

Andrew Imwalle

Notebook

Team: MIKey

CSCE 483 Section 931
Rabi Mahapatra

Date: 8/24

I sat with a group of four others who seemed like hard workers. Our skill sets are wide enough to cover the possible project assignment.

I have worked with Jackson Hagood and Max Smith before. They have a strong work ethic. I have shared a class with Connie Liu and she seems to be a hard worker. I have spoken to her a few times during that class, and she seems like a reliable team member given our limited interactions.

Finally Brittany is someone that I haven't met before, but she seemed to get along well with the team.

The team has been discussing ideas for what we can work on. Brittany has suggested doing some sort of assistive technology for disabled people. I suggested the idea of creating a mouse for people with parkinsons. I also came up with the idea of a wagon that will follow the user. This could make transportation of materials easier. We would like to reach out to disability services for more ideas.

Date: 8/29

Abhishek is someone that I shared a class with last semester, but I haven't worked with him before. He expressed interest in joining our team at the end of class on the 24th. After checking with the professor that a team of size 6 is allowed. He has been added to our team. The team has not been finalized yet.

Jackson came up with the idea to create a keyboard for those with disabilities rather than a mouse. This could implement error correcting code to find the closest words. The following notes were taken

Oversized keyboard for those with disabilities. Error correcting code to find closest words.

- Change Keyboard Layout
 - Keyboard for people with one usable hand?
- Spacing and shape of the keys

Date: 8/31

Abhishek has been added to the team discord and document access.

Max briefly suggested automated hydroponics or aeroponics. The team did not express lots of excitement for this idea. Also the team has further discussed the oversized keyboard idea. The following additions were made to this idea.

- Auto-Complete on keyboard
- Braille Stickers per keys

- Remap keys

We would like to meet with Justin Romack and Diana North who are representatives for TAMU disability services. Brittany sent them an email with the following text:
Howdy Justin,

I am a senior computer engineering major in my final semester at Texas A&M, and my capstone team has begun brainstorming for our project. A topic that interests us is developing a technology that would solve a problem that students with disabilities experience.

I am reaching out to you because I saw on the TAMU disabilities services page that you manage Assistive Technology Services for the university and my team would value advice from someone who is knowledgeable about assistive technologies that exist for different disabilities and where some disparities are in that technology.

We are interested in solving a problem that people who have a disability face regularly. Do you know of any specific disparities that remain prominent issues for students with disabilities on campus or in general? We have considered hearing and visual disabilities, but if there are other communities of students we could consider while deciding on a direction to take with our project we would love to know more.

We also would like to be allies for students with disabilities by respecting the barriers that this community of students faces. Do you have any advice on how to best respect that as we move forward with our project?

What is one thing you wish more people understood about people with disabilities in general?

A couple of ideas we have considered are a keyboard and mouse developed for people with Parkinson's disease and a sign language to English digital interpreter. If you have any suggestions to improve these ideas or see stronger needs elsewhere, we would love to consider those.

I would really appreciate your time answering some of my questions, and thank you for considering offering my team advice as we get started on this project! If you have any other information that you believe my team should know or any questions for me, please reach out by email or by phone!

Sincerely,
Brittany Cape Jenkins

Date: 9/7

The keyboard has been chosen as the project. The team needs to make a few decisions. The following notes have been taken.

- Multi language options : swapping dictionary
- Keyboard mapping for different languages(possible)
- Sticky Keys usage
- Quick Swap keyboards
- QMK firmware
- Keyboard has been chosen as the project
- Remove the front of the word if the word becomes long
- Scale font size
- Trie for word parsing
- Ability to press keys?
- Embedded Approach vs Software Approach

Embedded Approach

- Smart keyboard, dumb signal
- More user accessible
- Appeals to older users
- Plug and play
- Hardware decisions
- Memory Requirement
- Runtime vs Memory Efficiency

Software Approach

- Dumb keyboard/signal, smart application
- Needs to interact w OS
- A lot of steps for software installation
- More customizable on user end
- Ability to use dictionaries, less memory

Date: 9/9

Brittany got an email from Justin. The team would like to meet and has scheduled a meeting for Sept. 14, 2022 from 10-11 AM before class.

R Romack, Justin <justinr@disability.tamu.edu>
to Brittany ▾
Howdy Brittany!
Super good to hear from you!
I'll be entirely honest... This population is not something we work with in our office, so I don't really have a read on the technology used in this space.
As much as I'd like to be a help to y'all, I actually think you could use other community resources to get better info.
I want you to reach out to the Brazos Valley Center for Independent Living (<https://www.bvcil.org/>) to speak with their Executive Director, Jackie. She may have direct experience *and* be able to connect you with others in the area. It'd be ideal if you talked to someone with Parkinson's to understand the barriers they navigate (that first-hand account is critical in the research development phase because it's often we assume barriers).
Just thinking out loud... With tremors and other physical challenges that impact motor control, big, flat keys would be great. Also, think about keys that could be programmed to macros for common, yet complex tasks. Maybe assigning favorite websites or key resources. What about a key that launches dictation or voice control? Those are things I'd consider.
Let me know what you think.
Thanks,

Date: 9/12

Dysfunctions of a team Quiz

Brittany got in contact with Mac at BVCIL who was able to schedule a meeting with him at their campus for Thursday 9/15 at 11-12.

Date: 9/14

Needs Statement Due

The team is discussing additional assistive technologies that already exist. A keyguard was brought up and can be shown below.



A keyguard is a plastic or metal shield that fits over a standard keyboard. Holes are drilled into the guard to help an individual with poor dexterity or hand control press only the desired key without inadvertently pressing other keys. Keyguards are available from a variety of manufacturers.

Only Jackson, Connie, and Brittany are able to make the meeting that has been scheduled for tomorrow

Date: 9/15

Connie gave us the following notes about the meeting with Mac from BVCIL

Hey guys, our meeting this morning with Mac from BVCIL went pretty well, here's a recap and some key takeaways I jotted down:

- Apparently, the reason why technologies labelled as "assistive technologies" are so expensive is bc typically the users don't foot a majority of the bill, other things like insurance will cover it. Just something to keep in mind bc we mention "cost-effective" in our proposal a lot
- When asked abt doing an embedded vs software approach, Mac said he is mainly a software guy but he can see the benefits of going embedded for plug-and-play functionality
- Interestingly enough, he brought up the exact same idea of an LCD screen with haptic motors underneath as a solution for completely customizable buttons and functionality
- He doesn't have Parkinson's, but does have limited strength in some fingers so he typically only uses his thumbs and pointer fingers to type - actually hates typing on QWERTY
- He said he doesn't have any personal connections with anyone with Parkinson's but he gave us the contact info of Cindy Conte from the Robert Conte Foundation who might be able to help us, Brittany should be able to reach out to her soon to set something up

Next steps:

Brittany - contact Cindy Conte

Everyone else - keep working on proposal report

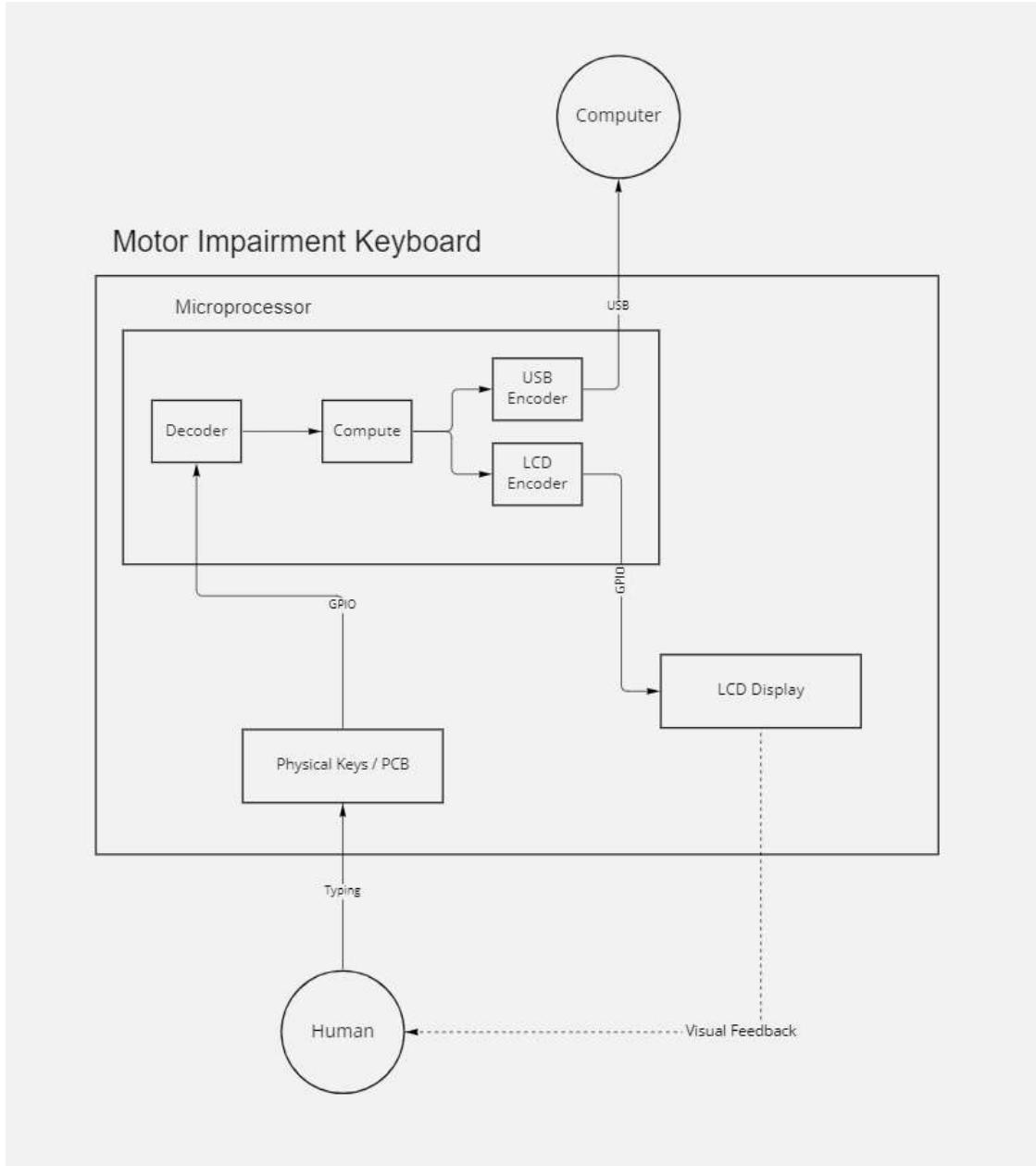
Date: 9/17

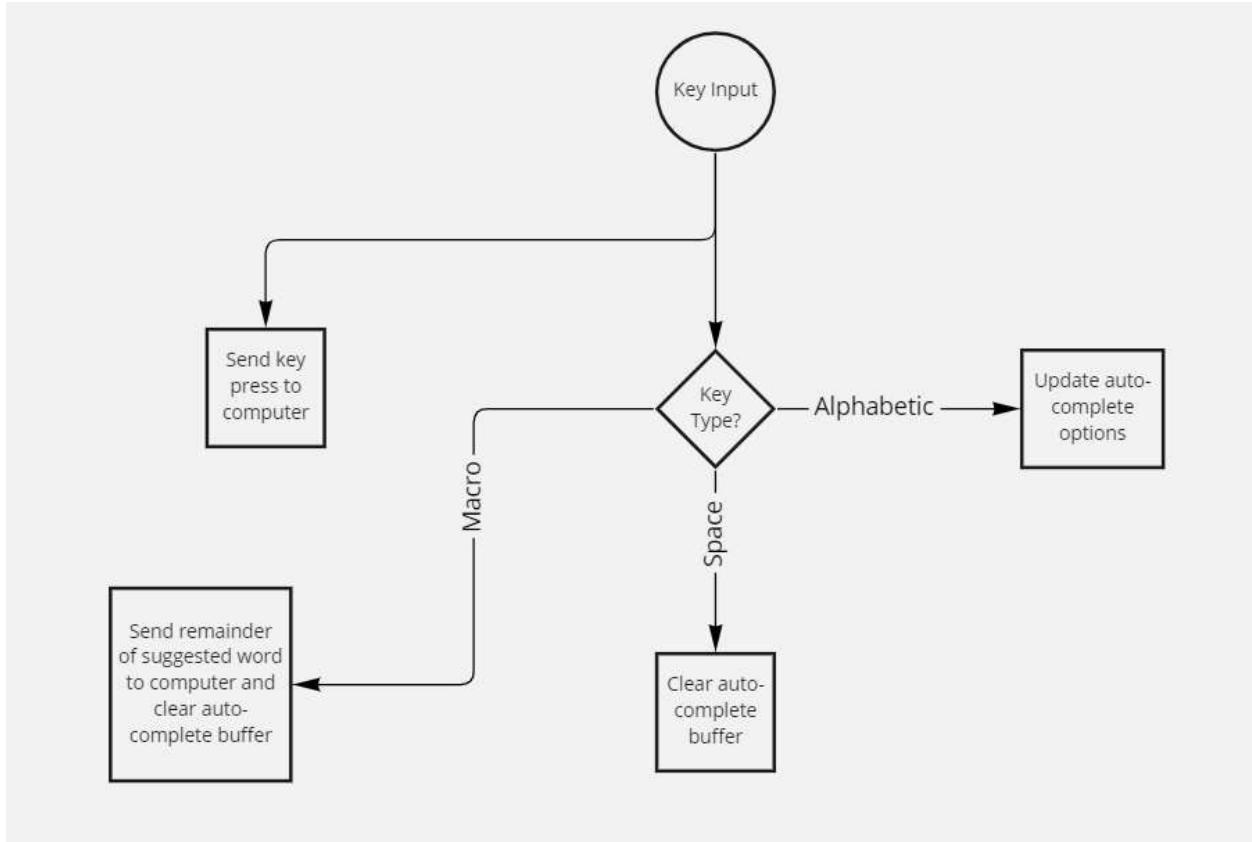
Discord Team Meeting for the proposal report.

Brittany created a Jira Board for the team to start using and began setup. The charts and schedule can be used in the documents for the report. The team has decided on using the agile software development approach.

Jackson created a github for the team and added everyone to it. The report was broken up and Jackson and I have completed our parts. Abhishek has gotten started, but the other three have not made progress yet.

The team discussed the block diagrams for the finished project. They can be seen below.





The meeting concluded with the following notes:

TODO by Monday:

- Individual parts on proposal
- Start thinking about user stories and tasks

TODO on Monday:

- Read through proposal
- Finish summary and intro sections
- Proposal powerpoint
- Establish tasks for the first sprint (user stories, tasks, etc.)

Date: 9/19

The team was able to nearly finish the proposal. The sprint details were ironed out. The class ended with the following notes:

TODO by Tuesday at 1:00 PM

- Add references
- Read the proposal
- Finish the presentation

ON Tuesday at 1:00 PM

- Finalize proposal and presentation
- Order parts
- Divide presentation
- Start sprint

There were a few notes for individuals. They can be seen below

Individual:

Brittany: Finish section 5.2 of Proposal, fix Jira

Max: Trie diagram, CV

Connie: slides

Abhishek: Parts lists (section 5.3)

Connie took the lead on the slides because she enjoys it. Also having one person design the slides can keep the look consistent across all the slides.

Date: 9/20

Short Presentation Meeting on Discord

Connie finished most of the slides with the Gantt chart left. The team divided up the presentation with the following notes:

Opening Slide (Brittany and Everyone Introduce themselves)

Agenda Brittany

Section 1 Connie

Section 2 Jackson

Section 3 Max

Section 4 Max, Andrew, Abhishek

Section 5 Andrew

Section 6 Connie

Section 7 Abhishek

Section 8 Jackson (Up to Roadmap), Brittany (Breakdown of roles)

The meeting then concluded with the following notes:

TODO:

Gantt Chart in Proposal

Gantt Chart in Presentation

Practice presentation individually

Max bio

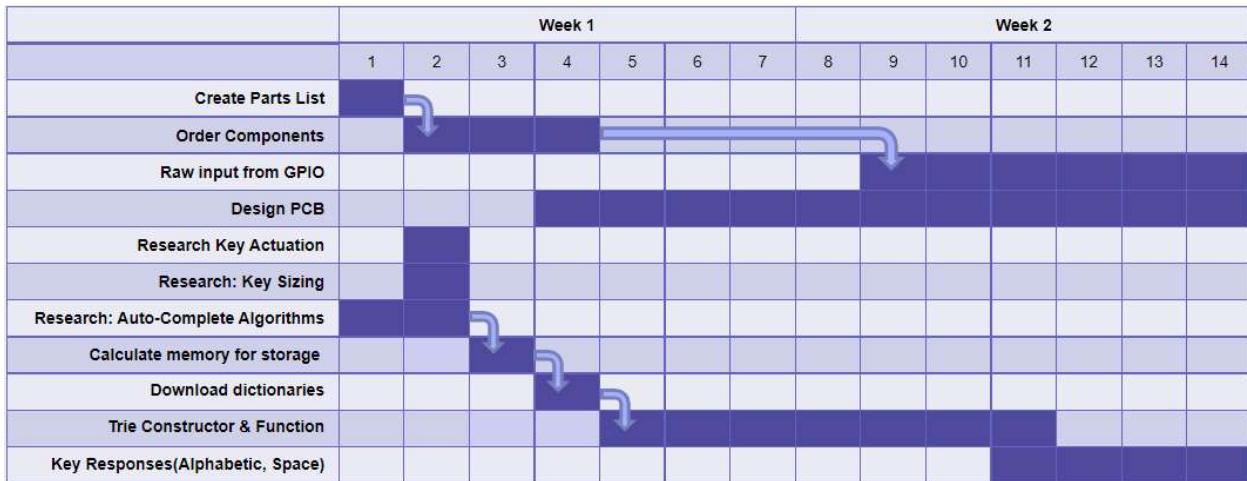
submit proposal

submit presentation

peer reviews

Date: 9/21

Proposal Report Presentation. The gantt charts were added today. They can be seen below:



The team has not submitted the proposal yet as Max has not finished his Bio/CV section. The slides were modified to ensure all aspects of the rubix were covered in the presentation. This was a suggestion I made as there was not a clear difference between the alternative solutions and the literature review.

The proposal was submitted by Max after he finished his section.

Date: 9/26

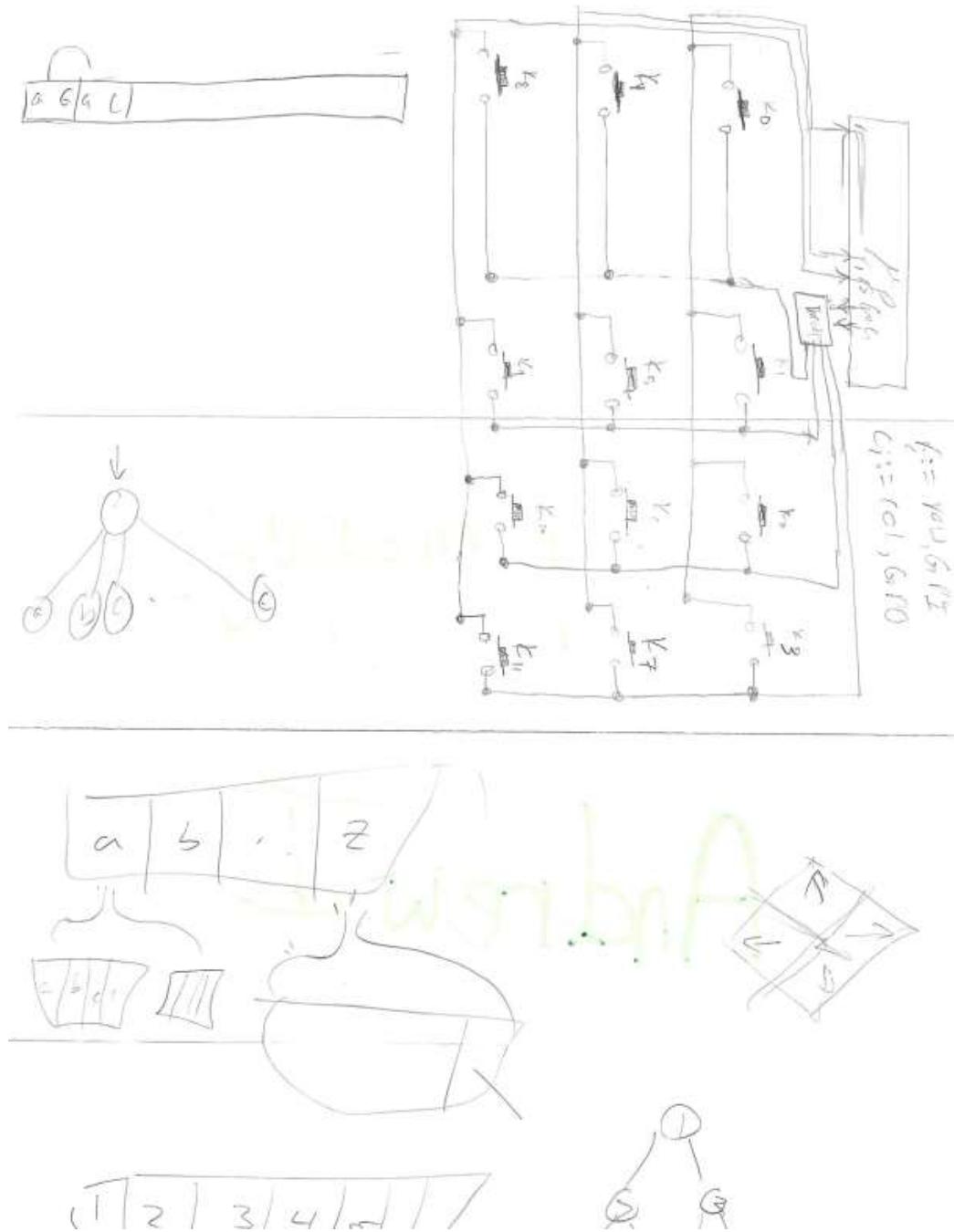
Today is the first day of class where the team is left to work on just the project. Connie woke up feeling under the weather, but notified the team early so everyone knew why she was gone. I will take short notes of what is happening today and summarize them to her in the chat.

Today Jackson and Brittany spent time setting up the Jira and GitHub so that the softwares could be integrated into each other. This took a lot of time due to various issues in setting up the software. Now that it is done, it hopefully will serve as a timesaving tool rather than an issue for us to deal with.

Weekly meetings will start on Wednesday and will occur every Wednesday on a first come first serve basis. Mondays will be workdays. Each week, the team will need to fill out a weekly report form that will be submitted on canvas. This should be led by Connie and Max.

Abhishek ordered the Raspberry Pi Pico. This is smaller than the Pi Zero and cheaper. It should arrive September 30th.

Max and I are discussing the details of the circuitry and how we can create the circuit to allow for multiple key presses. The best solution thus far has been a key matrix that will have to integrate some debounce circuitry for each key. The rough sketches are shown below.



Finally, the team is discussing how to store the project when we are not actively working on it. The options were to store in a case or tub and maybe give an individual responsibility. I

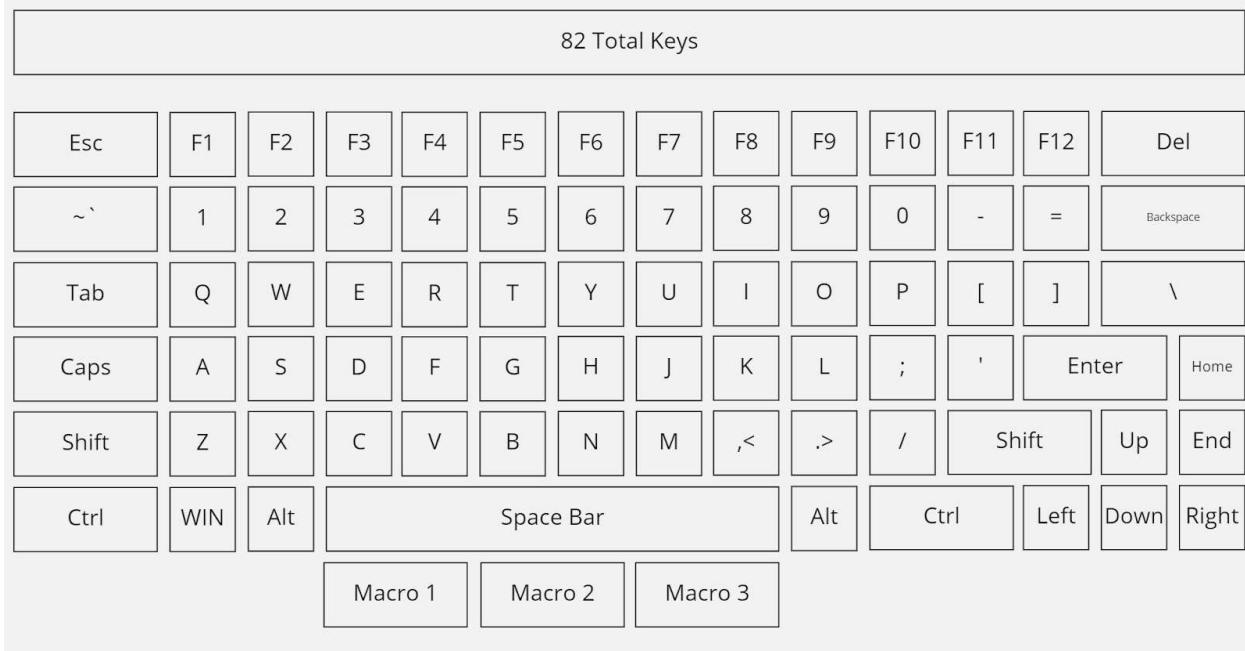
hope that the doors to the building are not locked and allow for access. Otherwise I do not want to put the responsibility of bringing the entire project onto one person's shoulders. We can discuss this in the meeting on Wednesday.

Date: 9/28

First Weekly Report with Prof Mahapatra and TA Karl Ott. The meeting went rather smoothly as the Professor and the TA know that we are making good progress on the project. I wonder whether the other groups are as organized as we are.

The team has hidden the key to the storage on top of a shelf that is near the desk that the professor uses.

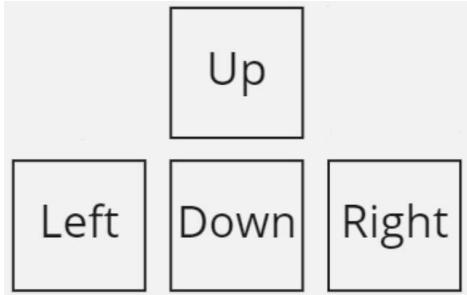
After the meeting with the prof, the team worked at the table to discuss details on design. I created a keyboard key layout so that Max would be able to progress on the circuit design.



The details on this design were discussed during our proposal. The team wanted a simple grid layout to allow ease of use for the users, as offset keys can be confusing. The keys that the team discussed were unnecessary were removed, but when creating the layout, there were two open key spaces that could not be filled up cleanly. This is where I decided the home and end keys could be inserted due to the fact that I like to use these keys.

It is now later in the day and Max asked if I could remove 2 keys to have a number equal to a multiple of sixteen to reduce the GPIO pin usage. The Home and End keys were late

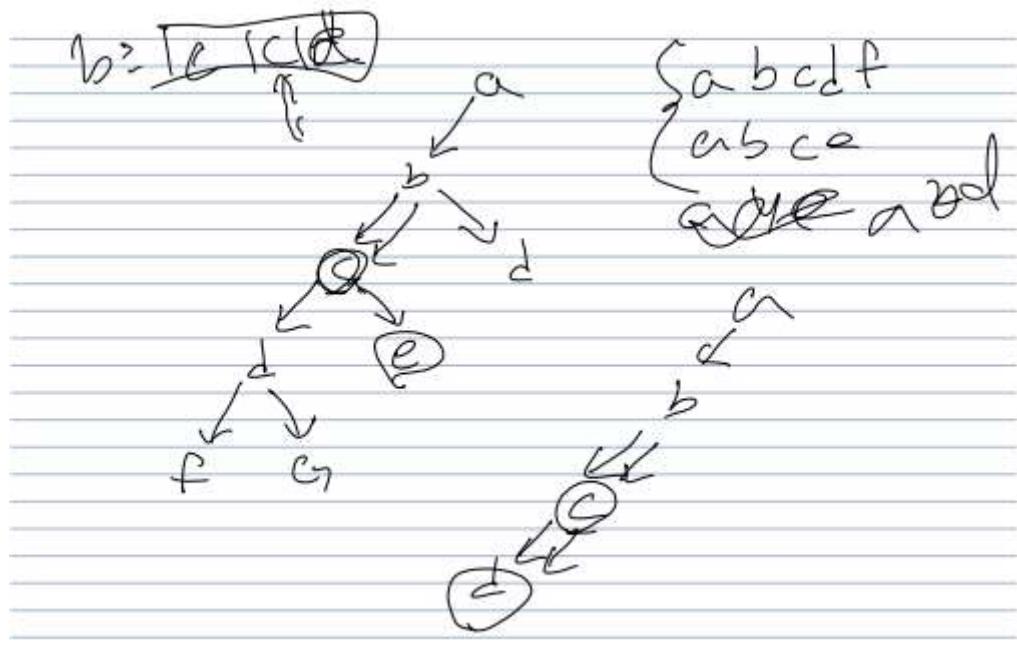
additions to the keyboard, so I will try and find an alternative solution to the layout that only uses 80 keys.



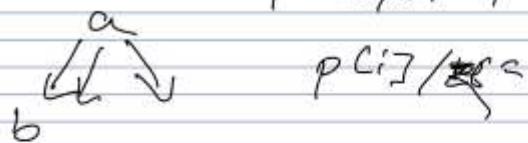
The arrow keys are making this difficult as I would like to shift them over to the left one, but to make the keys easy to use, they should be shaped as seen above. Unfortunately this would cut the right shift key in half and leave a space open.

Moving on from the keyboard design, the team was discussing the details of the software implementation of the auto-complete software. Navigating through a tree/Trie with $O(1)$ run time is complicated. This discussion was led by the software team. Discussing traversal that will reduce the amount of memory being used is crucial. Jackson and Max had finally landed on an implementation that doesn't require pointers. While ironing out the details of this, they lost Connie. Connie came up with her own implementation that is very similar in result however. The scribbled notes from the meeting can be seen below.

The core of this issue is due to the fact that different words such as “there” and “therefore” should be able to show as options. The tree has to continue navigating past “there” and into the next node. This needs both options to show up. I briefly brought up the option of only showing the short word and not implementing a space so that the user could hit “there” but that does not mean the word is finished. No space would be added. The team decided that this was not the final result that we wanted for the auto complete however, and this idea was discarded. The implementation will be more complex, but the result will be more user friendly.

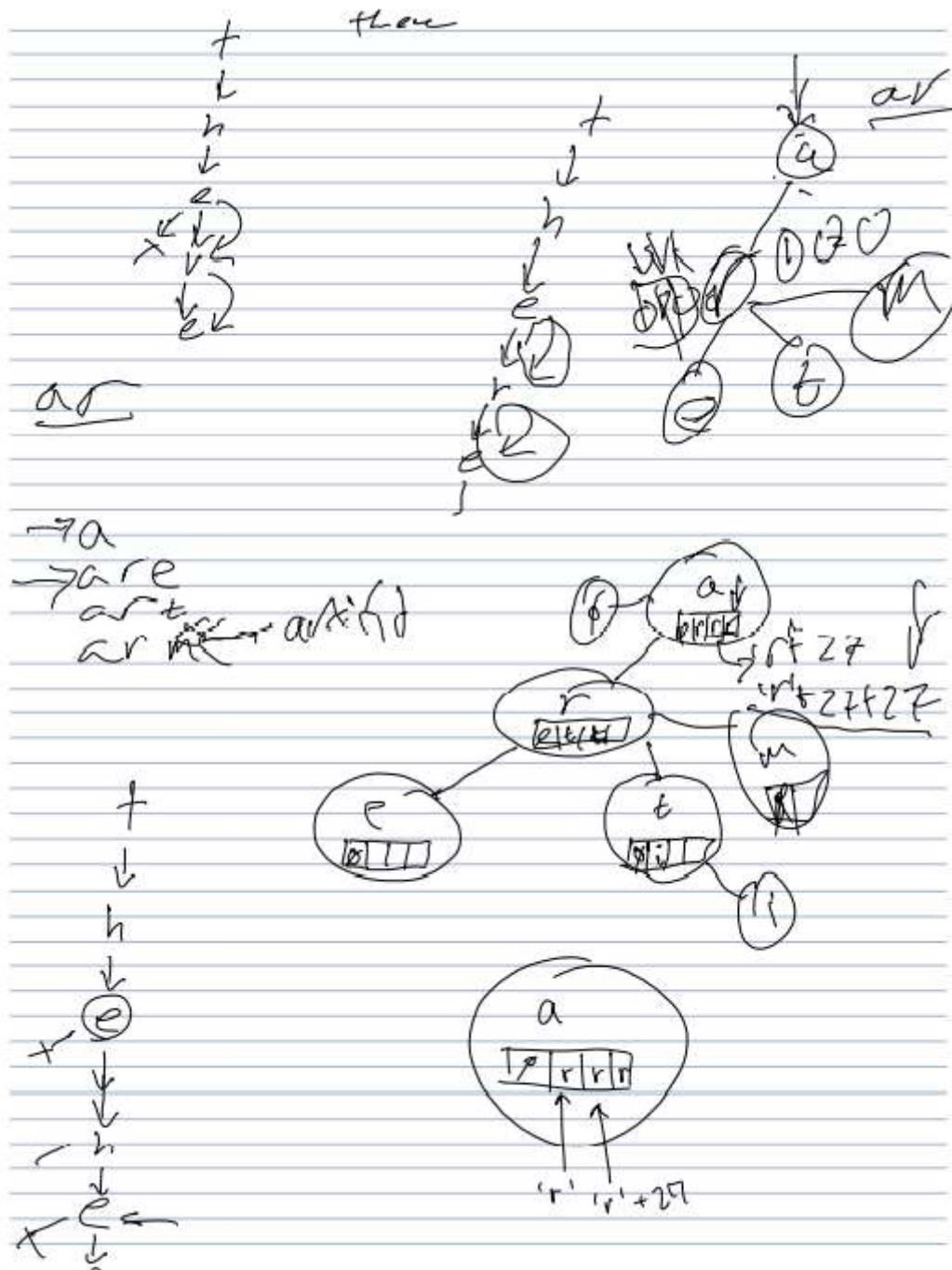


$p(C_{17}/27) = \text{char}$
 $p(C_{17}/27) = \text{parent note}$



for however many times
 note b appears in the
 children of a before i
 in the property in

the
 therefore



Date: 9/29

I have come up with two alternatives to the key layout. The first option is to shift the arrow keys to the right because they are navigation keys and could be important to reduce mouse usage.



The second solution is to shape the enter key like a Tetris L piece. I have seen this done on some older keyboard models. This allows the grid aesthetic of the keyboard to remain. I will ask the team what they would prefer.



After discussing the positioning of the keys with Jackson, he brought up shifting the bottom row of keys containing the shift keys to the right. This might make typing less left dominated by the hands. With this feedback, I could shift the arrow keys down and make the bottom 3 in line with the macros. This will isolate the keys to enable easy usage to navigate the computer without using the mouse. This version is shown below. Thus far, it seems favored by the team.



Max gave approval for this as well, saying “This should be easy to map onto the scanning matrix without much additional routing”.

Date: 9/30

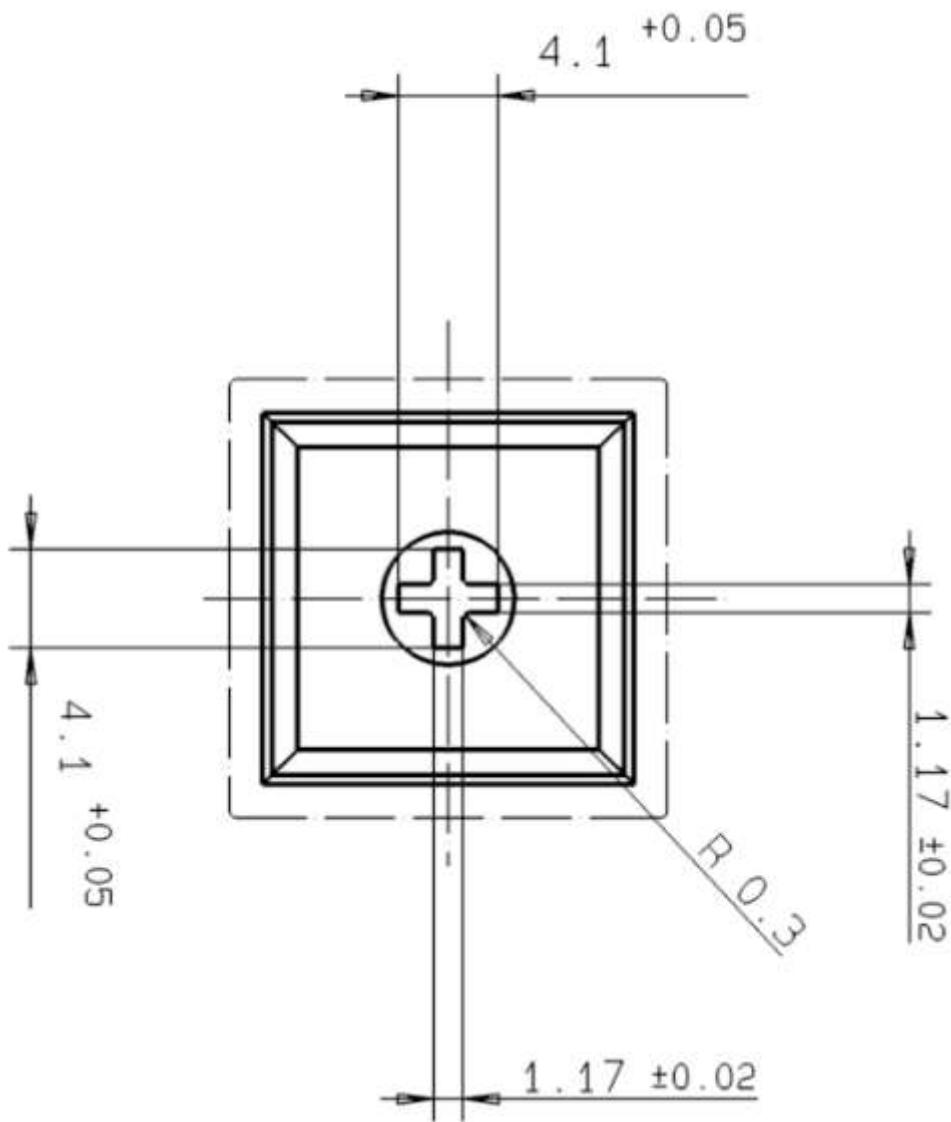
Today I will model an individual keycap. This is difficult because I also have to do research on how to make the key big enough to assist the user, but not too large to make the size of the entire keyboard too big.

There is little information on how large the key should be made to assist the user, but there is a keyboard on Amazon with the “largest print on keycaps available”.

<https://www.amazon.com/Visionboard2-Large-Key-Keyboard-Black/dp/BooEN1EU80>

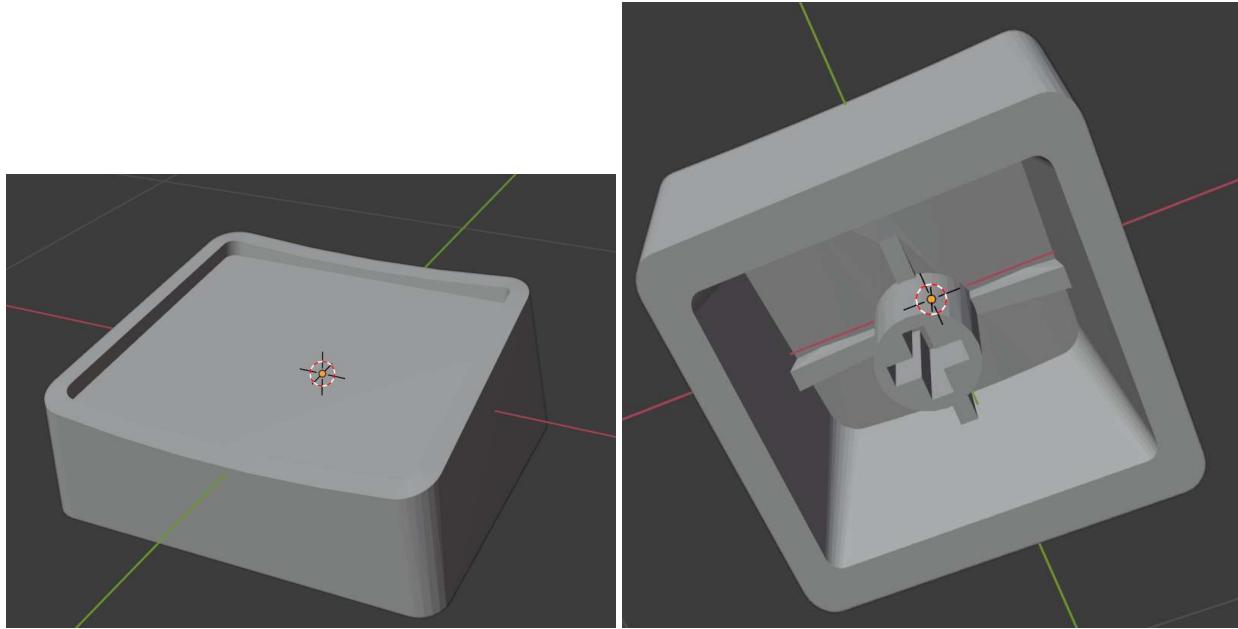
This keyboard has the desired appearance without being unwieldy. The size of each key is 1 in. However these keys bow inward at the top, making the top of the keycap smaller than the bottom. Additionally, users will have the hard shell wrapping that the keys will be inset into to further aid them.

All mechanical key switches have a plus shaped switch to place the key on top of. This is how I will mount the model that I print.



These dimensions were given to me by <https://www.cherrymx.de/en/dev.html>
This is the developer page for the Cherry MX keys.

Given this information and the previously discussed criteria for the keys, I will now model it to the best of my ability. The result will be shown below.



Width is .9 in

Length is .95 in (Slanting toward user)

Height is 0.4 in

If keys are touching with no space between, keyboard would be 13.5 inches wide

If keys have 0.15 in between them, keyboard would be 15.6 inches wide at end of the keys

I have posted this information in the group's discord under the #modeling text channel.

The project is definitely on track, I believe that the team has covered the most important aspects of the first sprint already.

Date: 10/3

Today the team was discussing strategies to implement for the hardware to send signals when a key is pressed. Due to the ease of the circuitry, the team decided that polling the software would be best, but this would impact the ability of the predictive algorithm. As a solution the team has decided to poll the hardware with a sub processor and send an interrupt to the main processor when polling finds a keystroke. This means that our design will use a Raspberry Pi 4 as our main processor, and the Raspberry Pi Pico will operate as our polling processor.

Another key discussion involved creating our system to handle the inputs which will then be converted to scan codes that are sent to the computer. The team decided that a custom encoding scheme will be the most efficient with the options on a keyboard.

With the custom encoding, the first 4 bits are the alt/ctrl/shift/win input and combos, next 7 bits are the remaining keys resulting in a total of 12 bits or 2 bytes or an unsigned short. Caps lock will be handled as a normal scan code. The name of this encoding scheme is MENA.

Finally, Brittany reached out to Cindy Conte about finding users that can test our keyboard. The email she sent is below:

 BJ Brittany Jenkins
To: fightpd@robertcontefoundation.org > 11:50 AM

TAMU Capstone

Hi Cindy,

My name is Brittany Jenkins, and I received your contact information from Mac at Brazos Valley Center for Independent Living. I am a senior Computer Engineering major, and My capstone team is working on developing a keyboard specifically designed for people with mild to moderate motor impairments such as a mild case of Parkinson's Disease. We are looking for people who may be interested in talking with us about our design and hopefully testing it in later stages to make sure we are not making assumptions about good solutions.

We are specifically looking for anyone who uses keyboards on a regular basis either in the workforce or for their hobbies. This will help us tell if our design is any better than an average keyboard, and we would not require much of the tester's time, we are looking at hopefully meeting with each tester 2-3 times over the course of the semester.

Please let us know if you are aware of anyone that might be interested, and please reach out to me if you have any questions! We are really excited about this project and would love the chance to work with you.

Best Regards

Date: 10/5

Today we had our weekly meeting. The meeting notes are as follows:
10/05 Weekly Meeting Minutes

Agenda Overview

Discussion of Software:

- needed auto-complete algorithm discussion after last meeting
- Jackson was able to implement the new algorithm, which is optimal for priority
- execution time is fast, but not constant time
- storing of keystrokes and encoding scheme
- creation of custom encoding method, MENA, and skeleton code for GPIO to MENA encoding transition

Discussion of Hardware:

- Andrew has modeled the keycap prototype for a larger-sized keycap
- model is hopefully consistent with switch stem
- display of finalized keyboard layout
- unfortunate delivery issues, will need to make some repurchases

Communication Update:

- Cindy Conte has responded to our email, and has shared our email with the Conte Foundation for potential participants
- Brittany also has a connection with a potential Parkinson's patient through her grandmother

- faculty member has experience with machine learning: Shuiwang G

Issues/Roadblocks:

- major hardware setbacks
- can workaround the setbacks by testing GPIO with a normal RPi that our members already own

Discussion of PICO:

- do we have full programmable control of the USB? Yes
- polling and interrupt workaround for storage (predictive algorithm run on regular RPi, everything else run on PICO)

Closing Thoughts:

- plans for the next sprint (researching USB protocol, etc.)
- CDR due Oct 19th
- cancel current order, place new one
- good progress

As a result of the ordering issues from Amazon, I have placed an order for the parts that Abhishek has ordered due to the fact that I have Amazon Prime. The hardware is the major choke point for our project due to the fact that we do not have everything that we need to get started. I would like to check the keycap sizing on the switches, but I will have to wait until they arrive.

Date: 10/11

This is after fall break and therefore the team did not get a lot of work done over the break. The parts I ordered arrived, but so did the parts Abhishek Ordered. We are figuring out the duplicates and if we can get a refund for the original parts. We had our weekly meeting and the notes are as follows:

1. Individual Accomplishments:
 - a. Brittany – GPIO encoding/decoding research
 - b. Max & Jackson – software keystroke encoding/scanning
 - c. Andrew – keycap printing (support and infill redesign, also some issues with key stem)
2. CDR:
 - a. Significant software demonstration (auto-complete)
 - b. Keycap and switch demonstration
 - c. Would be good to demo any working keys
3. Plans for remainder of Sprint 2:
 - a. Reorganize Jira tasks for hardware setbacks
 - b. Get started on USB encoding, GPIO decoding
 - c. Prep for CDR

After the meeting, I learned that the keycaps actually do fit the switches with the current stems. This is great news because I do not have to mess with the tolerances of the stem interaction with the switch. I will be redesigning the keycaps however due to the issues with supports and the fact that insetting the keys will not change the outcome of the keyboard.

The team also needs to produce a product that will be able to be demonstrated for the CDR report and this is the next priority.

Date: 10/13

Today we had a scheduling meeting involving Brittany, Connie, and I. We worked on planning out the sprints and priorities for the next sprint. The first sprint ran a little longer than originally planned so we started the next sprint. Our biggest priority as a team needs to be to update the hardware team as quickly as possible to ensure that the software is not held up by the hardware issues. We will have a hardware meeting on the 15th to start catching up so we can stay on track.

Date: 10/15

Today was a hardware meeting for the group. We are finally able to explore the different hardware devices that we acquired in the mail and the nuances of using them. The

Raspberry Pi Pico operates similar to an arduino that I have used before and is surprisingly user friendly after understanding how it operates. We need to understand how to interact with the GPIO using C++. A link talking about the Pico is below.

PICO

<https://datasheets.raspberrypi.com/pico/getting-started-with-pico.pdf>

While Max spent time exploring the Pico, I looked at the LCD displays that we ordered. I found a website that talked about the PICO that we ordered because we will be using a SPI port on the Raspberry PI 4 to interact with them. This significantly reduces the number of pins that we are using for the displays. Unfortunately this link is for python and not C++ but it will be a useful resource.

LCD Exploration

<https://how2electronics.com/interfacing-16x2-lcd-display-with-raspberry-pi-pico/>

Date: 10/17

Today was a work day on the CDR as well as the demo that we will produce. Yesterday Connie and I met to break up the CDR into parts that the group can understand and start working on. I completed the modeling section of the report as I am the only person who has done any work on that section. Next I helped Max with the breadboard that we are using to simulate a 2x2 keyboard to show that our circuit is working as desired. After the class was finished, the group was assigned to finish the report sections and presentation. The main thing to finish was the demo, which Max, Jackson and I did shortly after everyone left. A demo link can be found below.

<https://youtu.be/nU4Bqcodl7o>

This demo is a good starting point, but I would like to use the keys and switches. Unfortunately they do not fit in a breadboard due to a large pillar in the back. The next step for the group will be to finish the CDR report and presentation.

Brittany is dealing with the IRB paperwork which is proving to be more of a hassle than originally intended. Jackson, Connie, Brittany and I are all IRB certified due to taking the Human Computer Interaction course. This paperwork might not be done by wednesday.

Date: 10/19

Today we had our in class CDR presentation. Unfortunately Brittany woke up feeling ill, but we filled in for her as best as we could during the presentation. I was able to demonstrate the keycaps fitting the switches for the Professor. The professor mentioned that he would like an update regarding the IRB paperwork during the meeting next week.

The report was finished as I started the introduction section because nobody else took the lead. After getting the team to review the report it was submitted.

Brittany has continued making an effort on reaching out for the IRB paperwork, but the people she is contacting are not being particularly helpful.

The team will have another hardware specific meeting soon to make priorities and hopefully lots of progress.

Date: 10/21

Quick update, Brittany is still having IRB issues as people are giving her the run around. The group may have to do the testing ourselves until IRB is approved.

After more work, Brittany gave the group the following update:

we will have to submit a determination, and if they decide it is human research then we will also have to submit for an exemption, they cannot do it all in one. She was fairly impatient with me, but I got all of my questions answered. She would not let me speak with anyone else and said they would just tell me the same thing. I was hoping to skip the determination. I will be working on the documentation for that today. I hope to have it turned in by this evening. I am going to have to submit a research protocol, a risk assessment, and a questionnaire.

Finally she was able to add Jackson and I as investigators for the study.

Date: 10/23

Today the team had a meeting for Hardware that took place in ZACH. There were a lot of people in attendance, so we split up the work. Brittany and I worked together on PCB related items. After some research we decided that we would be using KICAD for our PCB and schematic designing. I did some research regarding footprints for a keyboard switch which brought me to a github link that can be found below.

<https://github.com/perigoso/keysswitch-kicad-library>

Unfortunately, the keyboard switch that we picked for this project is not standard. This means that we will have to make our own footprint for the PCB. I will lead the efforts on this and hopefully create a prototype soon that we can submit to the FEDC to get a prototype. Using this we will verify that my design is good.

I explained our schematic to Brittany who is understanding the schematic now. There was some confusion regarding the decoders. We are using the decoders to power one column of the PCB at a time and checking for input on the rows. This would be a total of 21 GPIO pins as we are doing a 16x5 matrix. To simplify this process we want to use a decoder for the columns so that we are only using 4 pins. This will reduce the pin usage from a total of 21 to a total of 9. This does however complicate the circuit a bit but this will prove to be useful later.

Powering the system might be more simple than we originally thought. We should be able to power the PI through the USB into the computer, and power the Pico through the USB into the PI. This will significantly reduce the GPIO pins as well as complexity as each machine should be able to communicate directly.

Date: 10/24

Today was a work day for the group. Along with some research and helping other individuals in the group, specifically Max with the hardware code, Jackson took my laptop. He was doing this to test using the PI as keyboard input. This was done while the PI was being powered by the laptop's USB port. The successful output is encouraging for the future of the project.

Date: 10/26

Today was the weekly meeting. This went pretty well, but the professor expressed urgency regarding the ordering of the PCB. This is priority number one because we do not know how long shipping will take and the completed assembly will depend on this. I will create the footprint for the keycap today as well as create a senior design team for the FEDC so I can submit a request for a prototype PCB.

The footprint creation was successful as well as creating a FEDC team account. I need to wait for approval before submitting the request with the team number.

Date: 10/27

Today I was able to test the footprint prototype. This was successful on the first attempt which is wonderful. One of the drill holes was a little tight for the pin so I will enlarge this to ensure ease of use. However, an unforeseen benefit of this was that I was able to test this footprint without soldering. A video showing the testing is linked below.

<https://drive.google.com/file/d/1-JeEngJluz9hXZ-lkgJFyl2ooJ6lTu7t/view?usp=sharing>

When creating the final PCB, I will need to mirror the footprint to ensure that we can solder the switch to the board. Due to the orientation of the board, soldering in the current state would be difficult and likely frustrating unless the board was on the other side. That or through hole plating was done on the board.

Date: 10/29

Today I learned that the decoder that we were originally planning on using is not outputting the way we originally intended it to. It is outputting lows rather than highs. The current decoder output is as follows.

INPUTS			OUTPUTS							
ENABLE	SELECT									
G1	G2*	C B A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X X X	H	H	H	H	H	H	H	H
L	X	X X X	H	H	H	H	H	H	H	H
H	L	L L L	L	H	H	H	H	H	H	H
H	L	L L H	H	L	H	H	H	H	H	H
H	L	L H L	H	H	L	H	H	H	H	H
H	L	L H M	H	H	M	L	H	H	H	H
H	L	L M H	H	H	M	H	L	H	H	H
H	L	H L L	H	H	H	H	L	H	H	H
H	L	H L H	H	H	H	H	H	L	H	H
H	L	H H L	H	H	H	H	H	H	L	H
H	L	H H H	H	H	H	H	H	H	H	L

* $\bar{G}2 = \bar{G}2A + \bar{G}2B$

H = high level, L = low level, X = irrelevant

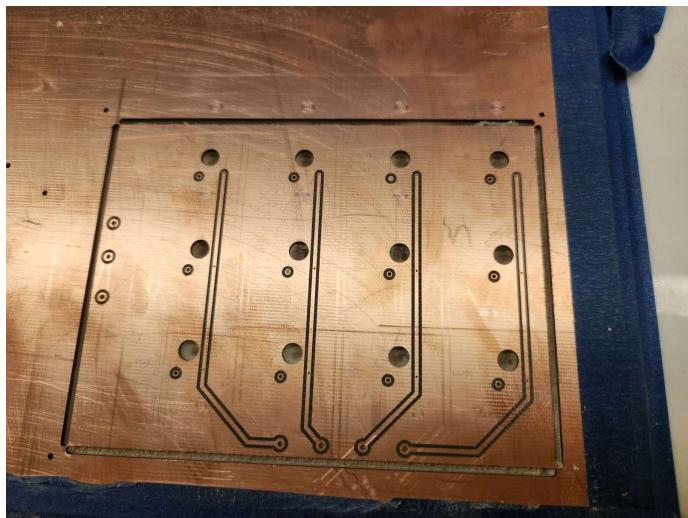
Unfortunately this is opposite of what we had originally planned as the original plan for a decoder is shown below.

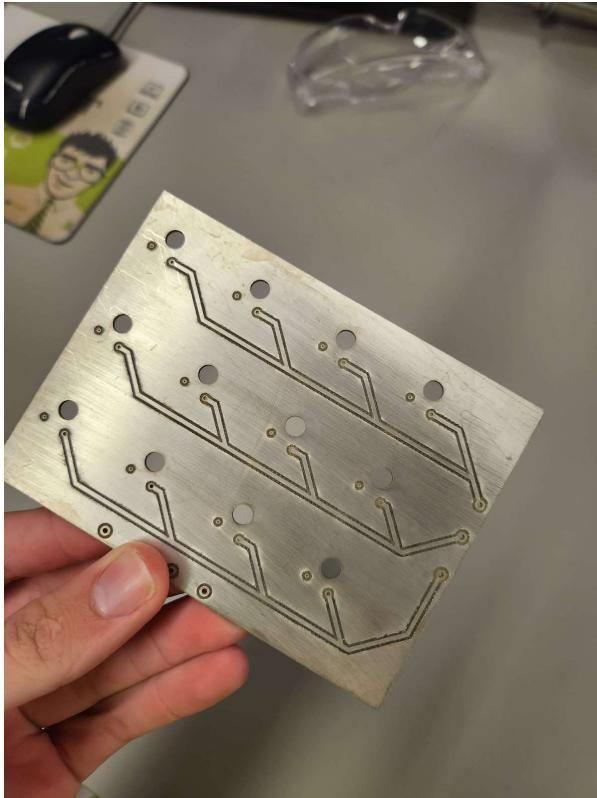
FUNCTION TABLE

ENABLE INPUTS			SELECT INPUTS			OUTPUTS							
G1	$\bar{G2A}$	$\bar{G2B}$	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	X	L	L	L	L	L	L	L	L
X	X	H	X	X	X	L	L	L	L	L	L	L	L
L	X	X	X	X	X	L	L	L	L	L	L	L	L
H	L	L	L	L	L	H	L	L	L	L	L	L	L
H	L	L	L	L	H	L	H	L	L	L	L	L	L
H	L	L	L	H	L	L	L	H	L	L	L	L	L
H	L	L	L	H	H	L	L	L	H	L	L	L	L
H	L	L	H	L	L	L	L	L	L	H	L	L	L
H	L	L	H	L	H	L	L	L	L	L	H	L	L
H	L	L	H	H	L	L	L	L	L	L	L	H	L
H	L	L	H	H	H	L	L	L	L	L	L	L	H

This might require the usage of inverters to give the proper output. That or maybe we will need to change the logic in the software but as of right now, I do not see how that is possible.

Date: 11/1





Today I created a request to the FEDC to test our PCB design in a small 4 x 3 format. This will allow us to test the grid circuitry and ensure that it functions correctly. The board can be seen above. I will solder keycaps to the board to test.

Date: 11/2

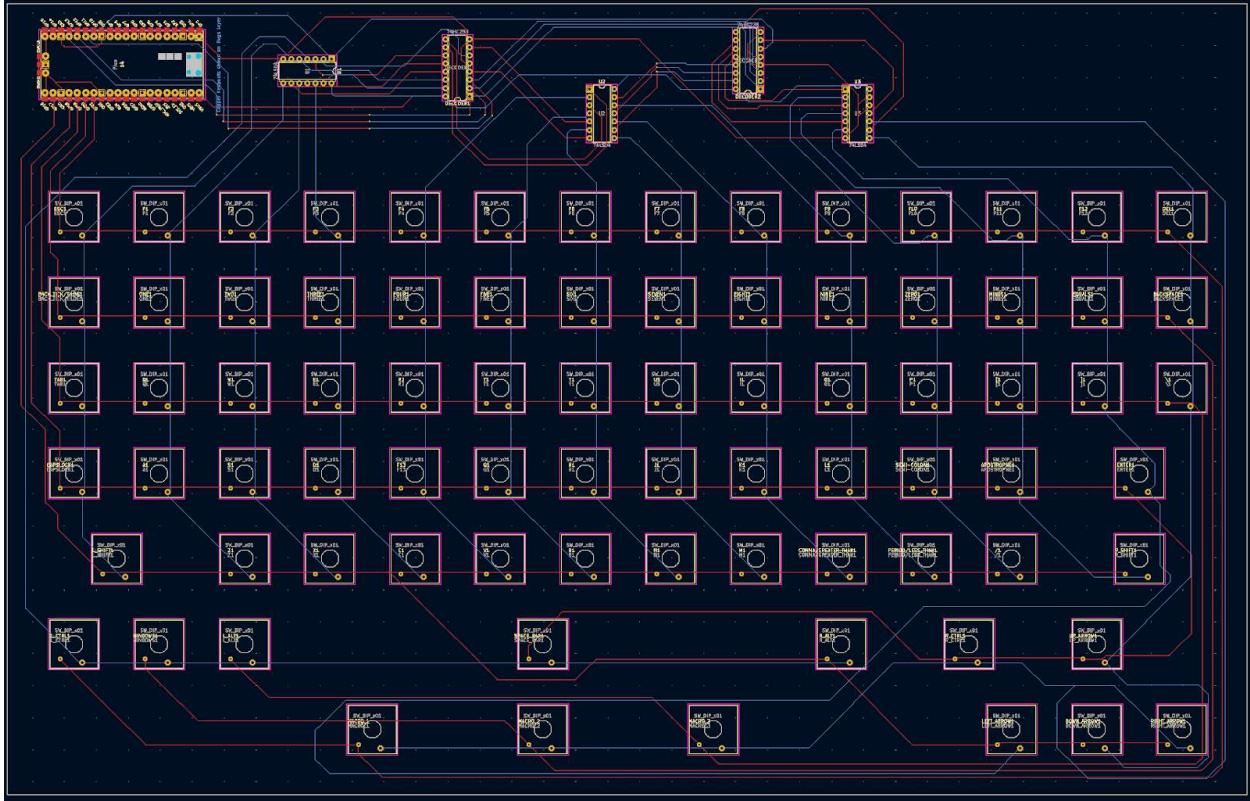
Today we tested the circuitry. Soldering the board proved to be difficult due to the fact that the FEDC does not do THP(Through Hole Plating). This made some of the connections unstable but the board proved to function correctly.

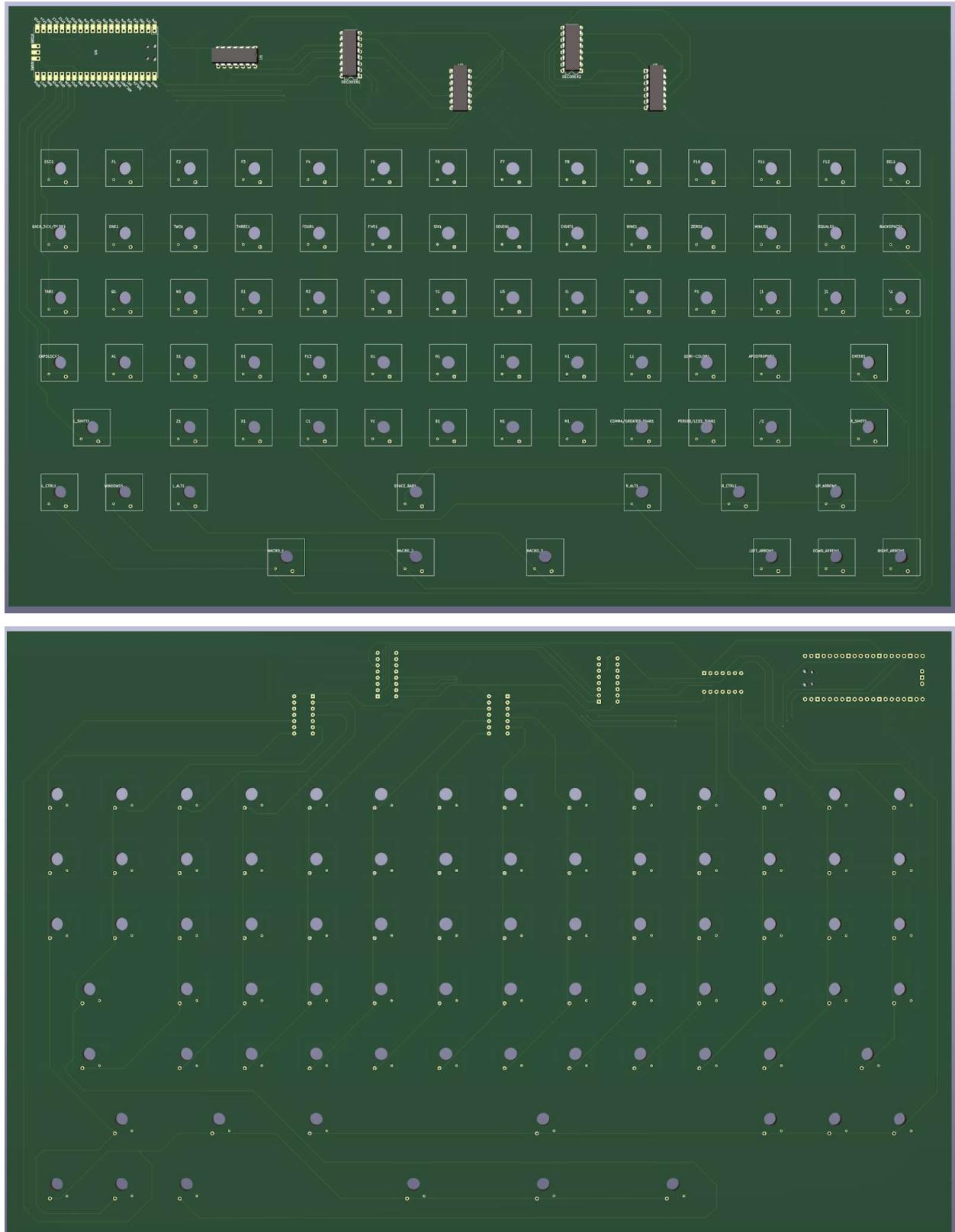
When trying to create a board to be professionally manufactured, Connie, Brittany and I are running into an issue where the footprint does not display correctly in the software when doing a 3D render. Hopefully we can solve this problem soon and quickly.

I learned what the issue was with the PCB. The board needed an outline to display correctly in the software. With that fixed, we can proceed with creating the PCB request. Brittany found the footprint for the PICO and the inverters and decoders. She has created a schematic for the board that will make it easier to route.

Date: 11/3

Today I spent time creating the traces and routing for the board. This took some time, but all the switches are spaced correctly. The PICO, inverters, and decoders are placed above the keyboard switches to be covered by the LCD and housing in the future. The routing was checked by the software and correctly corresponded with the schematic. The routing and 3D rendering can be seen below.





Before we make any submission we need to check the rules of the website we are submitting to and ensure that we are adhering to their requirements. We can do that with

the Design Rules Checker. When routing, I left the design rules as default. There seems to be no issues as of yet with the DRC.

Date: 11/4

Today I helped Brittany learn how to navigate the KiCAD software and create Gerber files. I also showed her how to edit the DRC to ensure that the routing falls within the rules of the manufacturer that we choose.

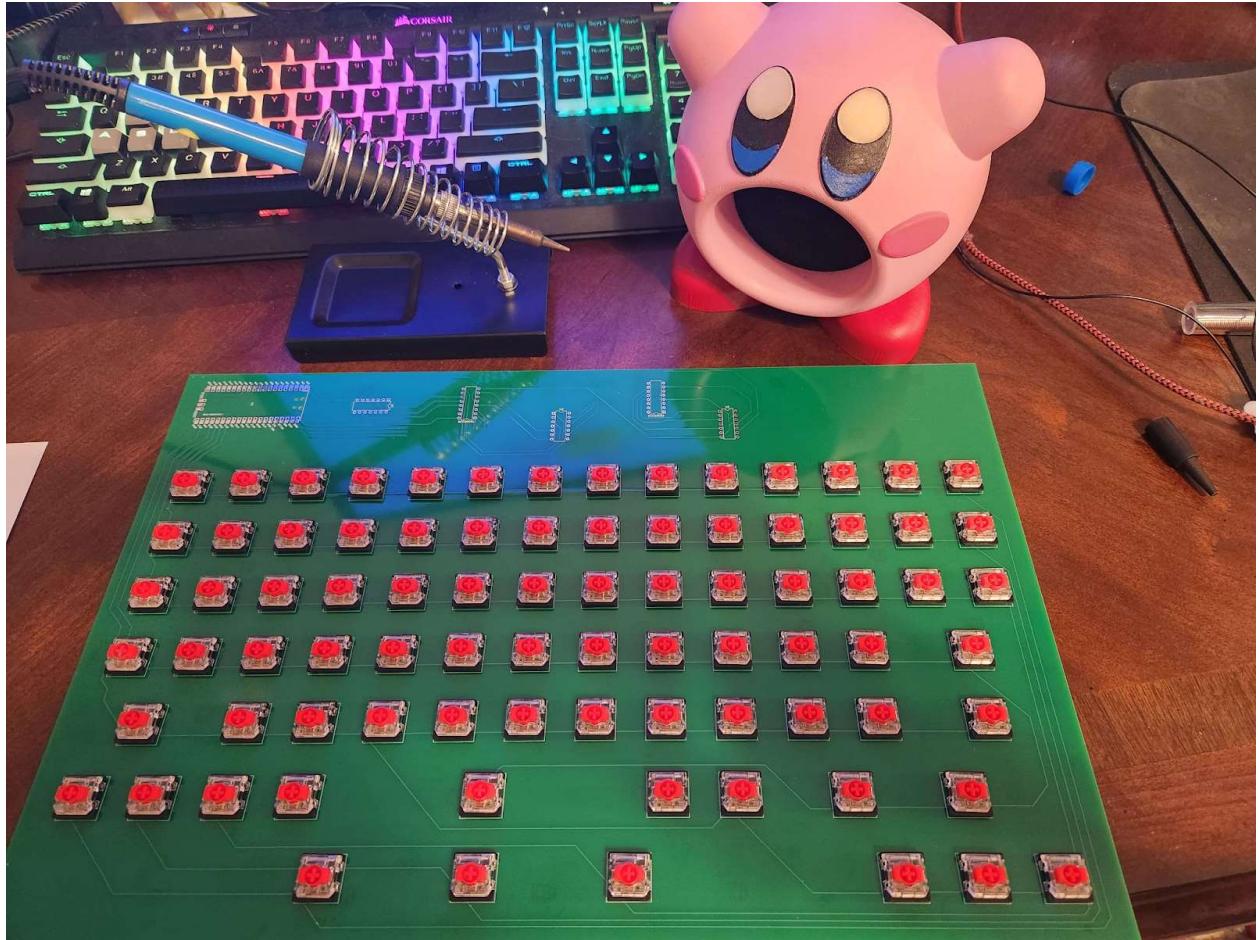
When looking at manufacturers we wanted to pick one that would deliver as quickly as possible. The two companies that we were looking at are JLBPCB and PCBWay. Due to the size of our board, this is going to cost us quite a bit of money. Given that, we want to ensure that our design is correct and PCBWay has better reviews, faster shipping times, and a few checking stages. We have decided to go with them and place the order.

Date: 11/10

Today the PCB arrived at Brittany's place. I picked up the boards so that I could solder the switches onto the board. Upon quick inspection, the PCB does have THP so that will make the process much easier than that of the FEDC. Tomorrow I will work on the soldering. Here is the package next to Brittany's kitty.

**Date: 11/11**

Today I soldered on all the key switches. The switches are very secure to the board. I will put on the pico, the inverters, and the decoders on Monday (11/14). The board can be seen below.

**Date: 11/14**

I soldered on the Decoders and Inverters. I also soldered on the PICO. However, upon soldering on the PICO we learned that there was an issue in the schematic and therefore in the design that caused all the pins to be grounded. Due to this, the board was not booting. To remove the pico we used a heat gun and pulled off the old PICO. Fortunately, if we only connect the pins that we need, the hardware should still work as originally planned. This will have to be tested Wednesday as this took all day.

Date: 11/16

After attaching a mounting system to the board, we connected only the pins that we needed to the mounting system. This however did not solve all of the problems. The code to test the board was not working correctly, and I am worried that there is an issue with the decoding circuitry. If there's an issue with the decoding circuitry, I think we can pull those out, do the decoding on a breadboard, and just wire those outputs to each row. I am slightly panicking but we will have a product somehow.

Date: 11/21

After looking through the hardware and software, we learned that the hardware is working correctly. There were issues in the code that were being run as well as a few other minor issues. This is a huge relief as we spent a lot of time and money on the PCB and I did not want it to go to waste.

Date: 11/22

I created a keycap printing request to the FEDC for 80 keycaps. This will be ready after Thanksgiving break.

Date: 11/23

Max just got it to where we can just plug the Pi into a computer and use the keyboard. We will need to configure the LCDs and the boot is slow, but the keyboard is working as we intended. I am extremely relieved.

Date: 11/27

Team meeting in Zachary.

Jackson and Max worked on software where they solved some various bugs in the code as well as the LCD setup.

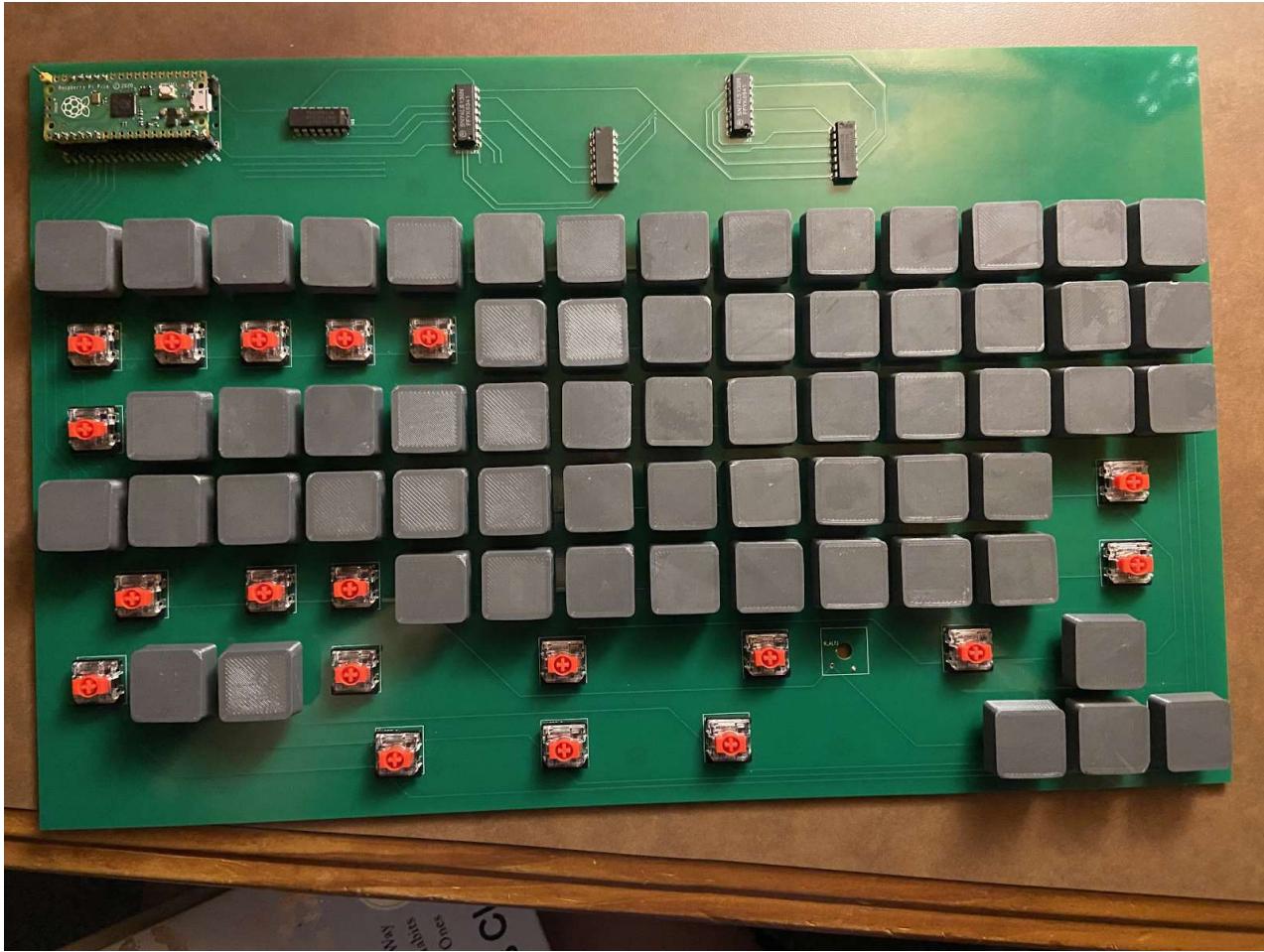
I picked up the keycaps from the FEDC and they are difficult to fit onto switches. This is frustrating because the test keycaps were printed on my home 3D printer and did not have this issue.

Brittany and I helped Connie start modeling the housing. This process took a lot of measuring with calipers and minor tweaks to the files.

I created a spacebar keycap model as well as some double wide keycap models by modifying the model from the singular keycap in Blender.

Brittany left to get a label maker for the tops of the keycaps. After returning, she took MIKey home with her to try and put keycaps on.

Late at night, Brittany got in a rhythm to put the keycaps on the switches. Some keycaps stick down a little. The current state of MIKey can be seen below.

**Date: 11/28**

Today I soldered a broken switch back onto the board. This was the right alt key and can be seen in the above image. The team demoed the keyboard to the prof which went rather well. We got feedback on things to include in the report as well as minor improvements to the product that we could make. After the demo, the team got to work.

Jackson and Max made improvements to the latency for the keyboard. Testing the latency, we learned that it is barely different from a normal keyboard.

We need to sync the LCDs to the display. We also need to allow autocorrect when shift is being pressed down.

I created a 3D Printing request for the remaining keycaps including the Spacebar, the Double wides, and some normal keycaps to finish out the board. The stems for these requests were slightly modified to make the interface with the switch easier.

Later in the evening, after helping Connie with the housing model further, I submitted a 3D printing request for the housing. The product is coming together and I am excited.

Date 11/30



The keyboard was completely assembled and tested.

It works as desired, and this is our final iteration of the board for the semester.

The team will work on creating a demo video, report, and presentation.

I am extremely happy with how it turned out. The only part of the housing that did not work as intended was the snap on. Instead we taped the sides together instead of gluing so that we could show off the internals during a presentation. Otherwise, the space bar fit perfectly, which I was anxious about, and all the switches were placed on. Testing is going well and a demo is coming soon.

Jackson has made a demo for the product and this can be seen below.

https://youtu.be/CSIN_KwBNN4