



# Capstone Project: Energy Conservation

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# Problem Statement

- Desktops **waste a lot of electricity when idle**, meaning being powered on and unused.
- “...always-on energy use by inactive devices translates to \$19 billion a year -- **about \$165 per U.S. household** on average...”
- Currently, there are not many effective and efficient solutions to counteract this problem.

## USB Hub

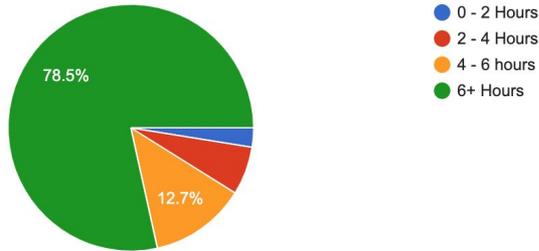


*USB hubs are a small external device that allow for more USB ports to be connected to a computer.*

# Problem Data

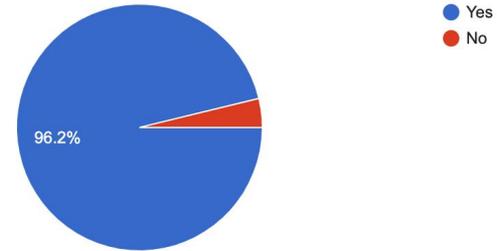
How many hours per day do you spend on your computer?

79 responses



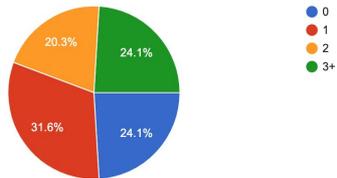
Do you rely on using a computer for work, school, or personal needs?

79 responses



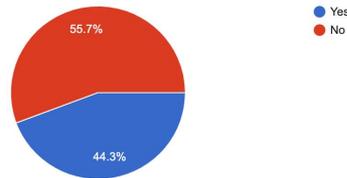
On average, how many external devices do you have connected to your computer through a USB? (This does not include keyboards or mice)

79 responses



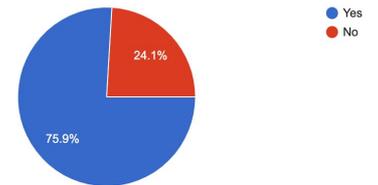
Do you think idle devices connected to your computer through USBs contribute to your electricity bill?

79 responses



Does your personal computer have enough USB inputs?

79 responses



*Images of data collected from our survey regarding computer/electronics use.*

# Previous Solutions: Power Strip

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## Pros

- Small and compact
- Saves a lot of wasted power (manual switch)

## Cons

- Some versions are expensive
- Energy Efficiency determined by the grade of the item

## Power Strip



*Power Strips can power multiple electrical devices through only one electrical socket.*

# Previous Solutions: USB Hub

## Pros

- Can turn off individual ports
- Connects directly to the computer
- Has multiple plug in ports

## Cons

- Manually have to turn off the ports
- Would not benefit mouse or keyboards
- Not very efficient in saving electricity

USB Hub



*USB Hubs allow for extra USB outlets and USB management.*

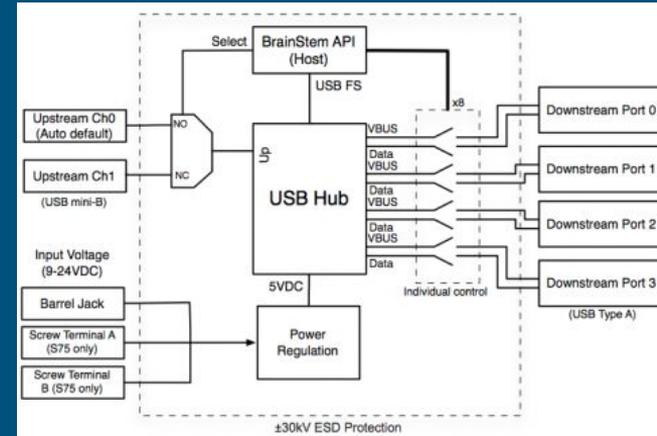
# Design Requirements

- Physical lightweight USB hub with software
- Under \$40
- The software will turn off external devices when they have been idle for 5+ minutes
  - Devices can also be manually turned off by the user
- Service life of at least one year

USB Hub



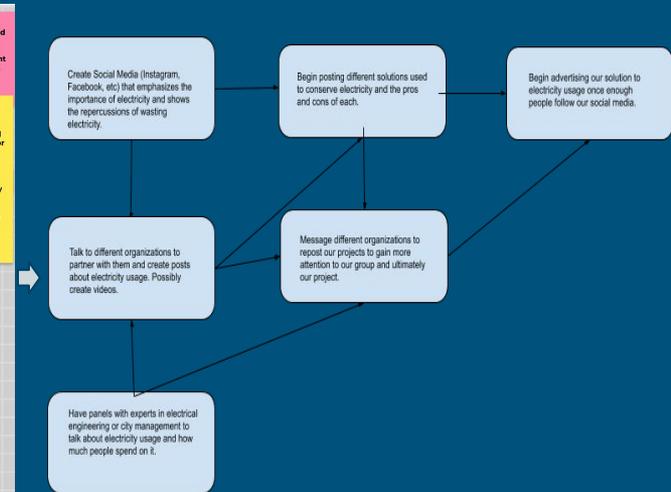
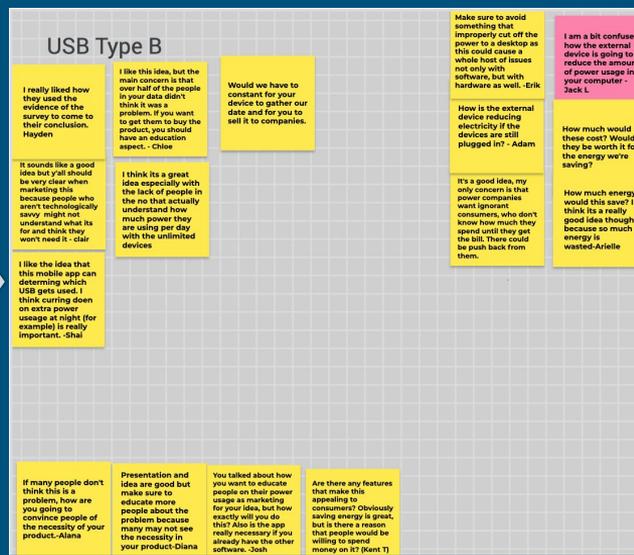
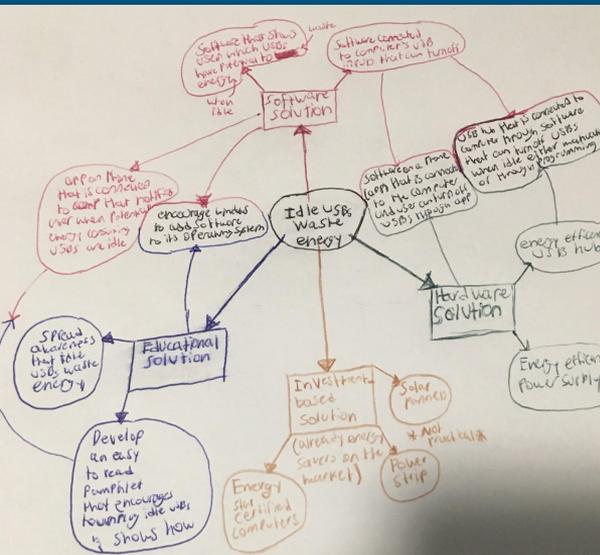
USB Hub Circuit



*Shows how a USB hub works on a circuital level.*

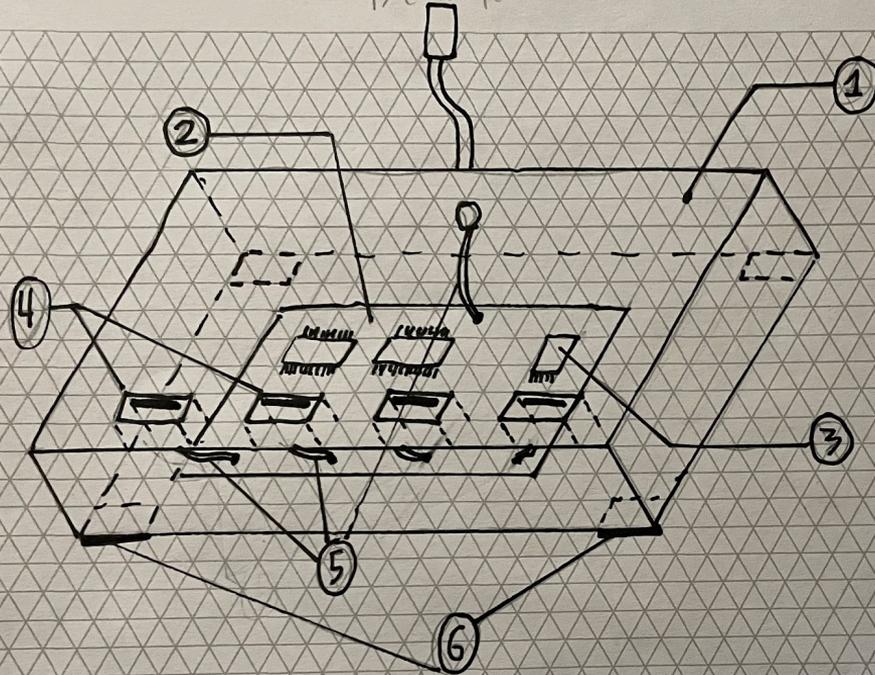
# Design Concepts Generation, Analysis, and Selection

Pictures of brainstorming techniques and peer feedback.



# Prototype Design Documentation

Detailed Annotated Sketch:

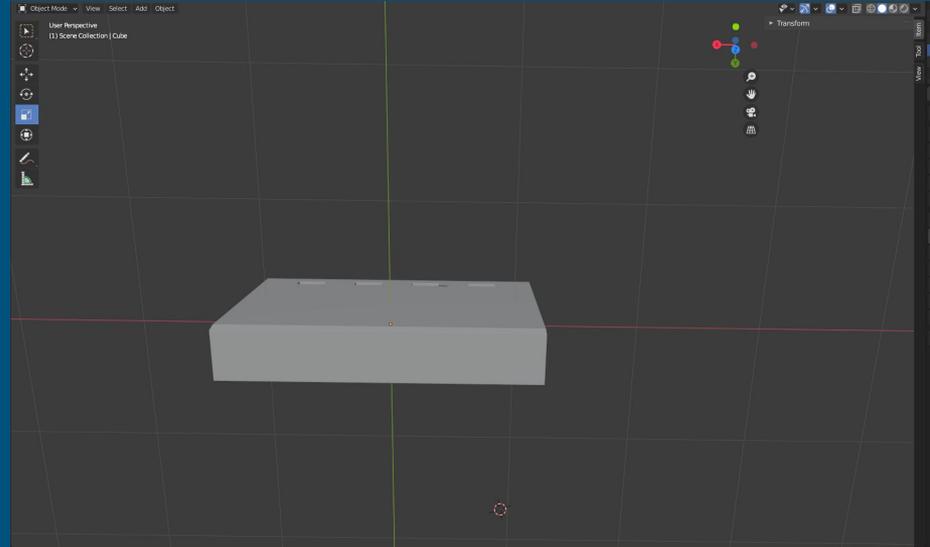
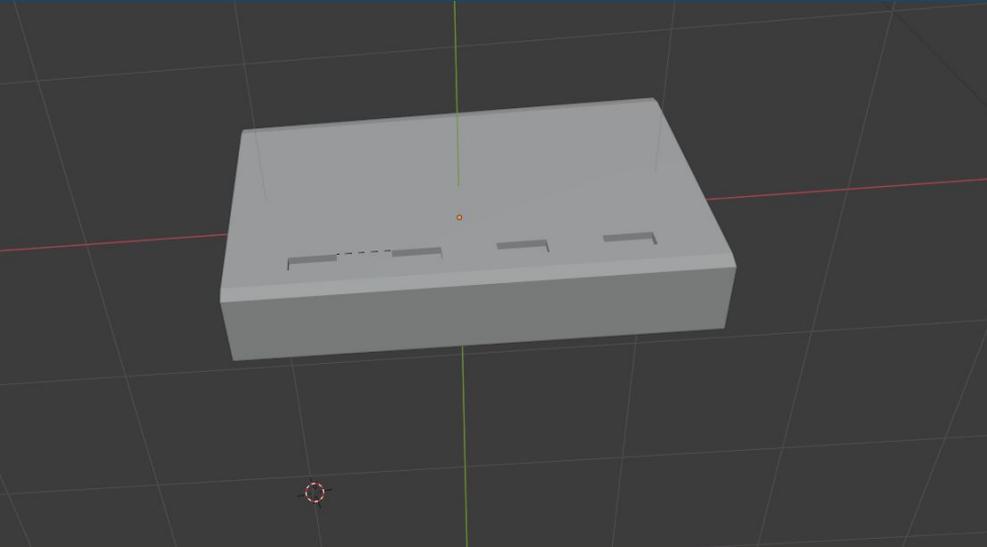


- Annotations for sketch:
- 1. Shell of USB hub
- 2. Raspberry Pi Zero W
- 4. USB adaptors
- 5. Wires
- 6. Rubber feet

*A detailed sketch, that includes annotations, of our only physical component to our solution: a USB hub.*

# 3D Computer Model of USB Hub

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*3D models made on Blender (CAD software) for the USB hub component of our solution. The prototype model has 4 usb ports on the top, with bevels on each top long length corner, with 4 rubber feet on the bottom.*

# Cost Analysis of Our Prototype

- Raspberry pi Zero W: \$10
- Usb Micro to Usb 2.0 adaptor: \$6.99
- Usb micro/Usb type C to 3.0 input adaptor: \$5.99
- Usbip open source: Free
- Micro SD card + SD card adaptor: \$7
- Usb micro to usb 3.0 output adaptor: \$5
- Time to build prototype: ~15 hours
- Predicted Design Cost: ~\$38



Figure 9: This is a Raspberry Pi zero, which will be used as the base of our USB hub

# Conclusion

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- If we had more time we would:
- Create a **shell** for the USB hub, **patch up** the software, code the **mobile app**, and implement our educational component.
- Find **cheaper parts** and implement a way to prompt a set up for the product to connect to the user's specified device.
- All in all, we are proud of our accomplishments given our time and resources.

