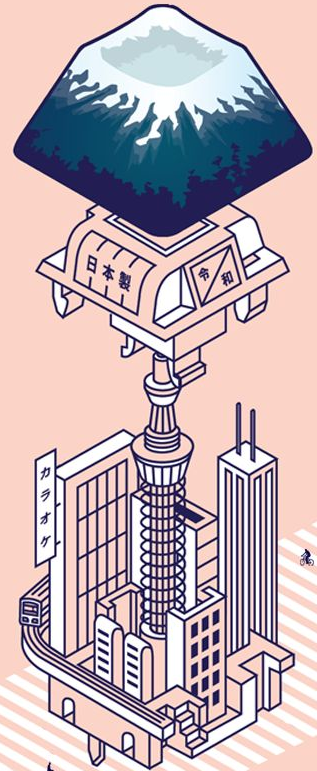


FP(Key)A

Ben Sun, Zhejia Yang,
Korene Tu



Use Case

A keyboard that's flexible to any layout imaginable!

- For testing different keyboard layouts without needing to buy multiple keyboards
- For customizing your layout on the fly for your different uses. Change from your gaming setup to your work setup without buying 2 keyboards.
- Areas: Software Systems, Circuits, Hardware Systems

Use Case Requirements(1)

Low Latency	<50 ms	Industry standard for wireless keyboards for gaming
Battery Life	>2 Day	To allow professionals and gamers to efficiently pull all nighters without interruption if needed.
Cheaper than buying multiple keyboards	<\$300	the average price of a decent mechanical keyboard is ~\$200s. \$300 is less than buying 2.
Keyboard Layout Freedom	n/a	Different uses and softwares require different keyboard layout.

Use Case Requirements(2)

Key Size	22mm ³ /key	19.5 + 2mm (std key + spacing). Can't be taller than cube to prevent wobble.
Min Adjustability	1mm	Typical minimum key stagger is ~6mm. Want finer, measurable control.
Max Avg. Finger Travel Distance	4cm	Finger should never have to move more than 2 keys on average
Portability	<1lbs	Bringing the keyboard wherever will increase the useability and the different situations the keyboard can encounter
N-Key Rollover	6 Keys	Industry Standard. For 2 player games and keyboard shortcuts.

Technical Challenges (Part 1)

- Sizing
 - Small vertical space for a PCB + power solution
- Communication protocol
 - Low power, low latency required + multiple device connectivity
- Power
 - Ease of recharge and long battery life needed
- Programmability
 - Easily programmable on the fly and remember keymaps across devices

Technical Challenges (Part 2)

- Microcontroller PCB Turnaround Time
 - Estimate to be 3 weeks
- Testing/Integrating multiple components together
 - 17 microcontrollers(16 keys + main microcontroller) to integrate together
- Configurator UI
 - User can easily program each key separately

Solution Approach (Part 1)

- Bluetooth Low Energy Protocol (BLE) between keys and microcontroller using premade boards
 - Minimizes power use for each key
- Bluetooth Low Energy from microcontroller to PC
 - Minimizes latency from PC to central controller
- Main Microcontroller which stores configuration across devices
 - Ensures portability of solution
- Desktop application for programming
 - Allows user to customize keyboard function easily

Solution Approach (Part 2)

- Keys on top of a baseplate on top of velcro base
 - Wider base with PCB for stability while typing
- Resonant Wireless Charging
 - Can charge without direct alignment
- LIPO battery attached to each key as power supply
 - Rechargeable and small enough to fit inside housing
- Seeed XIAO BLE in each key
 - Provides BLE functionality, programmability, and recharging functions

Testing, Verification (Part 1)

Portability (Weight)

- Using an accurate scale

Portability (Size)

- Base plate size measured with ruler

Cost

- Buy adding up the cost of the parts and cost of assembly (measured in time for assembly * \$30/hr)

Battery

- Measure continued usage of keys for set amount of time and calculate how long for battery to drain

Testing, Verification (Part 2)

Key Size	Measurable with calipers
Min Adjustability	Measurable with calipers
Max Avg. Finger Travel Distance	Film user typing on board and measure distance used in between
Latency	Film user typing with slow motion video and count frames per second
N-Key Rollover	Pressing multiple keys and measuring with online tools

Tasks and Division of Labor

Design Main Microcontroller

Korene

Magnetic Charging Station

Zhejia and Korene

Bluetooth Low Energy Implementation

Ben

Software application

Zhejia

3D Housing Design

Ben and Korene

Schedule (Gantt Chart)

Project Start Date: 2/6/2023 (Monday) Display Week: 1							Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Week 8																																									
Project Manager: ECE Capstone							6 Feb 2023		13 Feb 2023		20 Feb 2023		27 Feb 2023		6 Mar 2023		13 Mar 2023		20 Mar 2023		27 Mar 2023																																									
WBS	Task	Lead	Start	End	Days	% Done	Work Days	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su						
	Bluetooth Low Energy		Mon 2/06/23	Sun 3/19/23	42		30																																																							
.1	Ordering BLE Boards	Ben	Mon 2/06/23	Tue 2/07/23	2	0%	2																																																							
.2	Research into BLE programming/protocol	Ben	Mon 2/06/23	Sun 2/12/23	7	0%	5																																																							
.3	Sending keypress data over BLE	Ben	Mon 2/13/23	Sun 2/19/23	7	0%	5																																																							
.4	Single key interfacing with controller	Ben	Mon 2/20/23	Sun 2/26/23	7	0%	5																																																							
.5	Multiple key interfacing with controller	Ben	Mon 2/27/23	Sun 3/05/23	7	0%	5																																																							
.6	Latency and Power optimizations	Ben	Mon 3/06/23	Sun 3/12/23	7	0%	5																																																							
.7	Slack	Ben	Mon 3/13/23	Sun 3/19/23	7	0%	5																																																							
1	Microcontrollers		Mon 2/06/23	Sat 4/29/23	83		60																																																							
1.1	Research to find footprints needed	Korene	Mon 2/06/23	Tue 2/07/23	2	0%	2																																																							
1.2	Bill of Materials	Korene	Tue 2/07/23	Thu 2/09/23	3	0%	3																																																							
1.3	Design and Layout of Microcontroller	Korene	Fri 2/10/23	Thu 2/16/23	7	0%	5																																																							
1.4	Slack	Korene	Fri 2/17/23	Thu 3/16/23	28	0%	5																																																							
1.5	Set up and Testing	Korene	Fri 3/17/23	Thu 3/23/23	7	0%	5																																																							
1.6	Correct and Order new Microcontroller	Korene	Fri 3/24/23	Mon 3/27/23	4	0%	2																																																							
2.6	Verification	Korene	Tue 4/25/23	Sat 4/29/23	5	0%	2																																																							
2.7	[Insert new rows above this one, then hide or delete this row]																																																													
3	Programming		Mon 2/13/23	Thu 3/30/23	46		34																																																							
3.1	Program Key Controller	Zhejia	Mon 2/13/23	Sun 2/19/23	7	0%	5																																																							
3.2	Set up Microcontroller (Bootload, flash	Zhejia	Fri 3/17/23	Thu 3/23/23	7	0%	5																																																							
3.3	BLE software for computer connection	Zhejia	Fri 3/24/23	Thu 3/30/23	7	0%	5																																																							
3.4	Design UI	Zhejia	Mon 2/20/23	Thu 2/23/23	4	0%	4																																																							
3.5	Write UI for Keyboard Customization	Zhejia	Fri 2/24/23	Thu 3/02/23	7	0%	5																																																							
3.6	Backend Configurations across Devices	Zhejia	Fri 3/03/23	Thu 3/09/23	7	0%	5																																																							
3.7	[Insert new rows above this one, then hide or delete this row]																																																													
4	Charging/Power		Mon 2/06/23	Mon 5/01/23	85		61																																																							
4.1	Research Resonant Charging/Proof of Con Z+K	Z+K	Mon 2/06/23	Sun 2/12/23	7	0%	5																																																							
4.2	Bill of Materials and Purchase	Z+K	Tue 2/07/23	Thu 2/09/23	3	0%	3																																																							
4.3	Implement Power to Keys	Z+K	Tue 2/14/23	Mon 2/20/23	7	0%	5																																																							
4.4	Charger Creation	Z+K	Tue 2/21/23	Mon 2/27/23	7	0%	5																																																							
4.5	Implement Power to Microcontroller	Z+K	Sat 3/18/23	Mon 3/20/23	3	0%	1																																																							
4.6	Testing	Z+K	Tue 3/21/23	Mon 3/27/23	7	0%	5																																																							
4.7	Testing Final Integration	Z+K	Tue 4/25/23	Mon 5/01/23	7	0%	5																																																							
4.8	[Insert new rows above this one, then hide or delete this row]																																																													
5	Enclosure/Housing		Thu 2/16/23	Fri 3/03/23	16		12																																																							
5.1	Confirm Measurement of Parts	B + K	Thu 2/16/23	Thu 2/16/23	1	0%	1																																																							
5.2	Design in CAD	B + K	Thu 2/16/23	Wed 2/22/23	7	0%	5																																																							
5.3	Preliminary Fitting of Parts	B + K	Thu 2/23/23	Fri 2/24/23	2	0%	2																																																							
5.4	Adjust and Reprint	B + K	Sat 2/25/23	Fri 3/03/23	7	0%	5																																																							
5.5	[Insert new rows above this one, then hide or delete this row]																																																													
6	Integration		Mon 3/13/23	Mon 5/01/23	50		36																																																							
6.1	Proof of Concepts Integration	ALL	Mon 3/13/23	Sun 3/19/23	7	0%	5																																																							
6.2	Final.	ALL	Tue 4/25/23	Mon 5/01/23	7	0%	5																																																							

MVP

A 3x3 macro keyboard with adjustable layout that has wired charging and is programmable with customized key bindings

Free the keys from the cat ->

