

Extension Cord Upgrade

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Abstract

Millions of extension cords without proper safety precautions are sold to uninformed consumers in the United States each year. Extension cords are simply too convenient and are used prevalently in everyday usage. A typical consumer might be led to believe these extension cords are a safe means to provide multiple outlets at an extended reach. Unfortunately, their cheap and outdated design makes extension cords a potential fire hazard. A typical store bought extension cord may have flammable insulation and no implementation of cutting the current when the cords become overloaded. An extension cord upgrade would help prevent the cord from being a fire hazard by having a safety mechanism in the form of circuit breaking mechanism that is rated for the maximum current of the cord. The cord will also implement a circuit board with a bluetooth module and sensor components, which will be used to notify the user if the cord has been overloaded. The cord will include a hybrid circuit that can communicate with an app. The app will show real-time data regarding the current flowing through the cord and temperature of the wire while also providing a way to manually switch off the circuit with the mobile device. The circuit will include both analog and digital data, with the sensors turning the current and temperature information in the wire as analog inputs for the microcontroller and transmitting it digitally using the bluetooth module. Usually, fires start at the base where the outlet is, so the safety mechanism will be near the outlet. The extension cord would be in the proper AWG to prevent overheating of the cord and the wiring will be covered in with non flammable insulation.

Introduction

"Two-wire extension cords are easily overloaded, causing them to get hot enough to short-circuit or ignite combustible materials in contact with them, especially those cords equipped with multiple receptacles"

- Current safety measures
 - Warning labels
 - Fuses
 - Educational pamphlets

- Our goals
 - Implement smartphone app capabilities
 - Educate on safety
 - Develop safer cord.

Project Completion Schedule

Week	Task	Complete?
1	Order components	\star
2-3	Exchange received components, start work on coding and Fritzing diagram, preliminary testing	*
4	FIRST GROUP PRESENTATION Troubleshoot code and hardware, reorder defective parts	\star
5-7	Receive all ordered parts, wiring and code implementation for individual components, deal with potential issues	*
8	SECOND GROUP PRESENTATION Assembly of first working prototype, print component housing, interface w/ mobile app, second phase of testing	*
9-11	Hardware and code optimization, soldering and assembly of final product	*
12	NOVED Final phase of testing, troubleshoot remaining issues	*
13-14 (Preparation for Expo 2022	*
15	FINAL PROJECT SUBMISSION	

Upgraded Features

- 1. Manual Override Switch
- 2. 12 AWG Wire
 - a. Rated up to 20A
 - b. Household currents go up to 20A
- 3. Monitoring System
 - a. Current and temperature sensors
 - b. Information sent over bluetooth

Hardware

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Final Hardware List

Name	Description	Price
HiLetgo HC-05 (Bluetooth Module)	Allows a user to connect their smart device to the microcontroller to read the cord data	\$8.39
MAX31855 (Thermocouple Amplifier)	Reads data from the thermocouple and sends it to the Nano	\$14.95
Type-K Glass Braid Insulated (Thermocouple)	Measures air or surface temperatures by bare wires bead-probe	\$9.95
Gravity: Analog AC Current Sensor (20A)	Measures currents between +-20A	\$19.90
Optocoupler Isolation Relay Module 30A	Switches the main cord circuit on and off, acting like a switchable fuse	\$12.29
Nano V3.0 (Microcontroller)	Works as the main I/O device for all other components supported by external 5V ~ 12V DC power supply	\$14.99
120VAC/12VDC Transformer	Converts the 120VAC power from an outlet to 12VDC to power the components of the device	\$12.00

Hardware Design Flowchart



Component Housing



• Internal wires secured with bushings

- Wide base and medium height
- Larger end slot to fit plug cap
- Rectangular finger slots for air flow



Some Important Things to Note

- Not for outdoor use (no waterproofing and insufficient protection from external elements)
- FINAL DESIGN IS A PROTOTYPE (not intended for commercial use)
- The purpose of this device is to educate masses about extension cord safety, not to make an extension cord easier to use
- The safety protocols put in place are not meant to be a replacement for user awareness. Even with a safety upgrade, the cord <u>IS NOT GUARANTEED</u> to protect against carelessness

Software

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Experimental Results

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Final wiring of Components



Acknowledgements and References

Acknowledgements

- <u>James's dad and uncle</u> for giving us electrical advice and allowing us to use their office for assembly
- <u>CSUB Fab Lab staff</u> for assisting us with 3D printing and component testing
- <u>CSUB Library</u> for accommodating our in-person meetings
- <u>Dr. Wei Li</u> for general project supervision

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