Wearable Clap Switch
DESIGN RATIONALE

Introduction
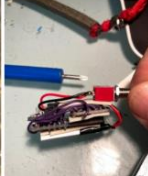
The Wearable Clap Switch is a device that operates a switch when the user claps. It is intended for users that have difficulty operating standard push or squeeze switches.

Research

Commercial Options			
Name	Picture	Price	Link
Clapper Activated Sound Switch		$39.15	Link
Wireless Switch Receiver		$19.02	Link
Little Candy Corn Proximity Switch		$310.14	Link

Files available at https://makersmakingchange.com/project/wearable-clap-switch/

DIY Options			
Wearable Bluetooth Controller for Switch Adapted Toys			Link
Simple Clap Circuit for Home Automation			Link
Light Proximity Switch			Link

Requirements

Goals

G01	Operate a switch when the user claps

Functional Requirements

F01	Device must operate a switch when the user claps(or just accelerates their hand?)
F02	Device must not hinder/obstruct user (e.g. tangle them with wires)

F03	Device must have adjustable switch delay and duration
F04	Device must have a 3.5 mm mono output port.
F05	Device must be chargeable/easy to change batteries.

Non-functional Requirement

NF01	All Parts must be off the shelf/3D printable
NF02	Maker Friendly/Easy to assemble
NF03	Any handheld/strapped parts of the device must be comfortable enough to wear for long periods of time

Constraints

| C01 | Low-Cost |

Ideation

The idea for this project came from the original instructable project, which designed a clap-based switch for a person who had difficulty interacting with push or squeeze based switches but was very good at clapping.

User Controllable Parameters

- Duration of the output
- Delay between activations
- Triggering sensitivity (i.e., accelerometer threshold)

Trigger Method

- Original – acceleration magnitude
- Gesture recognition
- Sounds intensity threshold

Conceptual Design

Original Design

This design stays true to the original Instructables design, using two ItsyBitsy nrf52840 microcontrollers, full size potentiometers, and soldered Dupont wires.

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The device consists of one handheld unit containing an accelerometer and a Bluetooth microcontroller. When the microcontroller detects movement over a threshold, it sends a signal to the receiver unit. The receiver unit contains another Bluetooth microcontroller, a relay, two input potentiometers, and a 3.5 mm mono jack. When the receiver gets the signal, it activates the relay to close the output jack with a delay and duration set by the input potentiometers.

~$100-$110

Opportunities for Improvement
- Find alternative relay board to reduce BOM cost

Concept 2 – Different Microcontroller

This concept is similar to the original design, but switches to Feather microcontrollers. This brings the battery backpacks onto the main board and allows for Featherwing boards to be used to bring the amount of soldering and loose wires to a minimum. There are several relay Featherwings, with both regular and solid state relays, as well as several accelerometer Featherwings.

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~$130-$140

Concept 3 – Wireless Relay Switch

This concept uses the same wireless relay switch as the Wireless Assistive Switch Link project with a small microcontroller such as the Seed Xiao SAMD21 connected to the accelerometer in the hand mounted enclosure. When the accelerometer detects a movement over the threshold, it signals the transmitter with a duration and delay set by the two input potentiometers on the handheld unit. When the receiver relay gets a signal, it will send a signal to the 3.5 mm mono output port as long as it continues to receive the input signal.

The primary downside of this concept is the fact that the duration and delay potentiometers have to be mounted on the hand section of the device to control the output to the wireless relay switch. This is added weight, but there are small potentiometers that can be used, such as the ones on the OpenAT Toy

~$50-$60

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Concept 4 – Clapper

This concept consists of a base station connected to the switch that monitors for the sound of a clap, and will activate the switch when a clap is picked up by a microphone. The switch is activated with a relay which is connected to a 3.5 mm mono output jack with a delay and duration set by two input potentiometers.

~$35-$45

Concept 5 – Microcontroller with Integrated Sensor

This design is similar to the original design but swaps the hand mounted microcontroller for a board with an onboard accelerometer, Bluetooth, and battery management such as the Feather nrf52840 Sense or the Circuit Playground Bluefruit. These microcontrollers typically have a microphone on board as well, which would allow for verification of a clap through both acceleration and sound.

The device consists of one handheld unit containing a Bluetooth microcontroller with built in accelerometer and microphone. When the microcontroller detects movement over a threshold and confirms the clap with sound from the microphone, it sends a signal to the receiver unit. The receiver unit contains another Bluetooth microcontroller, a relay, two input potentiometers, and a 3.5 mm mono jack. When the receiver gets the signal, it activates the relay to close the output jack with a delay and duration set by the input potentiometers.

~$100-$110

Concept Comparison

Criteria/Concept	Original	Concept 2	Concept 3	Concept 4	Concept 5
Function	7	7	7	6	8
Battery Life					
Size	4	6	8	7	8
Weight	5	6	7	9	7
Price	7	6	8	9	6
Adaptability	6				9
Customizability	6	6	4	3	9
Makeability	6	7	6	5	8
Design Effort	7	7	6	6	7

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Makers Making Change
A Neil Squire Program

Detailed Design

Power Supply Options

- LiPo Battery Pack
  - ~3.7 V DC
  - No power switch
  - Would need to be able to access the JST connector to charge the battery
  - Difficult to ship
  - ~150 mAh, can increase to up to 2000 mAh with enclosure redesign
  - ~5 to 66.5 h of battery life
  - With very minimal enclosure changes, 350 mAh battery can be installer with ~11.5h battery life
  - Charge rate of 100 mA
- AAA battery pack
  - 3xAAA batteries, ~4.5 V DC
  - Power switch
  - Would need to disassemble to change batteries
  - ~1200 mAh
  - As thick as the current enclosure
  - ~40h of battery life
- Coin cell
  - 2xCR2032 ~6 V DC
  - Power switch
  - Would need to disassemble to change batteries
  - ~235 mAh
  - ~7.5h of battery life

Circuit playground can take up to 6V DC and has reverse polarity, over-current, and thermal protection. The circuit playground consumes around 30 mA of current during operation.

Enclosure Design

Transmitter

- Lightweight
- Charging port accessible
- No sharp edges

Receiver

- Charging port accessible
- No sharp edges

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Opportunities for Improvement

Transmitter

- Integrate charging circuit into the enclosure
- Change the communication protocol so the transmitter can be used for more projects, like controlling a remote-control car.
- Stiffen base so it won't warp if removed from print bed while warm

Receiver

- Add knobs on input potentiometers
- Cover on programming port