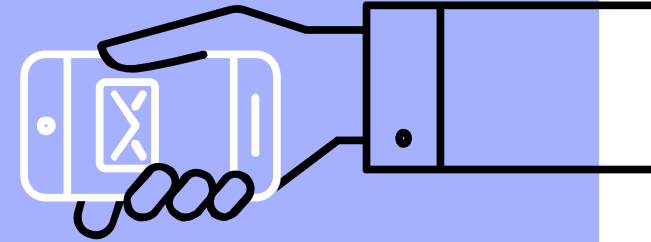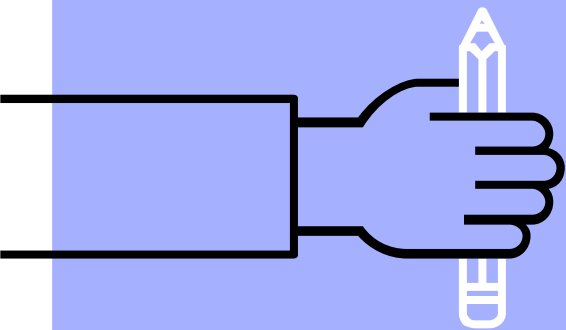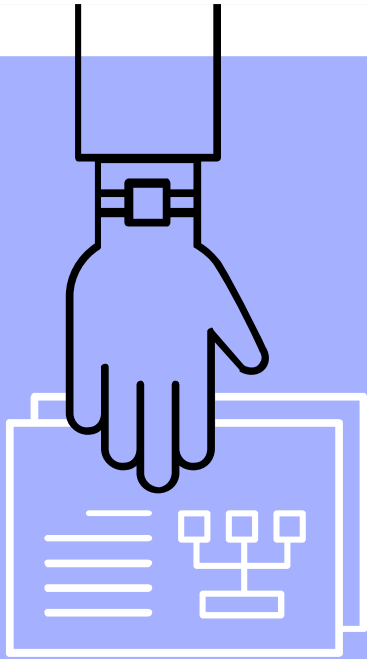# MOTOR IMPAIRMENT KEYBOARD (MIKey)
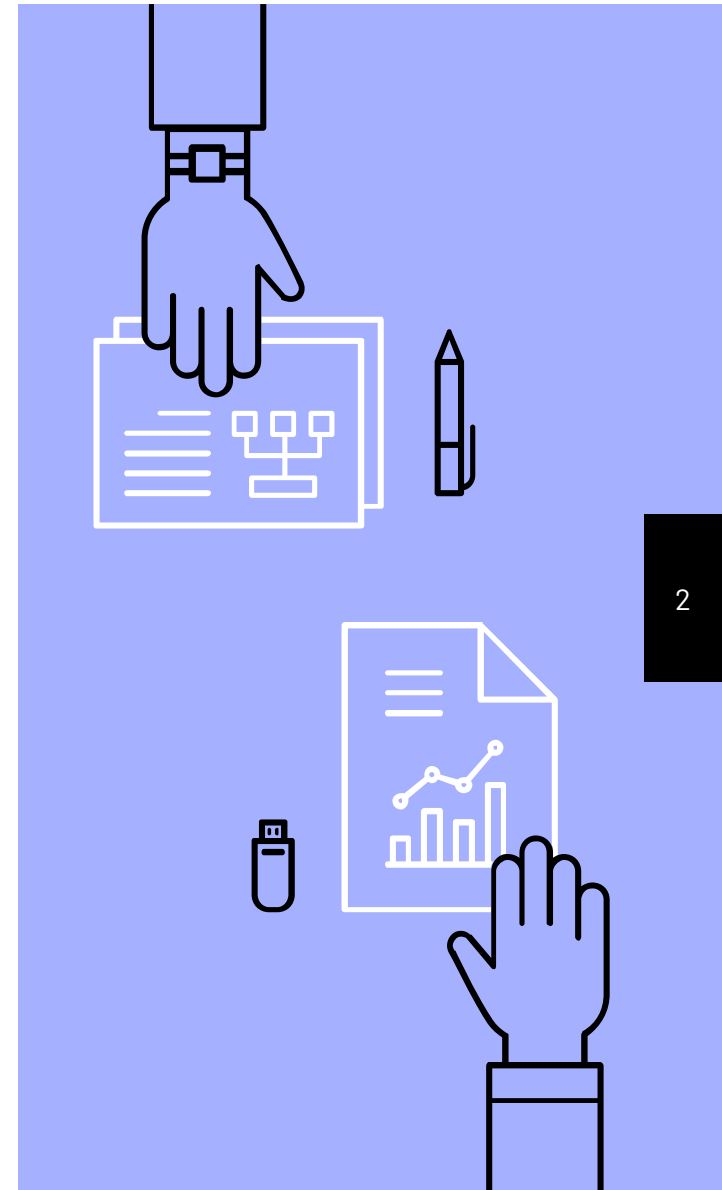
PROPOSAL PRESENTATION
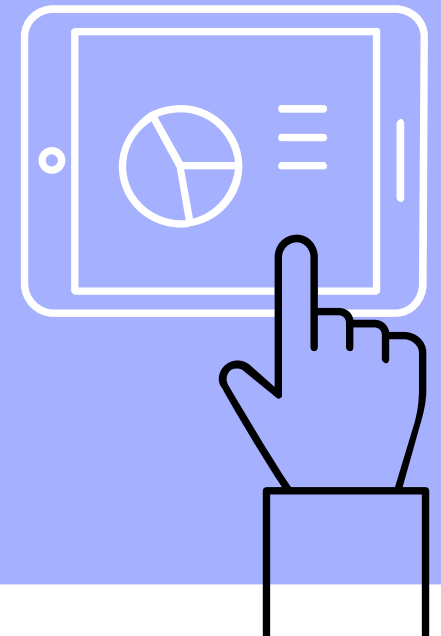
AGENDA

- ▷ Problem Background/Needs/Goal & Objectives
- ▷ Literature Review & Evaluation of Alternative Solutions
- ▷ Design Constraints and Feasibility
- ▷ Proposed Design
- ▷ Design Validation Approach
- ▷ Societal, Safety, and Environmental Analysis
- ▷ Economic Analysis & Budget
- ▷ Schedule of Tasks/Management & Teamwork Overview

1.
Problem Background, Needs, and Objectives

What are we trying to solve?
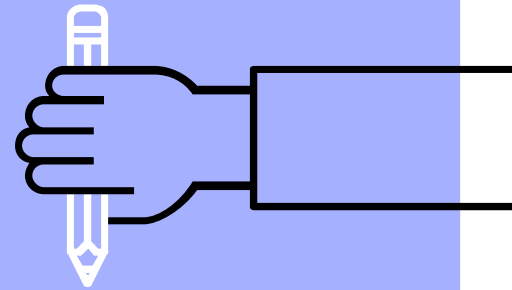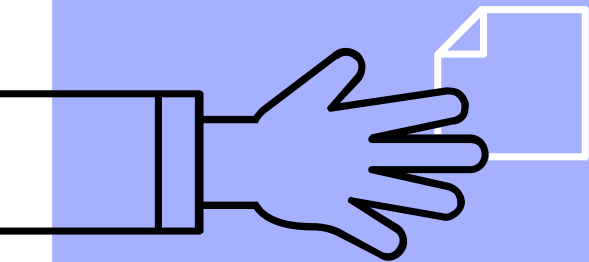
ABOUT PARKINSON'S
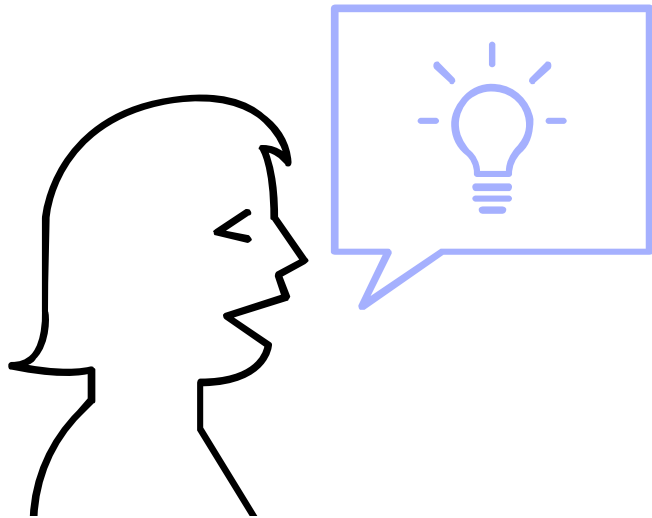
1,000,000+
Parkinson's patients in US [1]

60
Average age of diagnosis [1]

$2,500/year
Average cost of medication [1]

NEEDS STATEMENT:

There exists a need for a simple assistive technology that provides better computer hardware accessibility to individuals with Parkinson's disease or similar limited motor function capability.
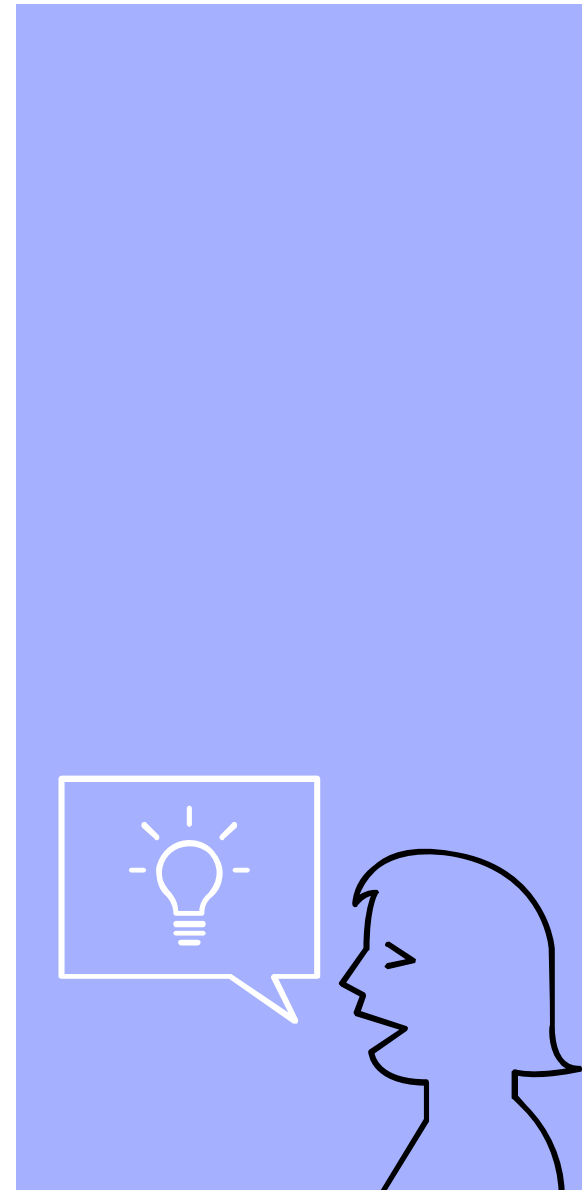
GOAL & OBJECTIVES

Goal

- Make the typing experience easier for people with motor function impairments

Objectives

- Cost-effective

- Accessible

- Should improve ability to interact with a computer

- Easy to learn

- Customizable

- Should not compromise capabilities of a normal keyboard

2.
Literature Review & Alternate Solutions
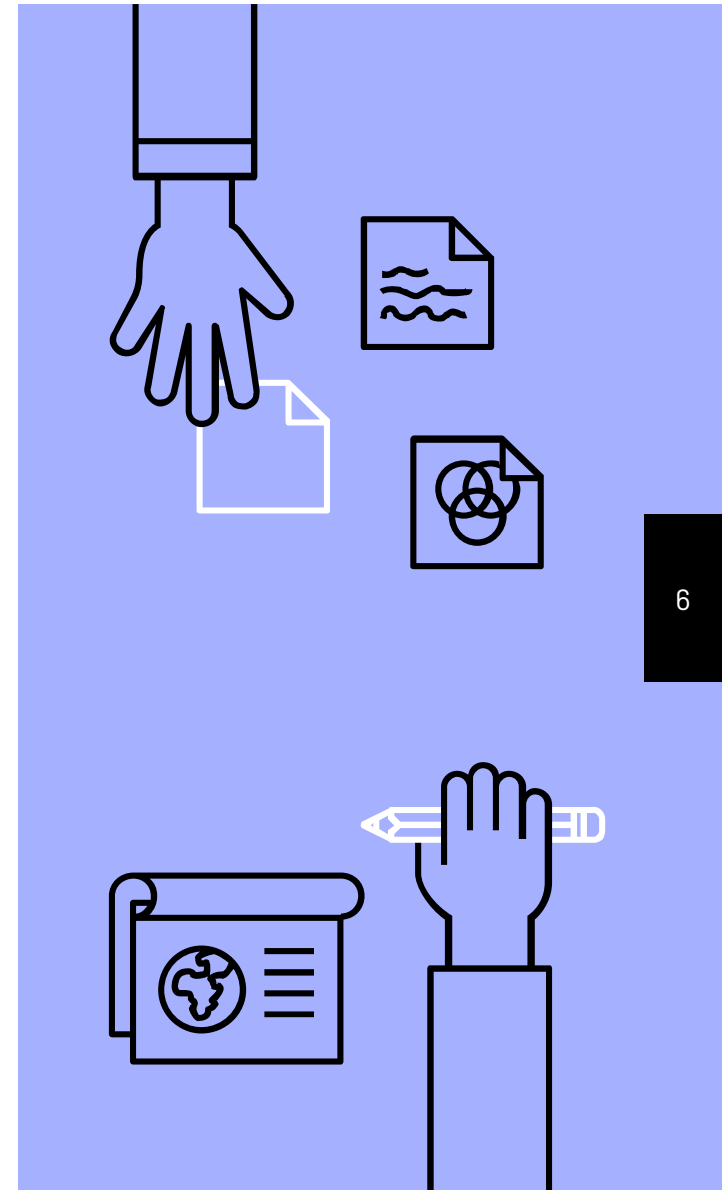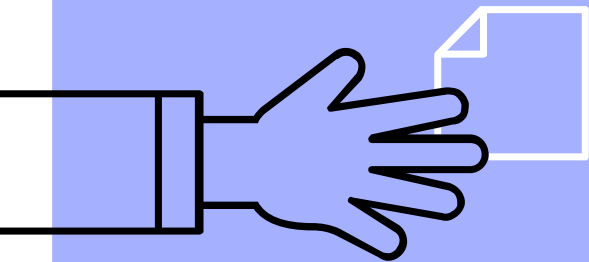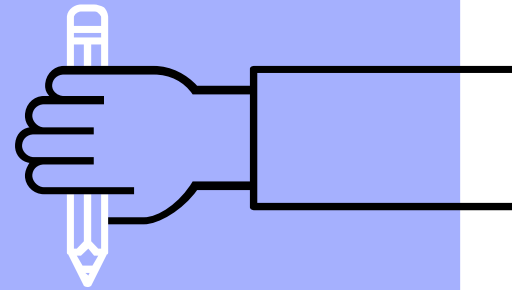
What solutions already exist?

EXISTING TECHNOLOGIES

Eye-Tracking

Severe motor impairment

Requires additional hardware peripherals

Expensive

Oversized Keyboard

Moderate motor impairment

Little to no additional software

Low portability

Auto-Completion

General user base

Helpful but incomplete

Software-centric solution

Speech-to-Text

Severe motor impairment

Already supported in many devices

Does not cater to our target audience

Inset Keys

Moderate motor impairment

Inflexible, not customizable

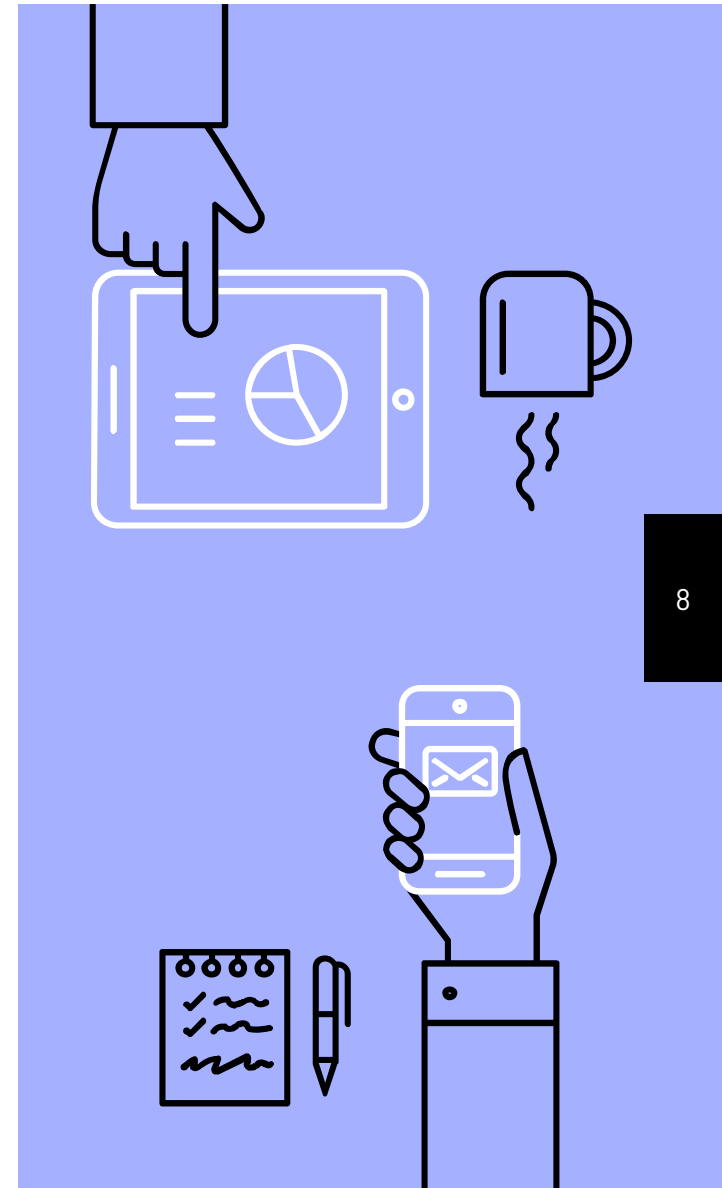Completely inset or as a cover

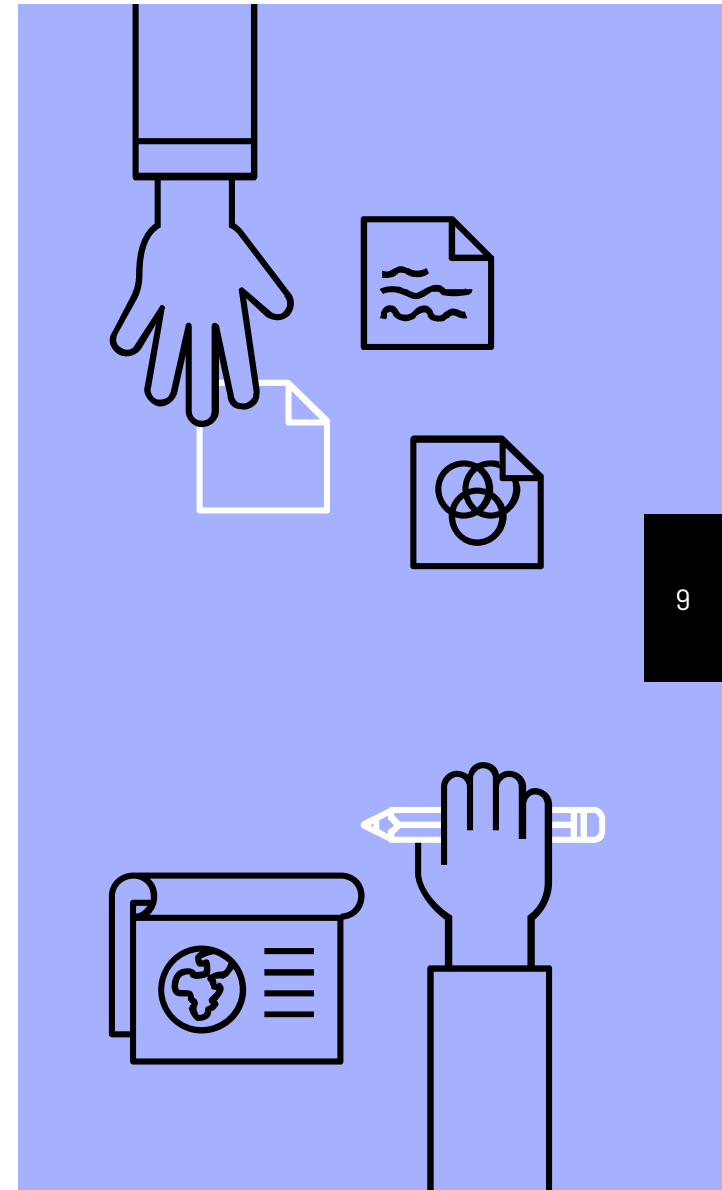### Customized Macros

General user base

Helpful for specific actions

Not as useful for typing strings

KEY TAKEAWAYS

- Devices for those with disabilities should be customizable and easy to deconstruct

- Existing devices are too expensive for most users

- Auto-complete has significant potential to assist those with disabilities, but lacks hardware integration

ALTERNATIVE SOLUTIONS

Eye-tracking with auto-complete

- ➢ Increased efficiency
- ➢ High barrier to entry
- ➢ Learning and adjustment period
- ➢ Not built for target audience (limited motor impairment)

Physical Keyboard with Speech-to-Text

- ➢ Combination of limited and severe motor impairment solution
- ➢ Already exists as speech-to-text, no market gap
- ➢ Potential stretch goal
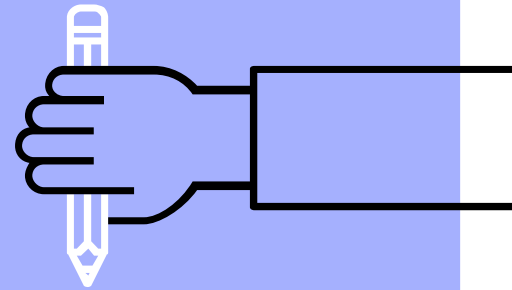
Touchscreen Display with Haptic Motors

- ➢ Provides software flexibility along with haptic feedback
- ➢ "Keys" on the screen are completely customizable
- ➢ Theoretical solution
- ➢ Cost & time constraints
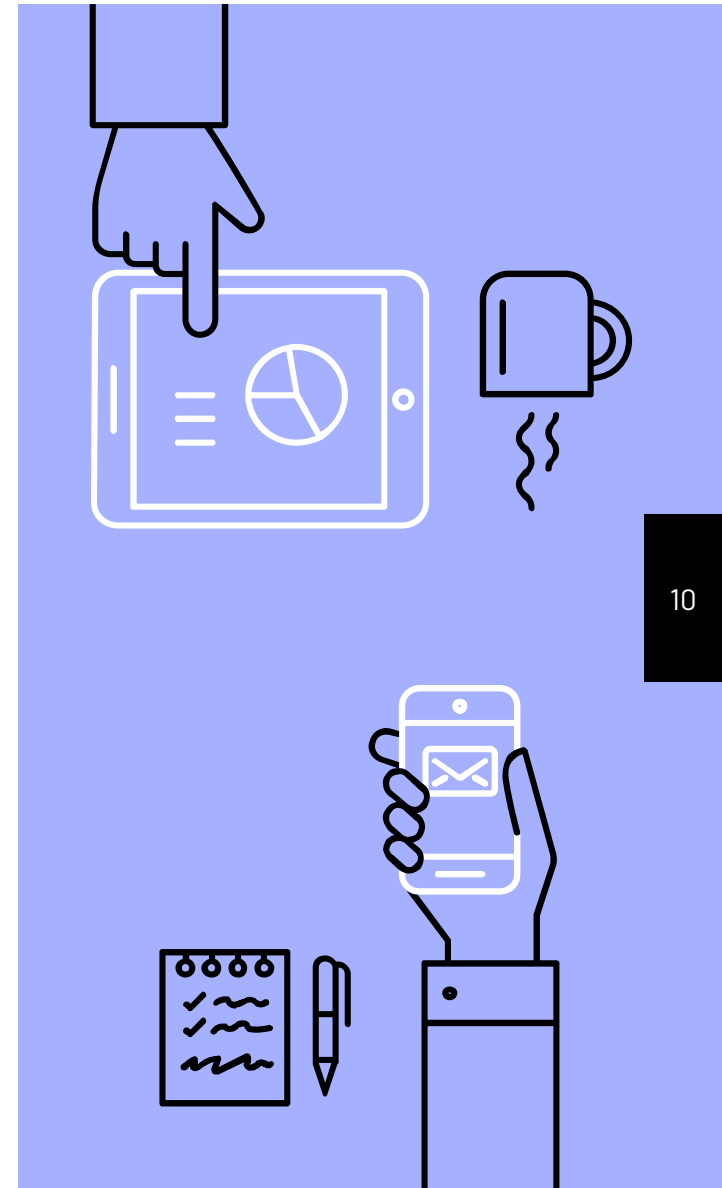
3.
Design Constraints and Feasibility

What is possible give the limitations?
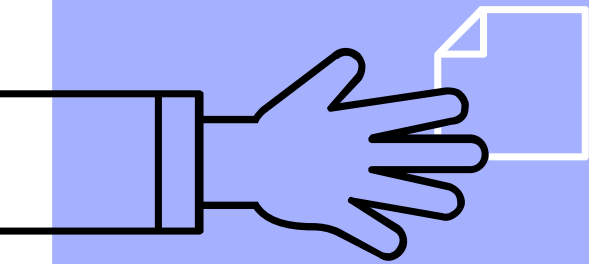
DESIGN CONSTRAINTS

- Less than $200 to construct prototype
- Easy for users to setup
- Portable
- Compatible with Windows, Mac, and Linux
- USB-A output
- Standard QWERTY format
- 10 weeks of development

12
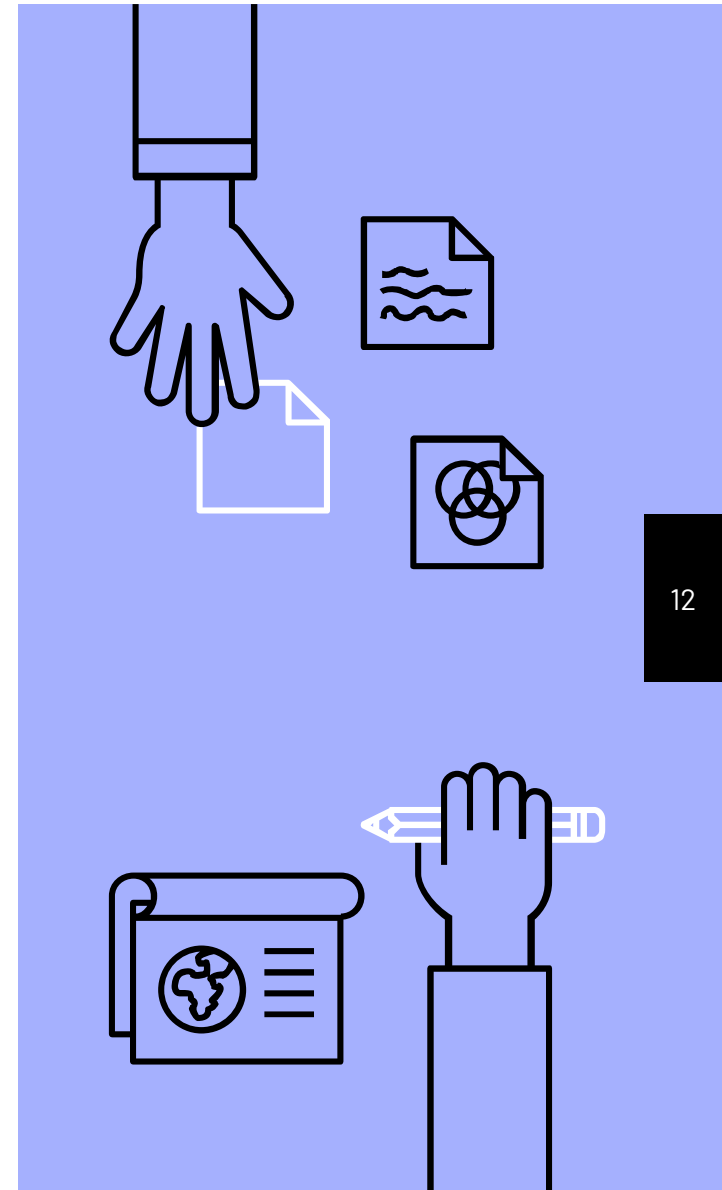
FEASIBILITY

- Looking at existing products and technologies, this solution seems viable

- Biggest challenge will be development time

- Might be difficult to keep cost low with supply chain issues
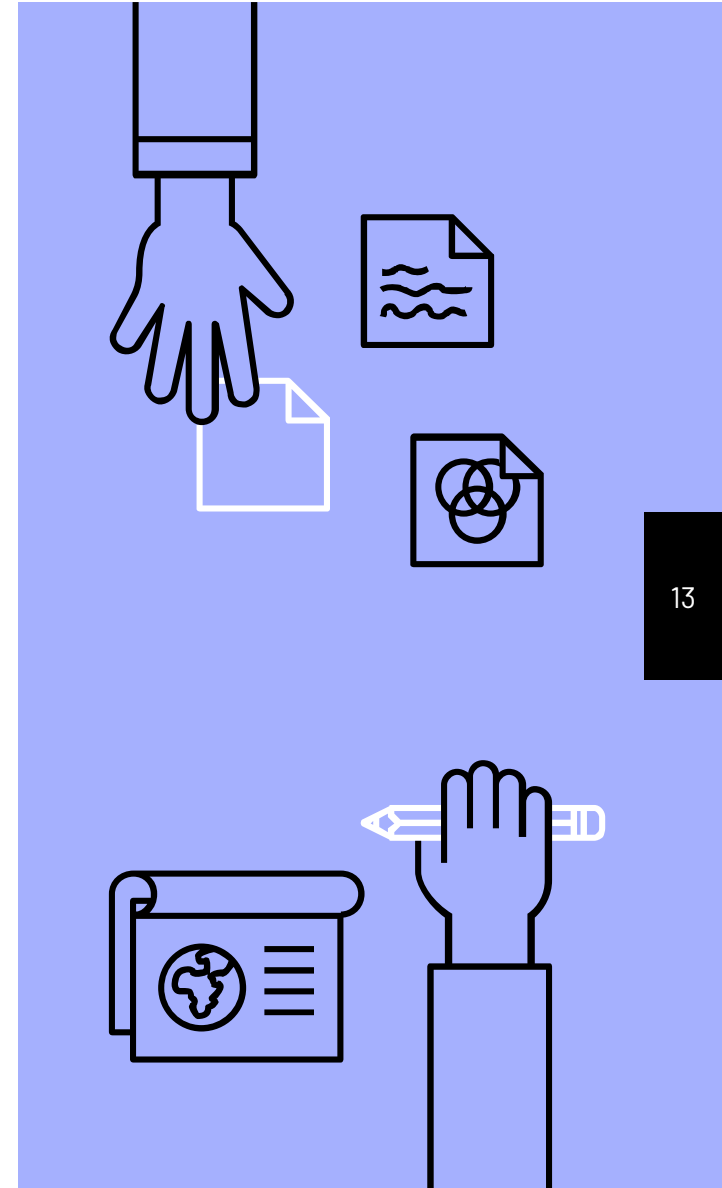
4.
Proposed
Design

What is our solution?
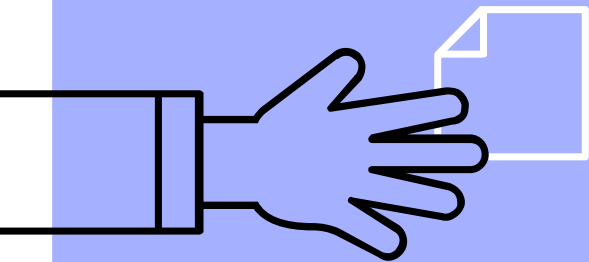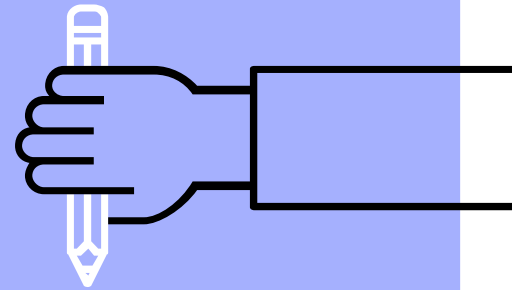
PRODUCT DESIGN (OVERVIEW)

- Input taken through key presses
- Output through USB-A to computer
- Main Components:
  - Physical keyboard/PCB
  - Microprocessor
  - LCD display

Motor Impairment Keyboard
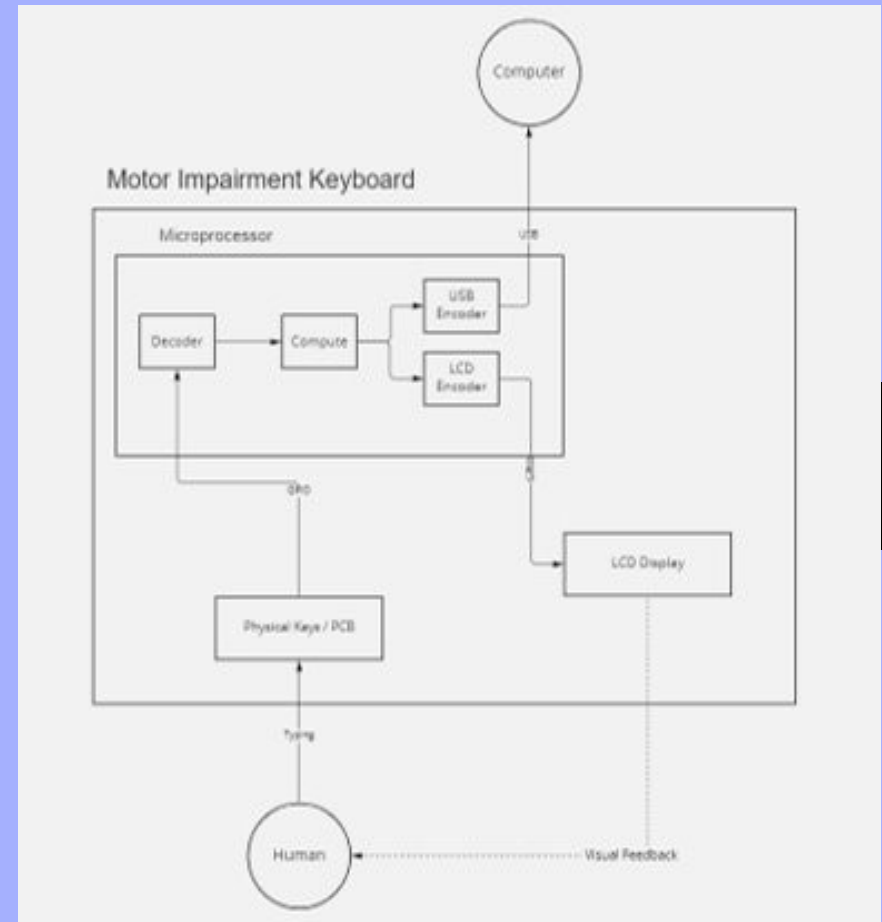
PROPOSED DESIGN (HARDWARE)

- Physical Keyboard
  - Custom QWERTY grid layout
  - Oversized, sunken, mechanical keys with slim key caps
  - Three macros for auto-complete selection
  - Key presses read in by microprocessor through GPIO pins

Motor Impairment Keyboard

Computer

Microprocessor

USB Encoder

Decoder → Compute

LCD Encoder

LCD Display

Physical Keys / PCB

Human — Visual Feedback
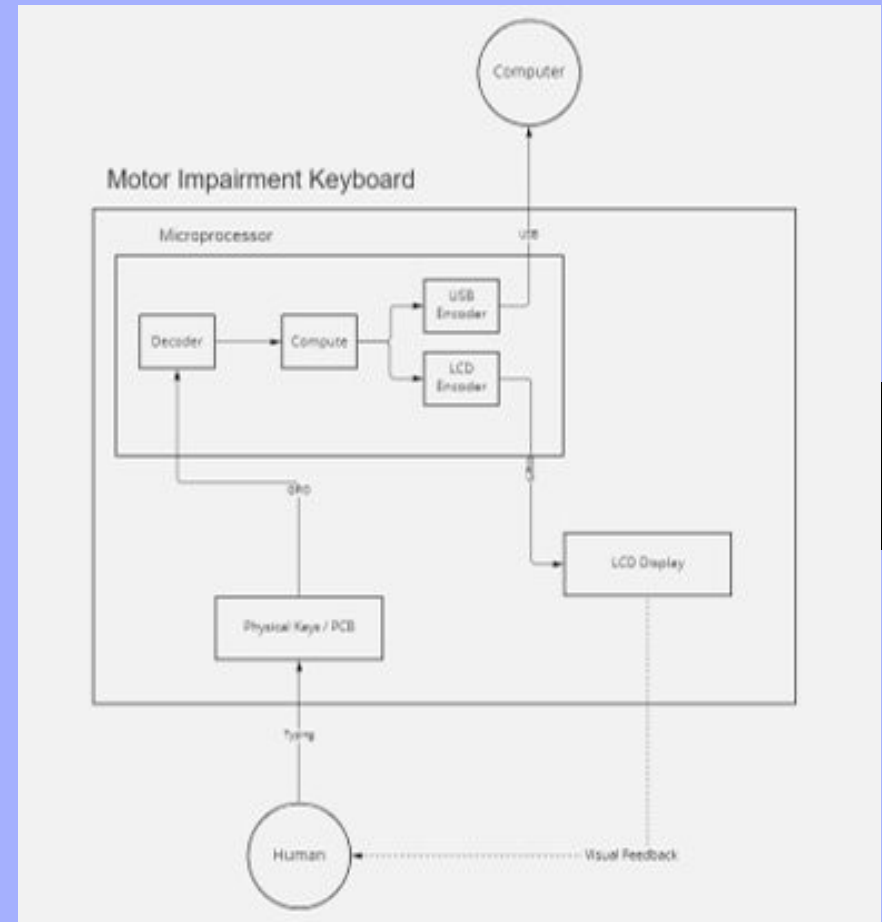
PROPOSED DESIGN (HARDWARE - CONT.)

- Design Implementation
  - Housing and keycaps designed in CAD
  - Printed using PLA on low-fidelity 3D printers
  - Custom PCB
  - Microprocessor and switches are off-the-shelf
  - LCD Display

Motor Impairment Keyboard
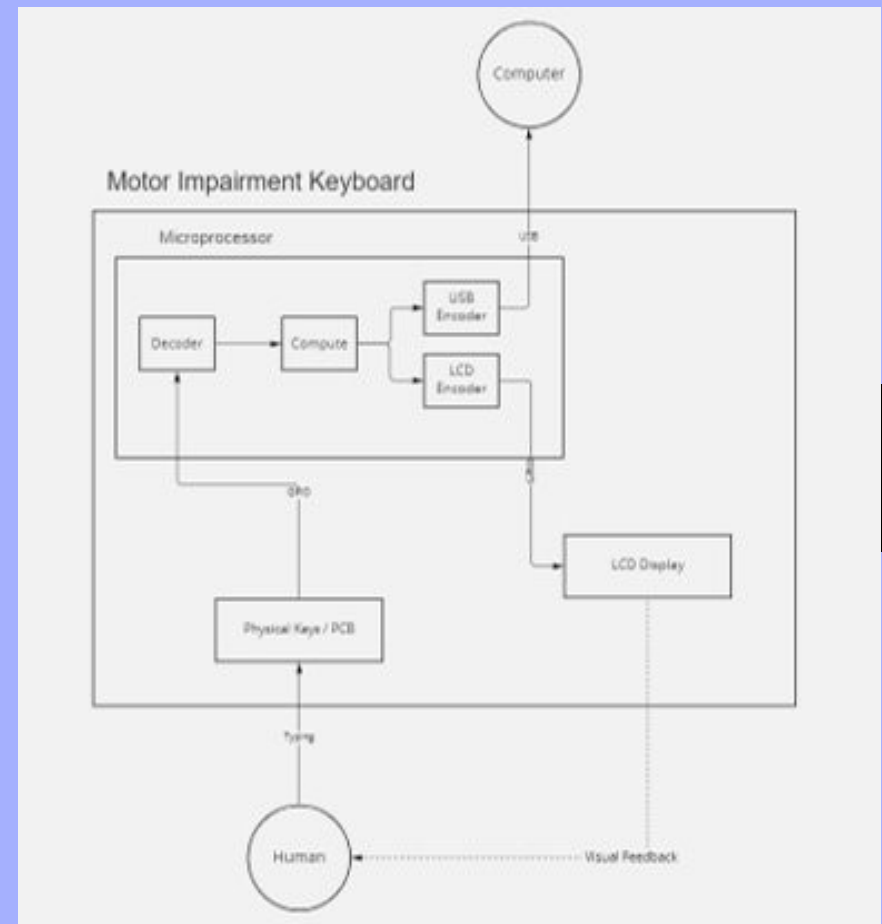
PROPOSED DESIGN (SOFTWARE)

- Language of Choice C++ (to allow for OOP and low-level access)

- Hardware signals are mapped to keys in software

- Auto-complete algorithm is centered around a Trie data structure

- Key presses are sent through USB protocol
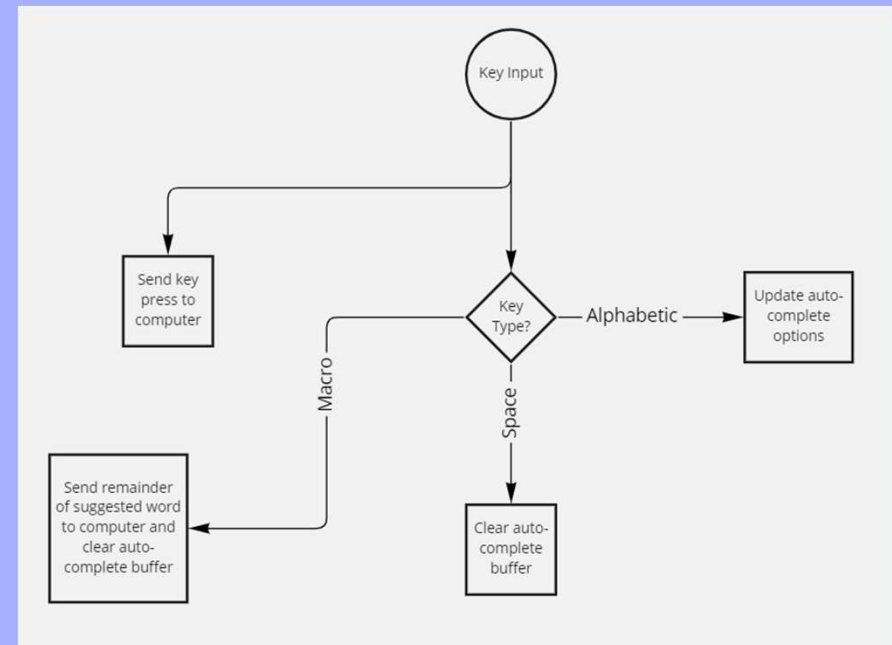
PROPOSED DESIGN (SOFTWARE – CONT.)

- Trie is traversed when alphabetic character is typed
- Top three candidates are selected and output to LCD
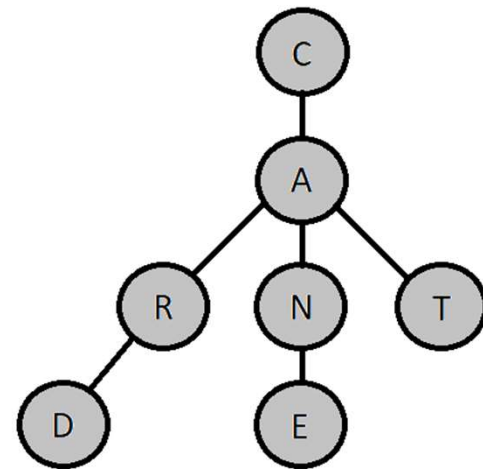
5.
Design
Validation

Does our product work?
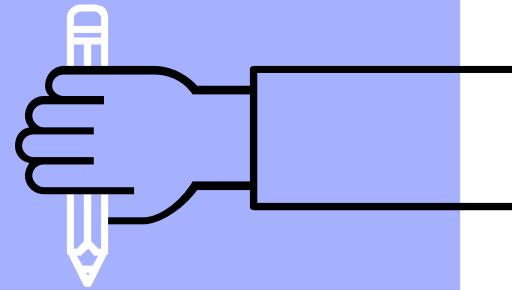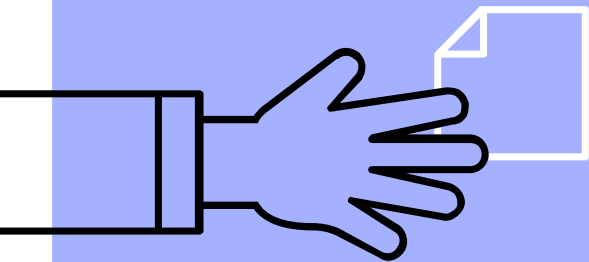
Agile development driven by user feedback and studies

Agile Lifecycle

01

02

03

User Feedback

Design Changes

Prototype Development
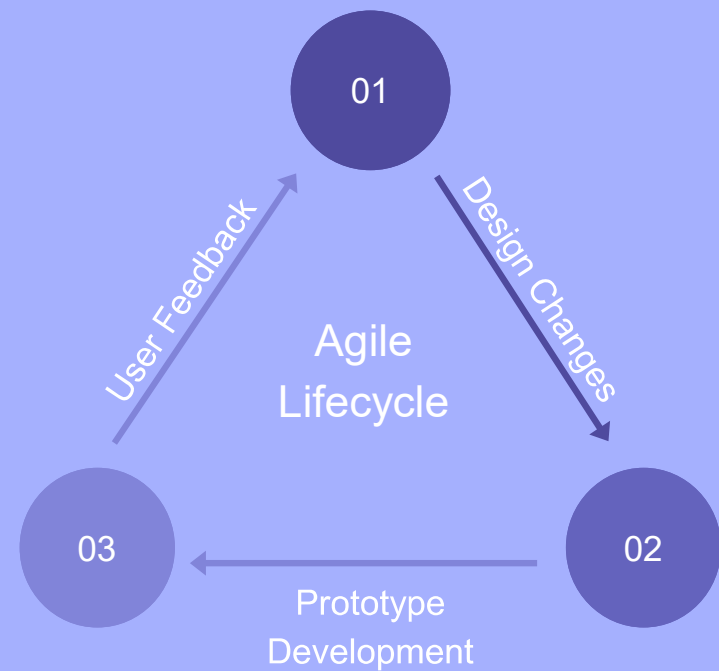
6.
Societal, Safety, and Environmental Analysis

How will we impact the world?
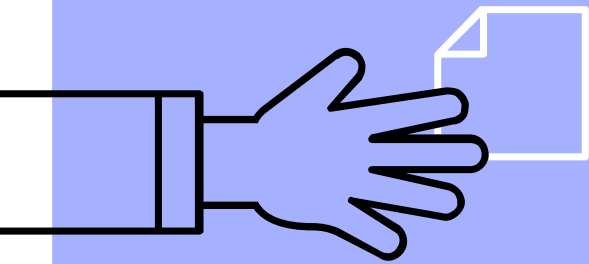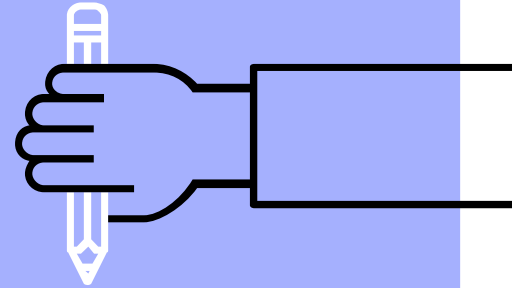
IMPACT ON SOCIETY, SAFETY, AND THE ENVIRONMENT
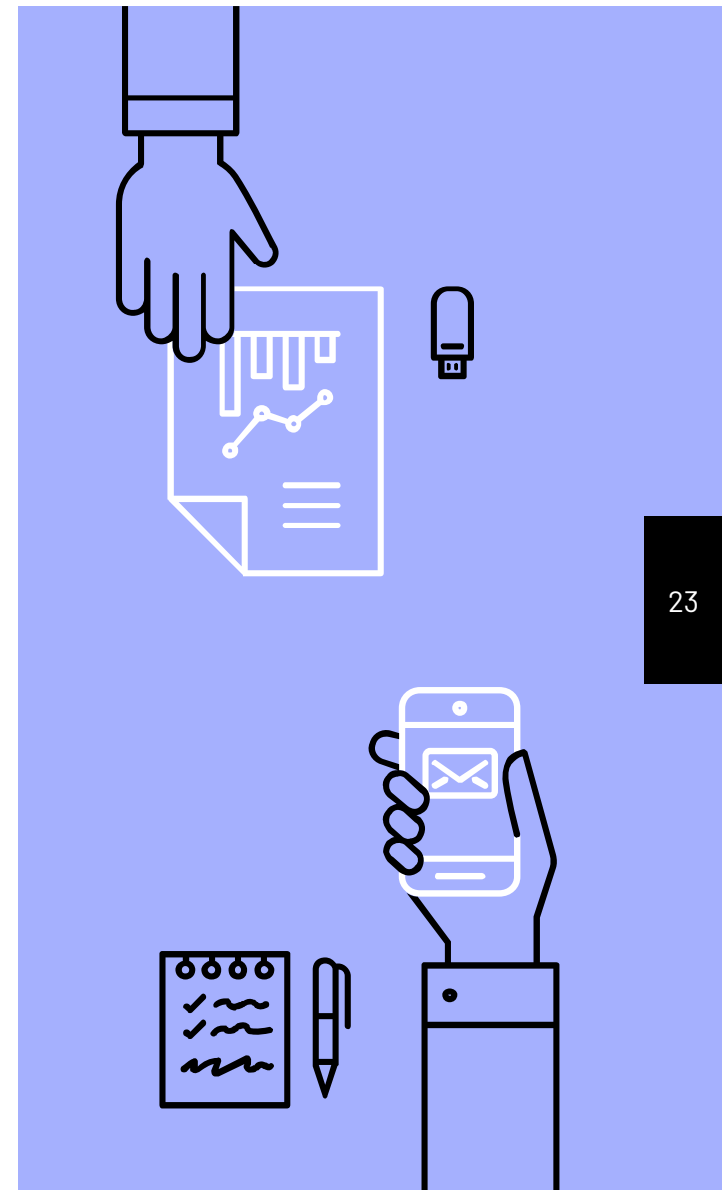
7.
Economic Analysis & Budget

What are the costs?
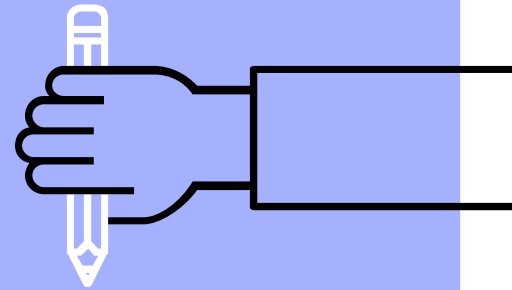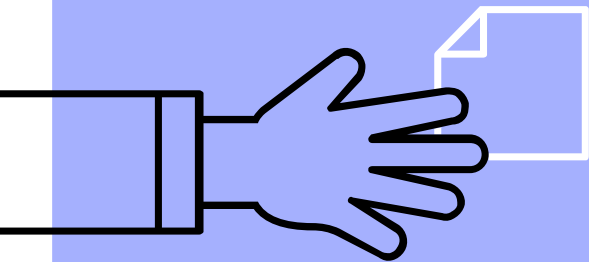
MARKET STATE

$7.93 billion

Expected market growth for assistive technology from 2020 to 2025 [2]

34% Growth

Market growth contributed by North America [2]

60,000/year

Americans diagnosed with Parkinson's [1]

TENTATIVE BUDGET

Product	Cost ($)
Raspberry Pi 0	79.99
3 LCD Displays	15.99
Keyboard Switches	47.98
O-rings	6.99
PLA Filament	18.99
PCB Material	90

TOTAL COST:
$260 USD
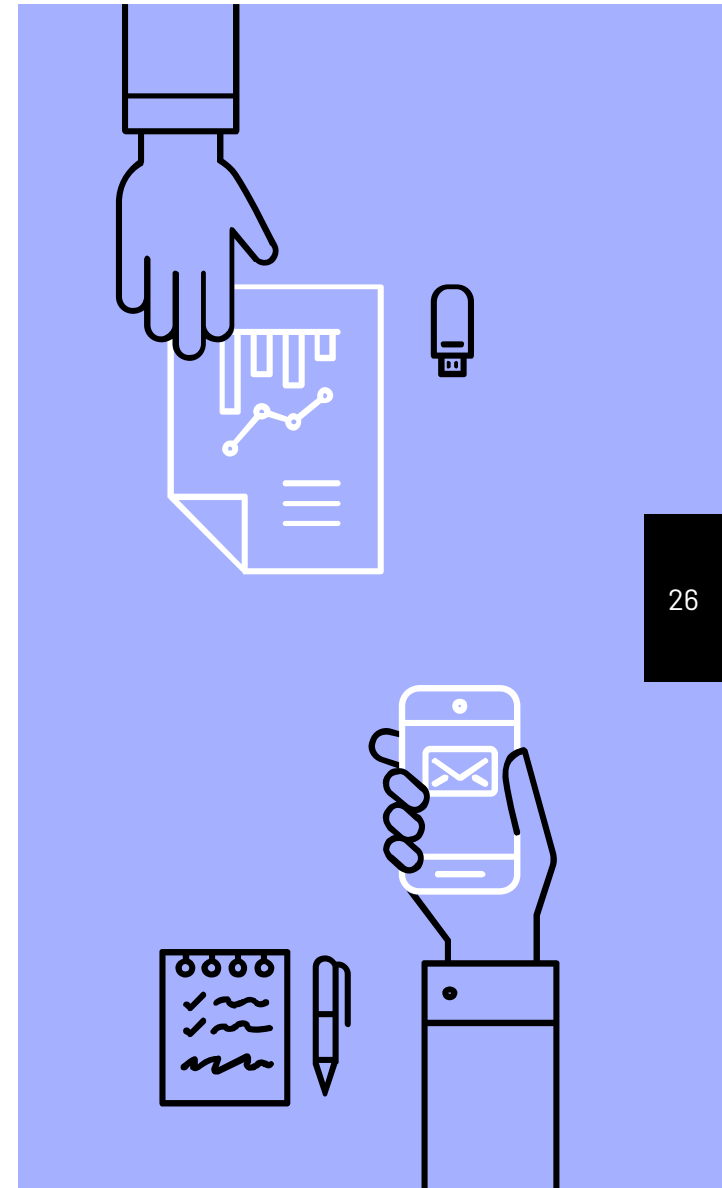
8.
Schedule of Tasks & Teamwork Overview

What is our timeline?

GANTT CHART

	Week 1							Week 2						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Create Parts List	■													
Order Components		■	■	■										
Raw input from GPIO									■	■	■	■	■	■
Design PCB				■	■	■	■		■	■	■	■	■	■
Research Key Actuation		■												
Research: Key Sizing		■												
Research: Auto-Complete Algorithms	■	■												
Calculate memory for storage			■											
Download dictionaries				■										
Trie Constructor & Function					■	■	■	■	■	■	■			
Key Responses(Alphabetic, Space)											■	■	■	■

TIMELINE

Research technologies, algorithms, neurological disabilities

Order Components

Begin building digital circuitry

3D modeling & printing

User testing 7 feedback

Finalize Product

SPRINT 1

SPRINT 2

SPRINT 3

SPRINT 4 & 5

Set up development environment & implement software functions

Integrate firmware

Hardware and software integration

Assembling housing

Debug final prototype & make adjustments

Implement user feedback

BREAKDOWN OF ROLES

Technical Role	Team Member(s)
Hardware	Abhishek, Andrew, Max
Software	Connie, Brittany, Jackson
3D Modeling	Andrew & Jackson

Non-Technical Role	Team Member(s)
Project Manager/SCRUM Masters	Andrew, Brittany, Jackson
Financials & Marketing	Abhishek
Technical Reports/Meeting Notes	Connie & Max
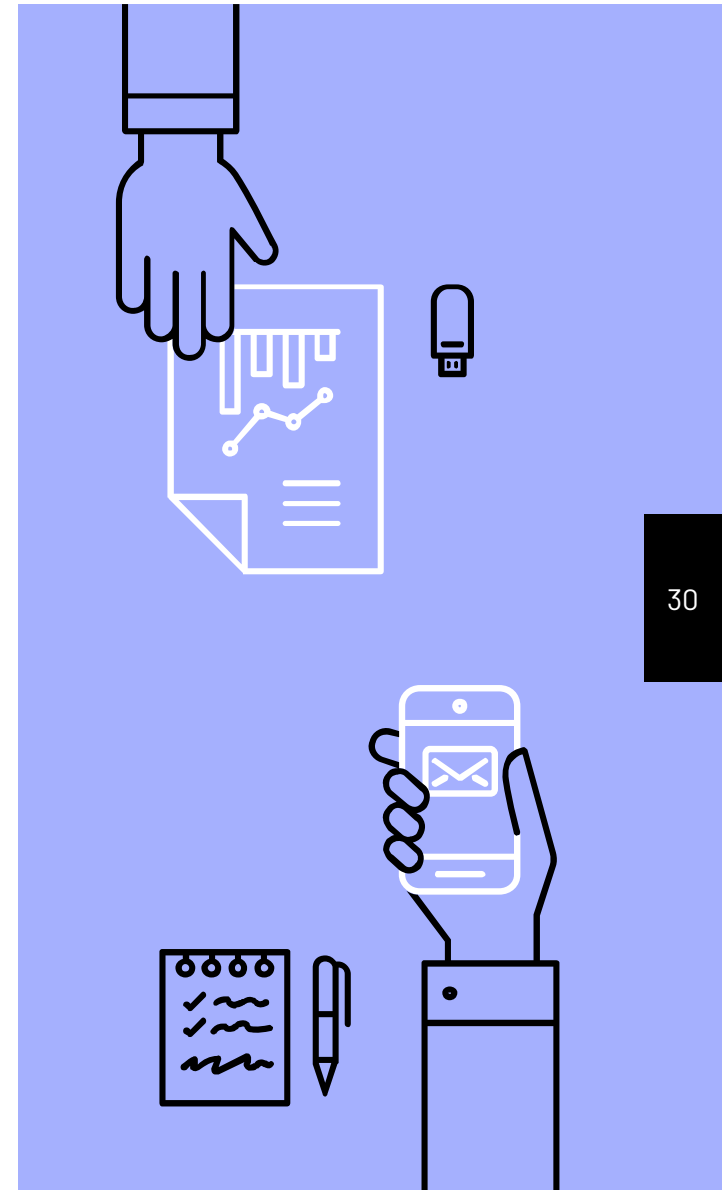
REFERENCES

[1] "Statistics," *Parkinson's Foundation*. [Online]. Available:
https://www.parkinson.org/understanding-parkinsons/statistics.
[Accessed: 19-Sep-2022].

[2] Technavio, "Assistive technology market to witness USD 7.93 bn
growth: Driven by rising cases of orthopedic conditions:
Technavio," *Assistive Technology Market to witness USD 7.93 Bn
growth | Driven by rising cases of orthopedic conditions | Technavio*,
24-Jun-2022. [Online]. Available:
https://www.prnewswire.com/news-releases/assistive-
technology-market-to-witness-usd-7-93-bn-growth--driven-by-
rising-cases-of-orthopedic-conditions--technavio-
301573863.html#:~:text=NEW%20YORK%2C%20June%2024%2C
%202022,significant%20growth%20in%20North%20America.
[Accessed: 19-Sep-2022].

THANKS!

Any questions?