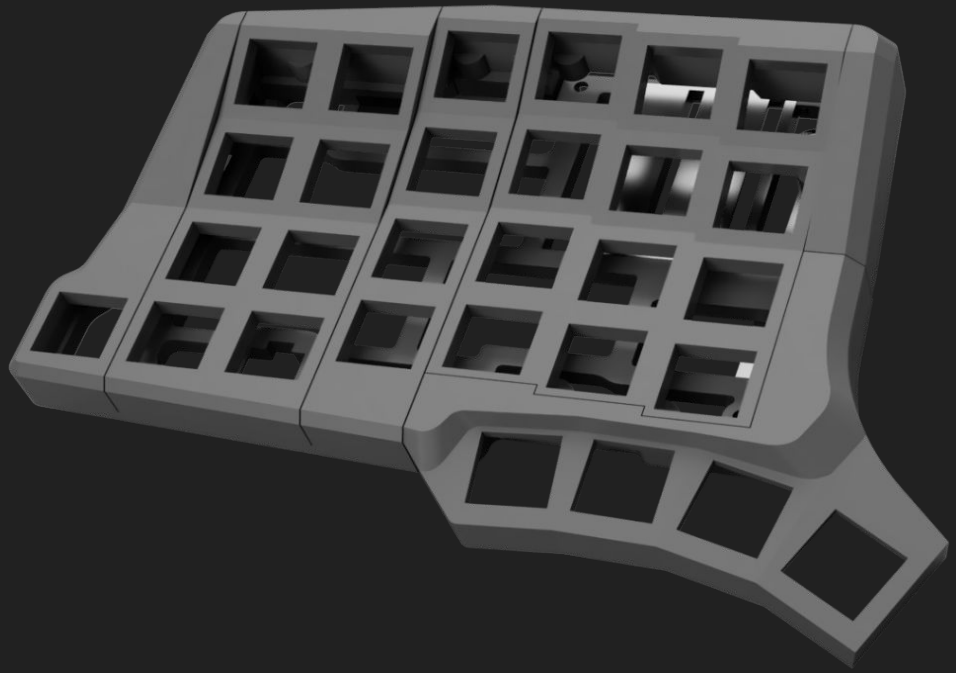
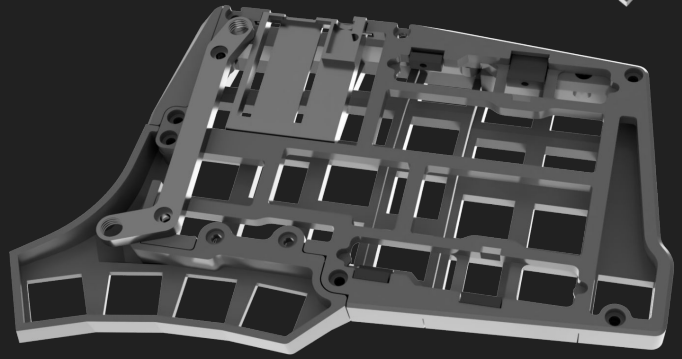
Bistable Split Ergonomic Keyboard





Bistable Split Ergonomic Keyboard

The problem:

- Regular keyboards have staggered rows for their typewriter origins and are not ergonomic compared to having staggered columns, offset relative to each other based on the assigned finger (column for middle finger should be furthest forwards)
- Column staggered keyboards are optimal for typing since each column has a dedicated finger and is positioned so
- When gaming using column staggered keyboard, our home row position moves from ASDF to WASD, middle finger moves from D column to WS column, which means the offset for typing is counterproductive when gaming

Existing solutions:

- Create a dedicated gaming layer that shifts keymap to the right by one, which solves the issue of the home row position shifted, but is an extra two keystrokes needed when typing in game
- Remap every game to use ESDF instead of WASD, but won't have ability to use all standard modifier keys and need to set up every new game

My solution:

- This product aims to find a middle ground that allows the user to game comfortably, but doesn't remove the ability to quickly type something

Bistable Split Ergonomic Keyboard

Design Goals:

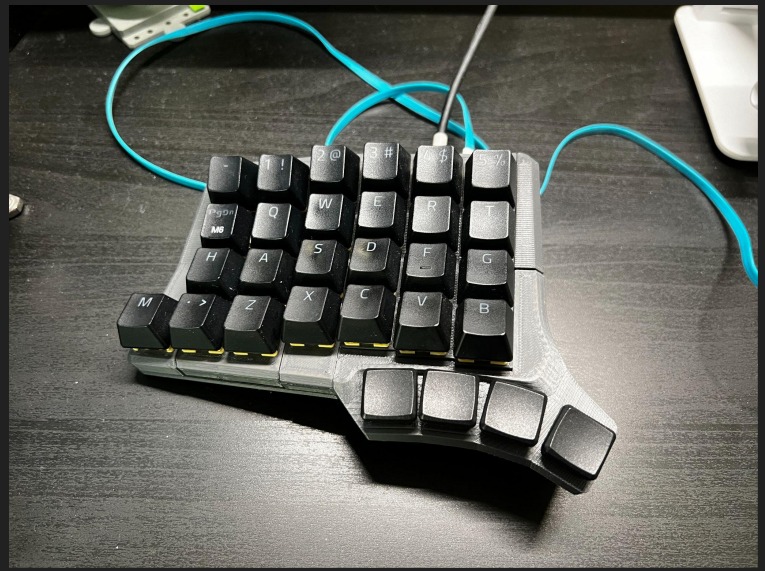
- Be able to move left 4 columns up and down from column stagger to ortholinear (demonstrated on next slide)
- Be able to tent the separate halves (hands tilted relative with the table instead of parallel)
- Be as low to table as possible to reduce wrist bending upwards
- Have thumb keys on a lower plane than the rest of the keys because when hands are in natural position, thumbs are lower

Future Goals:

- Implement Hall Effect switches for analog input instead of regular on-off switches
    - Need PCB that is more secure to switch plate
    - One Hall Effect sensor per key, can’t use key matrix for scanning anymore, would need multiplexer since controller has limited ADC pins
    - Would require either software or hardware filtering for Hall Effect input
    - Would require custom firmware, since existing firmware doesn’t support analog inputs for key presses

Bistable Split Ergonomic Keyboard

Typing Mode (Column Stagger), observe the downwards offset of the A column relative to S relative to D for the increasing lengths of pinky to ring to middle finger respectively



Gaming Mode (Ortholinear), observe how ASD are inline with each other, and when fingers are on WASD the index finger doesn't have to reach further than the middle finger

Bistable Split Ergonomic Keyboard

Use of compliant mechanism to move sections up and down

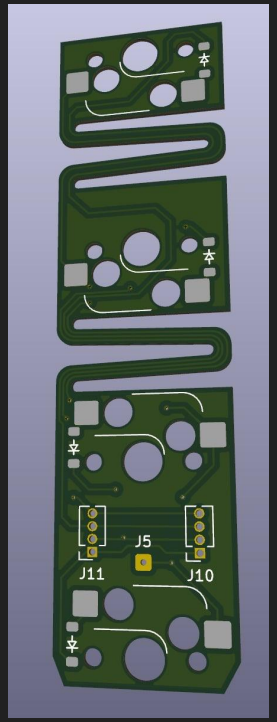
- Adjustable amplitude based on where holes are placed
- Moving one section would move the other together
- Whole section can be mounted on a pair of compliant mechanism on top and bottom, without need of rails or sliding interface

Other solutions I considered and rejected

- Detents
  - Have to make sure sliding mechanism is smooth, difficult with 3D Printed Parts
  - Might wear down over time
  - Hard to tolerance
- Magnets
  - Have to make sure sliding mechanism is smooth, difficult with 3D Printed Parts
  - Would interfere with future implementations of Hall Effect switches

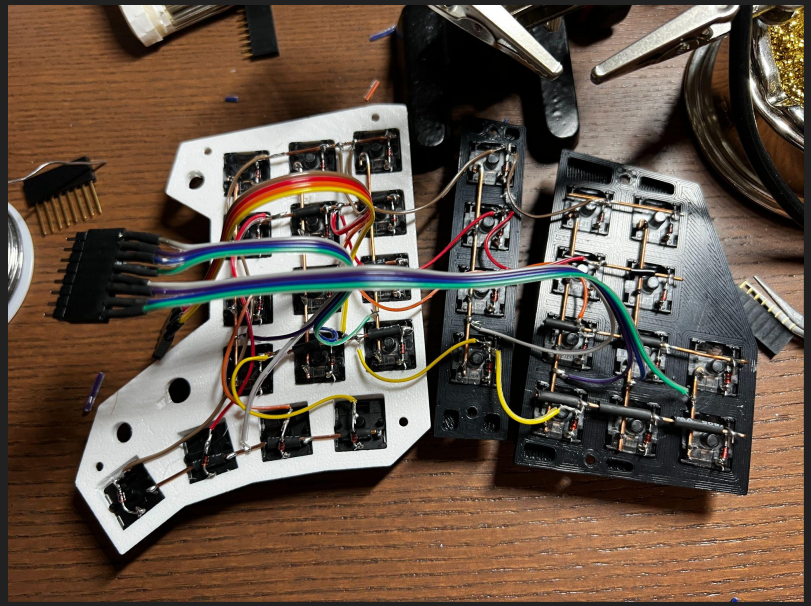
Key Column PCB with Flex Cuts and Hotswap Sockets

- Custom PCBs allows for modular assembly of keyboard for quick prototyping and iteration
- Flex slots cut out to allow PCB to bend, accommodating the slight curvature of the key columns



Previous Iterations of Ergonomic Keyboard

- Previous versions had wires soldered directly, making it impossible to disassemble
- Key columns don’t have curvature to make upper keys more accessible
- Mechanism moving keys up and down was much thicker



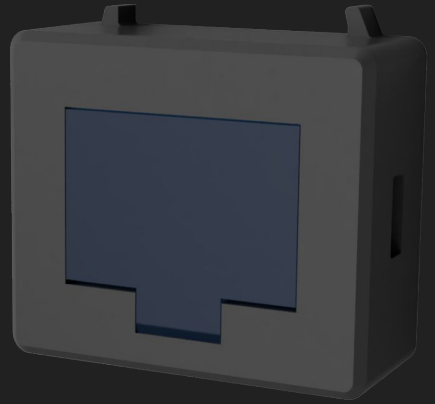
Previous Iterations of Ergonomic Keyboard

The problem:

- To check the temperature before I change to go out, I'd have to walk back from the closet to my desk and unlock my phone
-

My solution:

- An OLED display that displays the outside temperature and weather
- Uses an API hosted by me that digests information from OpenWeather and parses it into a format that Arduino C can easily process
- Offloading data pipeline logic to a Go (programming language) instead of Arduino C makes processing much simpler



Other considerations:

- OLED screen will have burn in eventually - I'll just replace the whole device when that happens
    - Could turn OLED off during the night but I wanted low hanging fruit prototype with minimal resistance
- Don't want to query OpenWeather too often - My hosted API queries it once every 30 minutes
    - Can only update during the day so it doesn't update when I'm asleep

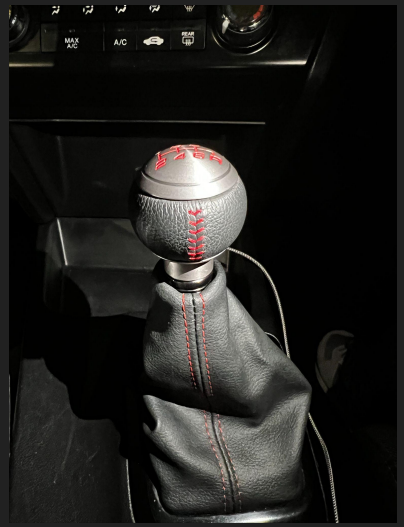
Shift Boot Collar

The problem:

- Shift boot collar of 2012 Honda Civic SI is extremely fragile (four thin prongs)
- OEM replacement doesn't improve design, so would break again
- Aftermarket shift boot collars don't imitate the design exactly, with the leather fold around the collar

My solution:

- Design parts out of TPU, taking advantage of increased flexibility to add support to previously fragile parts
- Allows the shift boot collar to be indexed on the nut to keep leather stitching straight



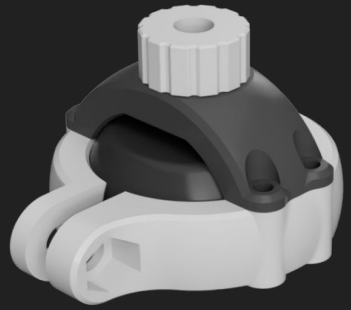
Indestructible Tripod Head and Feet

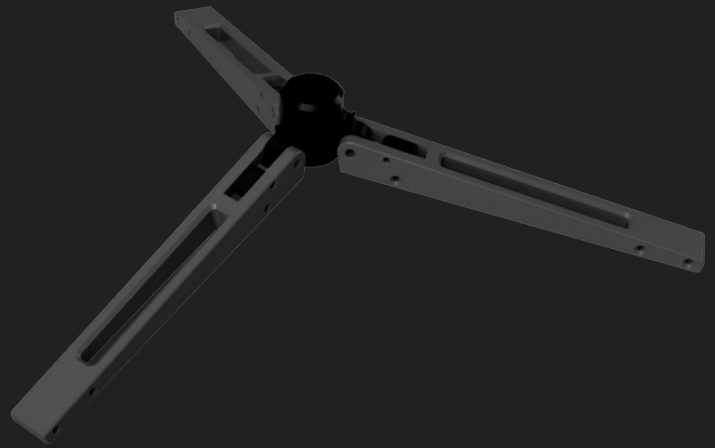
The problem:

- I record volleyball games with a tripod, and occasionally the tripod and phone gets hit with a ball. If the tripod is not well designed and made, it would break and without spare parts, I can't record the rest of the session

My solution:

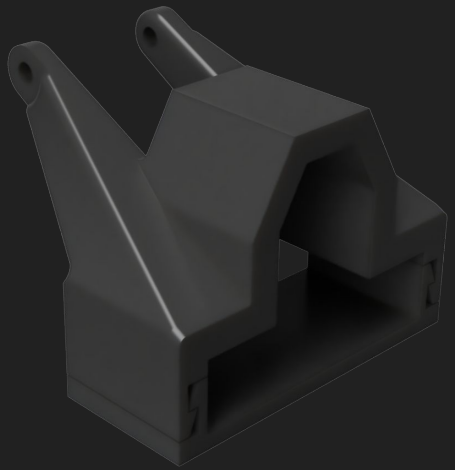
- Design a tripod with designated compliant spots and failure points
  - Use of TPU parts allow parts to flex instead of break
  - Designed specific failure points (phone adaptor, legs getting unlocked) with easy to replace parts to avoid hard-to-replace parts getting destroyed instead
  - Multiple parts to get the best strength directions when 3D printing
  - Use of screws and heatset inserts to reinforce 3D printed parts perpendicular to layer lines

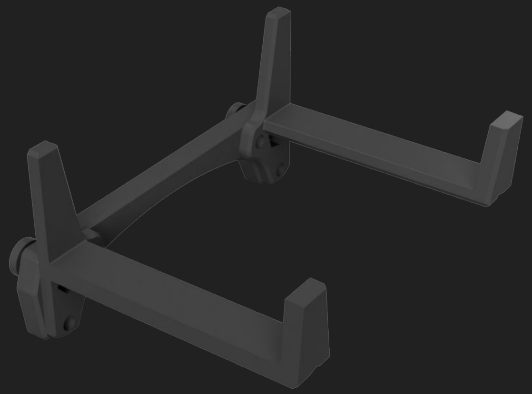


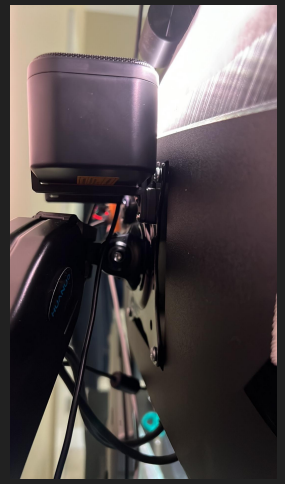


Integrated Webcam and Monitor Light Bar Mount

- Allows mounting of webcam above the lightbar
- Moves the webcam as low as possible so it’s not looking down at me





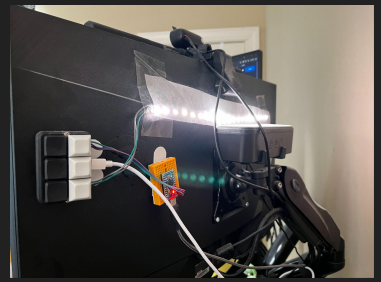


Speaker VESA Mount

To use the remaining VESA slots to mount a USB speaker behind the monitor

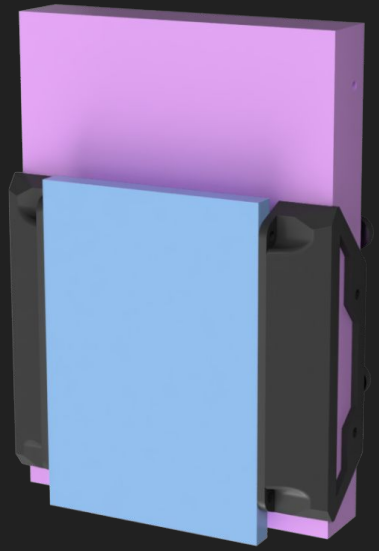
Macropad

- Controls monitor backlight
- Based on Arduino, sends Serial communication to another Arduino which has HID support, to imitate keystrokes to send to my computer
- Utilizes key matrix scanning, where 5 GPIO pins control 6 keys, was a prototype for my keyboard where 12 GPIO pins control 32 keys
- Connects to local network to control smart lights around the house

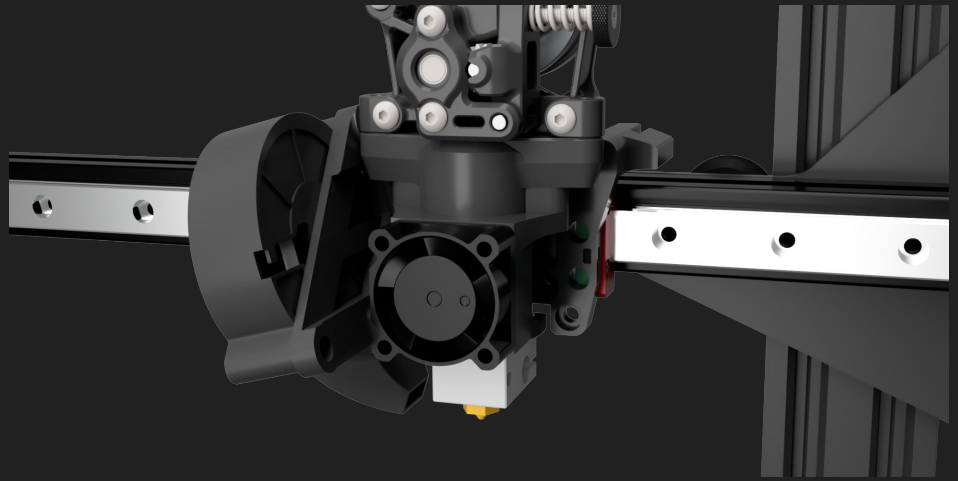


PC Hard Drive Expander

- Mounting bracket for 3.5 HDD to my PC case
- Mounting bracket for 2.5 SSD to the 3.5 HDD



Lightweight and Modular Printhead



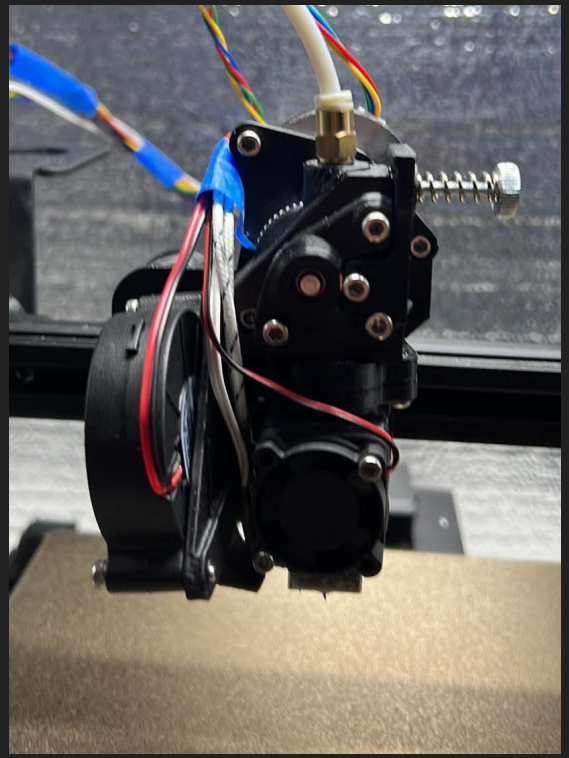
Design Goals:

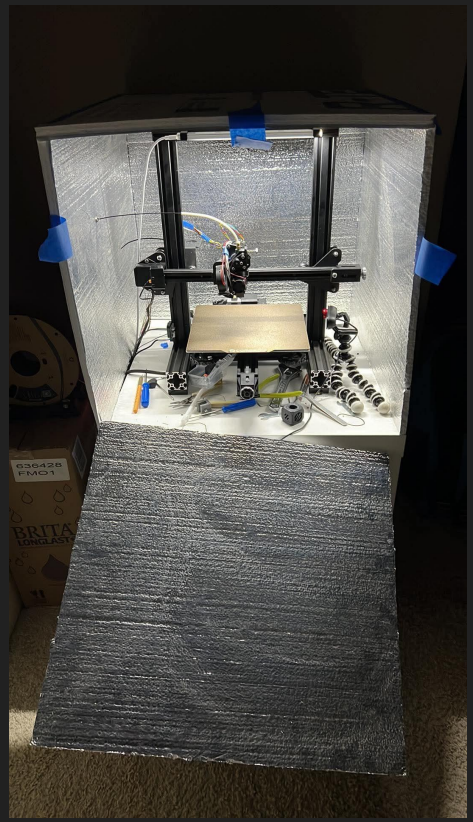
- Needed to support a larger part cooling fan
- Needs to support better heater components to print engineering materials (ASA, ABS, Nylon)
- Lightweight and modular
- As rigid as possible
- Center of Gravity as close to linear rail as possible
- Easy to service and replace components

Design for manufacture:

- Components designed to have one main direction of strength
- Minimal difficult geometry for FDM manufacturing (overhangs)

Lightweight and Modular Printhead





My Design Philosophies

- Make the low hanging fruit prototype and start using it, otherwise in the chase for perfection, the product would never get completed
- Don’t spend too much time future-proofing with modularity, otherwise the product would never get completed. When there’s a need for new features, that will be motivation for the next iteration