# Accessibility Pi/O Design Review

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# **Use Case/Application**

- Keyboard & mouse accessibility
- Disabilities, such as cerebral palsy
  - Most common form is spastic hemiplegia
  - $\circ$   $\,$   $\,$  Can use one arm and one leg  $\,$
- Solutions are expensive and not open source
  - Or cheaper and very generic
- Limited keyboard/mouse combination options
- Designing solution covers software and circuitry



### **Quantitative Use-Case Requirements**

- 30 WPM
- 74 characters supported
  - 26 letters (upper and lowercase), 10 digits, space, enter, punctuation at minimum
  - desired punctuation: ():.,!?"-'
- Reduce Rate of Common Errors
- Below \$200 to reproduce
- Comfort metrics based on Survey

# Solution Approach:

- Software & Hardware solutions to common errors
  - Toggle Switches for key combinations
  - Software recognizing miss-inputs
- Ergonomics
  - Design reasonable size
  - Custom key layout for use of one hand



# System Specification / Block Diagram

- Linear Key Switches
  - easiest and most comfortable to press
- Custom Matrix Scanning keyboard
  - allows us to make the most use out of limited input
- ~20mm keycaps, about 30% bigger than usual
  - more comfortable with one hand while not being unwieldy
- Mouse foot control
  - allows simultaneous input
  - Straps to foot like a sandal, probably velcro
- Self-Deactivating Toggle Switches

# **Block Diagram**



# **Implementation Plan**

- Bought items
  - Raspberry pi
  - Linear key switches
- Designing and developing
  - Keyboard PCB
  - Keycaps and housing
  - Mouse Housing
- Libraries Used
  - gpiozero
- Assembling
  - Foot Controlled Mouse

#### Test, Verification and Validation

#### • Comfort & Use Survey

- testing WPM
  - On one simple text and one complicated text
- Gauge whether certain key presses are difficult to perform
- 7 or higher average positive responses out of 10
- WPM minimum of 30
- No or few typing errors

#### • Rate of Common Errors

- Long key press error as priority
- Additional Key errors
- Missing key errors

## Schedule

					2/22			3/22			4/22				
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ECE Design Experience Tea	start	end	Oh	0%											
Design Planning	02/07/22	03/02/22	0h	0%											
Project Proposal	02/07	02/07	0	0%	<b></b>										
Physical Layout Sketching	02/07	02/11	0	0%	Physical L										
Part Selection & Implementation	02/12	02/16	0	0%	Part Select										
Design Review Slides	02/14	02/20	0	0%	Design	Review									
Design Presentation	02/21	02/21	0	0%											
Design Report	02/22	03/01	0	0%		De	sign Report								
Design Report Deadline	03/02	03/02	0	0%			4								
Design Implementation	02/27/22	04/08/22	Oh	0%				_		_					
Keyboard Software	02/27/22	03/18/22	Oh	0%				_							
PC Interface Software	02/27	03/18	0	0%			PC Interfac	e Software							
Keyboard Interface Software	02/27	03/18	0	0%			Keyboard I	nterface Sol	ftware						
Interim Demo	04/04	04/04	0	0%								•			
Keyboard Hardware	02/27/22	03/27/22	Oh	0%											
Keyboard Circuit Layout	02/27	03/18	0	0%			Keyboard (	Circuit Layou	ut	1					
Keyboard Mount Design	02/27	03/18	0	0%			Keyboard M	Mount Desig	In						
Keyboard Mounting	03/19	03/27	0	0%					E	eyboard Mount	ting				
Mouse Control Software	03/12	04/01	0	0%					Mouse Control S	oftware					
Mouse Circuit Layout	03/12	03/27	0	0%					Mouse Circuit La	yout	h				
Mouse Mount Design	03/12	03/27	0	0%					Mouse Mount De	esign	-				
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Integration	04/10	04/24	0	0%									Integration		
Final Stretch	04/25/22	04/25/22	0h	0%											
Final Presentation	04/25	04/25	0	0%											٥

# **Current Progress**

- Ahead of Schedule on Hardware
- Need to stay flexible
  - may redesign after meeting with HCI Professor
- Preliminary Board Schematic
- Interface with Pi





TR01 (1) (2) TR00 TR03 (3) (4) TR02

#### **Project Management**

- Software JT, CA
  - Receiving key signals from I/O and sending to external computer via USB
- Designing hardware
  - Keyboard circuit design JC, JT
  - Mount for Keyboard CA
  - Mouse circuit design -JC, JT
  - Mount for Mouse CA
- Build and Integration Everyone

# **Final Thoughts**

- Progress is on pace
  - Important to work ahead on the early stages
  - May need redesigns in the future
- Next Steps
  - Meet with HCI Professor
  - Emulate Keyboard on Pi
  - Breadboard prototype for testing
  - Preliminary Layout PCB for keyboard
- Obstacles
  - need flexibility in case design changes