USB Type B

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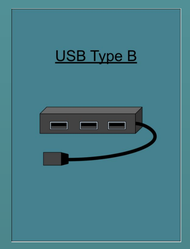
Problem Statement

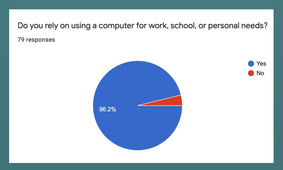
Those who rely on computers, specifically desktops, waste a lot of electricity when idle (when not in use but powered on). According to studies, “This always-on energy use by inactive devices translates to $19 billion a year -- about $165 per U.S. household on average -- and approximately 50 large (500-megawatt) power plants' worth of electricity.” Currently, there are minimal devices that cut down this power cost automatically.

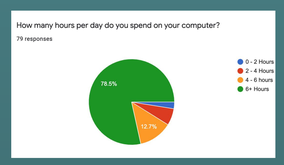


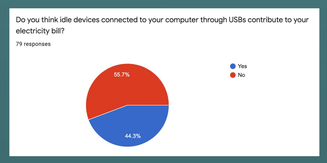
Justification

77% of careers rely on computers or computer proficiency. Therefore, America wastes tons of electricity due to idle electronics.

Our survey (out of 79 participants) results tell us that many people, especially today, spend the majority of their time on their computer, and they rely on it for many aspects of their life. However, the majority of our survey respondents do NOT think that idle USBs are actually a problem, as they don’t believe that idle USBs contribute to their electricity bill.







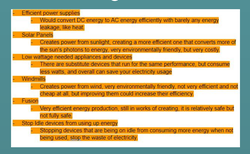
Similar Solutions

1. Simple USB Hub - this solution makes it easy to manage multiple USBs, however, USB hubs usually need to be manually turned off via a switch. This makes it more difficult for the user to efficiently save electricity.

2. “Smart” Power Strip - this solution is able to manage the power outlets rather than the USB outlets. This has similar pros/cons to USB hubs, as they are able to save electricity, but they require manual labor to use.

Design Process

1. Initial Prototype Brainstorming:



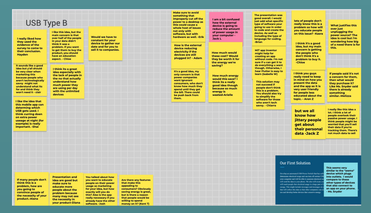
Bluetooth USB HUB with a personal app- This will connect to the computer wirelessly so it does not use energy from being plugged in. It will use batteries which will last a long time and save electricity, there are also rechargeable batteries already out there. The personal app will be able to turn it off whenever and wherever.

Tuned USB HUB- Connects to the computer when the computer is on so will the USB HUB but what makes it different is once the computer is not being used the USB HUB will turn off. The computer does not have to be powered off for the USB HUB to turn off.

App that keeps track of electricity usage- The app will keep track of the whole house and keep track of what's plugged in and can turn off individual parts of the house and areas which are using higher amounts of energy.

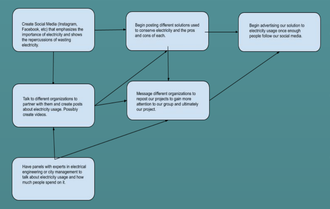
Power strip with personal app- The app will allow you to wirelessly turn off power to one of the ports since most power strips are put in hard to reach areas it will be convenient and save energy (Borna)

2. Initial Prototype Feedback



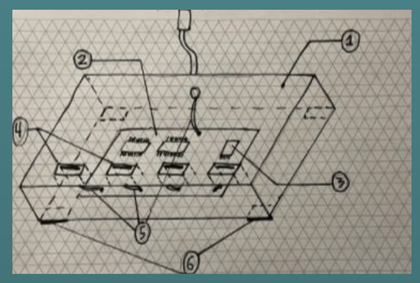
This peer feedback questioned how we would market/advertise our product to such a large target audience, as what our device will exactly do may not be apparent. To fix this issue, we need to first change attitudes on the problem since many people do not see it as a problem. We also need to advertise on how much electricity our device will save using statistics.

3. Initial Prototype Revision



4. Final Prototype Design:

- USB Hub with automated USB Power Switch with software that connects to a mobile app
  - Connects to computer
  - Determines electrical usage, can turn off certain USBs, and sends data to the user’s phone
  - Teaches user/public about the importance of conserving electricity
  - Possibility of sending the data to certain companies to use when developing electricity-conserving devices



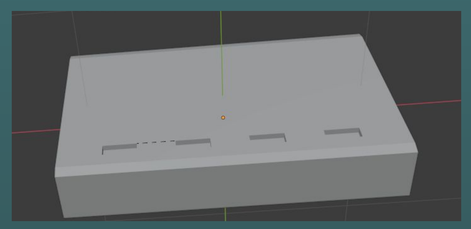
Annotations for USB hub prototype sketch to the left:
1. Shell of USB hub. Material aluminium to give the product a very clean look and keep the cost low.
2. Printed circuit board. Will be where the usb devices are turned on/off.
3. Bluetooth chip. For potential connectivity to your phone to either send notifications or to manually shut off certain devices.
4. USB ports. Contained within the USB hub, are where appliances will be plugged into.
5. Wires. To connect various aspects of the product to the circuit board.
6. Rubber feet. To prevent damage to the shell and any surfaces in contact with the shell.

Design Criteria

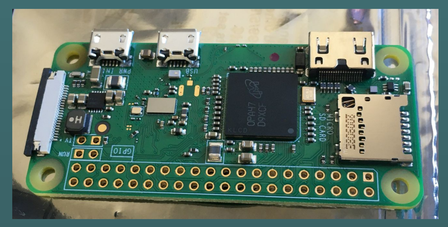
- Hardware
  - Must be lightweight and have at least four USB inputs that are able to be turned off manually
- Software
  - Presets within the USB switch’s code that allows the user to select when certain USBs should be turned off after a certain amount of time
- Cost
  - Should not be more expensive than $40, and should have a service life of at least one year
- Mobile App
  - Should connect to the software in the user’s USB hub in order to receive data on USBs and their electricity consumption
- Education
  - Should work to educate the public on the importance of electricity conservation by providing prominent statistics and showing promising results of electricity conservation via our product

Solution

Final 3D Model:
3D model 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.



Final Prototype:
Our prototype consists of a Raspberry Pi Zero, USB cables and a micro SD card for the booting system. The prototype is totally wireless so it can get a signal from anywhere within a network's radius, however, a power cable must be connected to it. The raspberry pi will be able to get a USB signal from anywhere in the house and be able to transmit it to any of the computers. However, unlike our final prototype design, we were not able to implement neither a shell for the USB hub, nor the code that allows the user to preset the USB switch to turn off USBs after a certain amount of time.



Testing Procedure

Test	Procedure & Safety Considerations	Criteria for Pass/Fail	Data
Pressure Test For Durability	*Procedure: Use a force meter to register how much force can be exerted on the usb hub before it breaks* *Safety: Dangers to plying plastic from impact of the shell breaking*	*If the usb hub resists 250 N*	*Newtons, N*
Wire Strain	Procedure: Bend the USB connection wire until break Safety: Dangers to build up tension in wire snapping back	*If the usb hub resists 30 N*	*Newtons, N*
USB Response Time	Procedure: Check weather there is a signal that reaches from plugging in the usb hub into the computer Safety: There are no safety precautions	*If the usb connection is less than 100 ms then it passes without tear*	*Seconds, s*
Software response	Procedure: Test the application and test whether the usb will turn on or off Safety: There are no safety precautions.	*If the correct USB’s turn off or on*	*Y/N*

Conclusion

Looking back, with the information we gathered throughout this whole capstone project, our team is pretty satisfied with our results. If we had more time, our team would have made redesigns and changes. Our main focus would be continuing on parts of the product that we did not have time to implement, such as creating a shell for the USB hub, patching up the software, coding the mobile app, and implementing our educational component. For now, mass producing our product would be out of the question. There are many ways we could have improved our product for mass production, such as finding cheaper parts and being able to implement a way to prompt a set up for the product to connect to the user’s specified device.

All in all, our group did a great job planning, designing, and building our product, but one aspect we could have improved on was evaluating the impracticalities of our design—do we really have enough time or resources to code and implement a mobile app? Also, we could have ordered the parts for our prototype ahead of time, so that we could have more time to workout the bugs in our product.