending on RCC?)

aeneas python library:

https://pypi.org/project/aeneas/1.4.0.0/

Useful info:

-the input format can support .txt (with plain/parsed/subtitles/unparsed format) or .xhtml(with all ids and class attributed)

-the input audio file can be in all ffmpeg supported format including both mp3. and .wav

-the output sync map can be CSV, JSON, RBSE, SMIL, SSV, TSV, TTML, TXT, VTT, XML

Thoughts: this library can support a variety of input and output format, which includes the ones we are using for our ebook; however, it is a challenge to import a python library on our microcontroller without using like micropython to support the language. So i think it is more effective to

pre-processed all the books and save them on the usb and then the text-to-speech system can simply call the audio and xml file and play them in the required speed, which can reduce the work load of microcontroller as well.

how to use XML to data drive the application to play sounds based on the content of the xml file?

https://stackoverflow.com/questions/21584503/playing-sound-files-based-on-xml-in-c-sharp/21585656

Thoughts:

I think the xml file contains all the ids to identify the audio intervals for the correct line of text, which will be accessible for text-to-speech system to play the sound based on these ids.

Text cleaning method:

https://machinelearningmastery.com/clean-text-machine-learning-python/

Thoughts: When we try to map ebook, I found out that when mapping the whole book it would be mapped based on blanks and paragraphs. So it is better to pre-clean the text document into parsed lines or removed punctuations so that it would work better.

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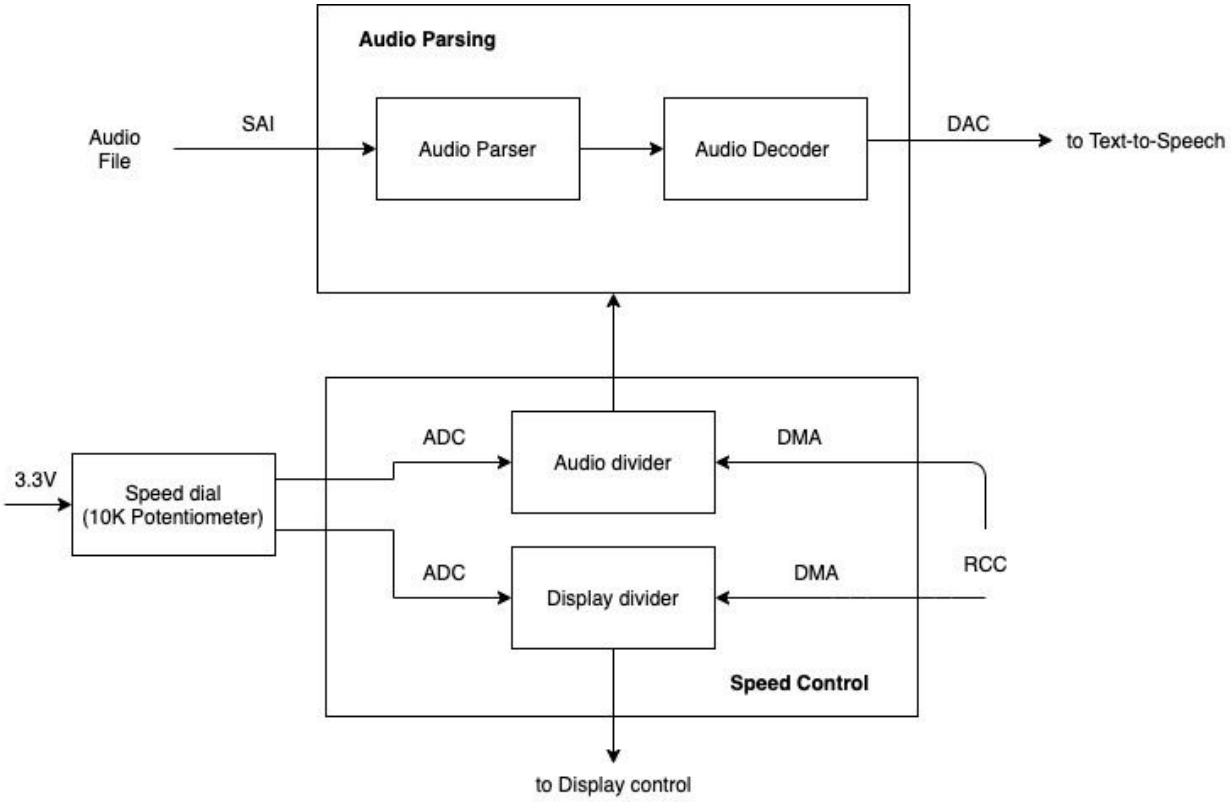
Week 3

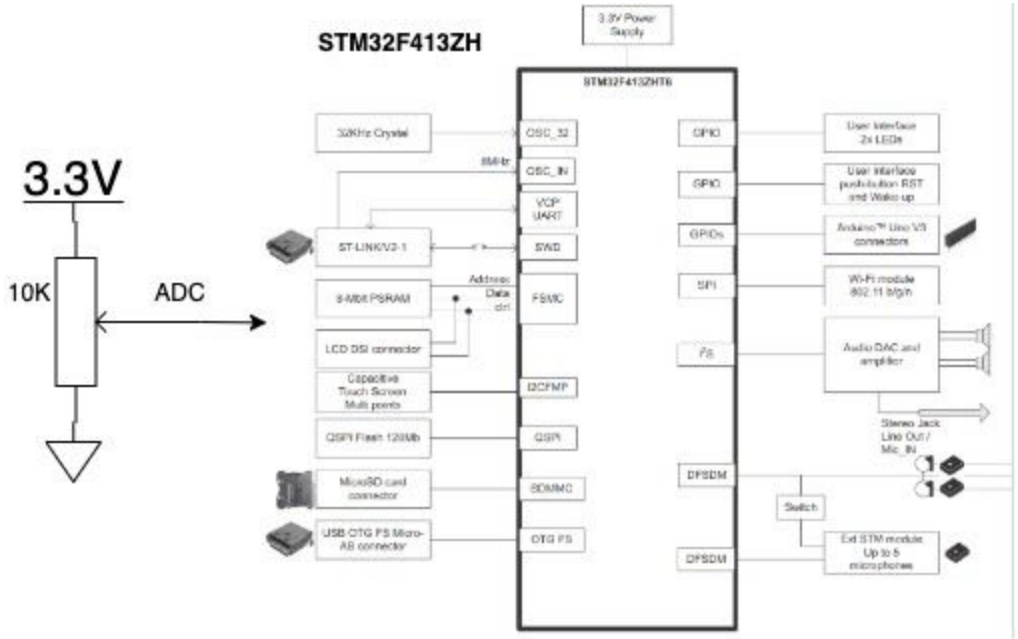
Main tasks completed for the week:

- Surveyed braille users and got feedback on how they expect the design to be in general
- Design document formation
    - Discussed individual subsystem division including block diagram details
    - Wrote revision log and subsystem description
    - Updated requirement

Block diagram:



Schematic:



- Researched audio parsing (definition, algorithm, articles)
    - .wav file input format and .xml output format
    - How to parse .wav file
    - How to tag and sync audio with text

        - Researched closed-caption standards
- Researched speed control design (schematic, potentiometer design, algorithm)
- Researched existent braille reader design
- Researched common reading speed for braille users and speaking speed for audiobook
- Researched STM32F413ZH specs document
- Updated project timeline Gantt chart

Goal for next week:

- Start looking into the detailed specs of microcontroller and figure out the correct pin to use
- Understand how a speed dial work and how to pass speed information
- Figure out how RCC plays in the speed control
- Start looking into the algorithm and the overall logical structure

Research note:
A library for syncing text with audio fragment:
https://www.readbeyond.it/aeneas/
https://github.com/readbeyond/aeneas/blob/master/aeneas/cdtw/cdtw_driver.c
http://software.sil.org/downloads/r/readingappbuilder/Reading-App-Builder-07-Using-aeneas-for-Audio-Text-Synchronization.pdf
Thoughts:
Once we have parsed audio we can load it into this synchronizer and make the text sync with the audio and output .xml file, however it seemed like it mostly work in python

Specs for microcontroller STM32F413ZH:
https://www.st.com/content/ccc/resource/technical/document/user_manual/group0/ad/82/4d/ae/bb/7a/42/9f/DM00340446/files/DM00340446.pdf/jcr:content/translations/en.DM00340446.pdf
Thoughts:
This source will help me identify the specs of the microcontroller we are using and make sure that I mark up the correct pins and signal inputs/outputs.

Braille reading speed:
https://www.researchgate.net/publication/228463176_Measuring_Braille_reading_speed_with_the_MNREAD_test
Thoughts:
The maximum reading speed is 185 words/min and minimum speed is 65 words/min for braille readers, so the speed should be range from 0.25 to 6 letters/sec for a reasonable slow to fast range for readers.

Common speaking speed:
https://virtualspeech.com/blog/average-speaking-rate-words-per-minute
Thoughts:
Common Audiobook speaking speed between 150 - 160 wpm, which is the upper range that people comfortably hear and vocalise words, which means the audio speed should range from 2 letters/sec to 11 letters/sec.

Audio parsing in C for WAV file:
http://truelogic.org/wordpress/2015/09/04/parsing-a-wav-file-in-c/
Libsndfile is a C library for reading and writing files containing sampled sound:
http://www.mega-nerd.com/libsndfile/
Audio parsing code reference:
https://github.com/rakyll/audio/blob/master/riff/parser.go
Thoughts:
In order to parse .wav file, we will have to store all the header info as well as the audio data and then parse them based on each line of the text file using markup language. However, I have to make sure what are the elements needed to sort the audio signal and output the write format for decoder to mark up the audio-text file.

Design and Implementation of an Audio Parser and Player:
http://docsdrive.com/pdfs/medwelljournals/jeasci/2017/5301-5306.pdf
Thoughts:
This research article gave ideas on how to input and parse an audio and actually use ID3 tag to specify each audio fragment and play it.

Cornell portable e-book for the blind design:
https://people.ece.cornell.edu/land/courses/ece4760/FinalProjects/f2017/mmm389_ahs278/mmm389_ahs278_final_report_2/mmm389_ahs278_final_report_2.html
Thoughts:
A 10K potentiometer for controlling speed and convert the resistance to reading speed (ADC), and the displaying speed will mainly depend on the common reading speed for braille reader while audio will share a different speed range so that it will not be messed up by the displaying speed. The specific details to convert the resistance to speed also requires clock and other parameters that I have to consider very carefully in writing my own algorithm.

How does potentiometer work?
https://randomnerdtutorials.com/electronics-basics-how-a-potentiometer-works/
Thoughts: this website provides a basic schematic diagram for the potentiometer that I am going to use to connect my circuit.

What is a .XML file format?
https://www.howtogeek.com/357092/what-is-an-xml-file-and-how-do-i-open-one/
https://www.rev.com/blog/close-caption-file-format-guide-for-youtube-vimeo-netflix-and-more
Thoughts: The .XML file XML is a markup language created by the World Wide Web Consortium (W3C) to define a syntax for encoding documents that both humans and machines could read. It does this through the use of tags that define the structure of the document, as well as how the document should be stored and transported.

Week 1-2

Main tasks completed for the week:

- Learned the difference between contracted and uncontracted braille language
- Detailed the design of braille reader
    - Design document write-up
        - Executive description
        - User story
        - Requirement
        - Influential factors
    - Discussed functionalities of the device
- Searched for potential mini speaker for audio output of the device
- Searched for potential mini push-pull solenoid products on the market
    - Compare prices between buying and building solenoid
    - Estimated specs for solenoid actuators

Goal for next week:

- Deciding which subsystem to work on
- Complete the design document revision
- Brainstorm questions to ask the DRC person
- More background research
- Create a project timeline

Research notes:
Portable Braille reader inspiration:
https://www.youtube.com/watch?v=N5iTWgvzhU8
Thoughts:
As shown in the video, the solenoids were all attached to the pin key pads directly, which means that when the actuator received the instruction from the microcontroller, the actuator pushed the pins up and down.

How to make a mini size solenoid:
https://www.youtube.com/watch?v=DvHiPvuWDPg
Thoughts:
Considering our budget is tight and the cheapest mini push-pull solenoid on the market would be around $5 each and we need around 48 solenoids, therefore, we may have to build our own solenoids if necessary.

Possible speaker choice for our audio system:
https://www.radioshack.com/products/radioshack-8-ohm-mini-speaker?variant=20332224901&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&gclid=CjwKCAiAgqDxBRBTEiwA59eEN0Wc5nuAtmsIiGCme7ke9AVYahdqlP_jP2SLQW7PASx0L5ksvPXzRhoC2HMQAvD_BwE
Thoughts:
It is an 8-ohm speaker with reasonable size and price, however, not sure if this will supply enough volume needed for our device.

How to translate text to Braille using C:
http://liblouis.org/documentation/liblouis.html#lou_005fhyphenate
How to translate Grade 2 Braille from text using Python:
https://github.com/LazoCoder/Braille-Translator
Thoughts:
First of all, we have to make sure that the translator recognizes the “break point” of each sentence or paragraph; second, we have to make sure that representation of numbers and letters are differentiated because they usually use the same representation in Braille; third, there should be an escape code”.” for the capital letters.
The module code size is 11.74kB (2.93 for printing Braille→ maybe switch to connecting to the actuator end)

Grade 1 vs Grade 2 Braille:
http://www.acb.org/tennessee/braille.html
Thoughts:
In grade 2 Braille, a cell can represent a shortened form of the word, so if we want to use contracted Braille then we can consider using this translation above.

How to extract plain text from html file using C:
https://stackoverflow.com/questions/15319329/extract-plain-text-from-an-html-file-in-c
How to extract plain text from html file using Python:
https://github.com/Alir3z4/html2text
Thoughts:

Since we are using html file for our input text format, the converter control will have to first extract text from html file then they can store the converted Braille for the use of further text-to-speech processing.