

# **ECE 445**

Fall 2022

Proposal

## **Bruxism Treatment**

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## **Introduction**

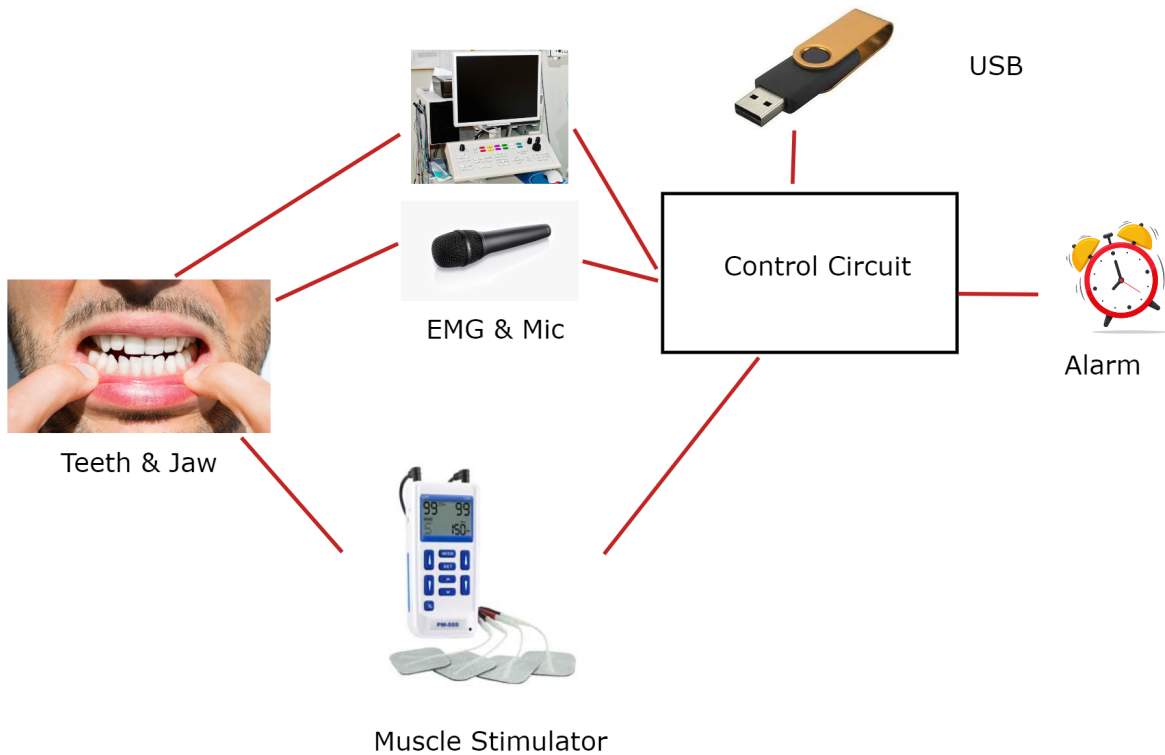
### **Problem**

Bruxism, more commonly known as tooth grinding, is a condition where one grinds or clenches their teeth unconsciously. Depending on the particular study, anywhere from 10-30% of the population can be affected by this condition. Should bruxism be severe and frequent enough, it can lead to jaw disorders, headaches, damaged teeth, and other problems. There is not one singular cause for bruxism and as such, current solutions act more as a temporary measure to minimize damage rather than address the issue itself. For example, common dental solutions include using a mouth guard and, in some cases, undergoing dental correction. Similar to treatments, medication serves mostly as a reactionary measure where they attempt to address issues and complications that arise from bruxism.

### **Solution**

Our proposed solution to Bruxism is to develop a system that relaxes the muscles while the user is clenching their teeth. This will be done via a two part system: detection and prevention. The detection part will be outside of the mouth and focus on the jaw muscles and any noises made by the tooth grinding. It will consist of an EMG in conjunction with noise sensors. These signals will be transmitted into a control circuit that will both save the data (possibly into a USB Type-A flash drive) for later viewing and activate an appropriate amount of electricity to relax the jaw muscles as well as sounding an alarm.

## Visual Aid

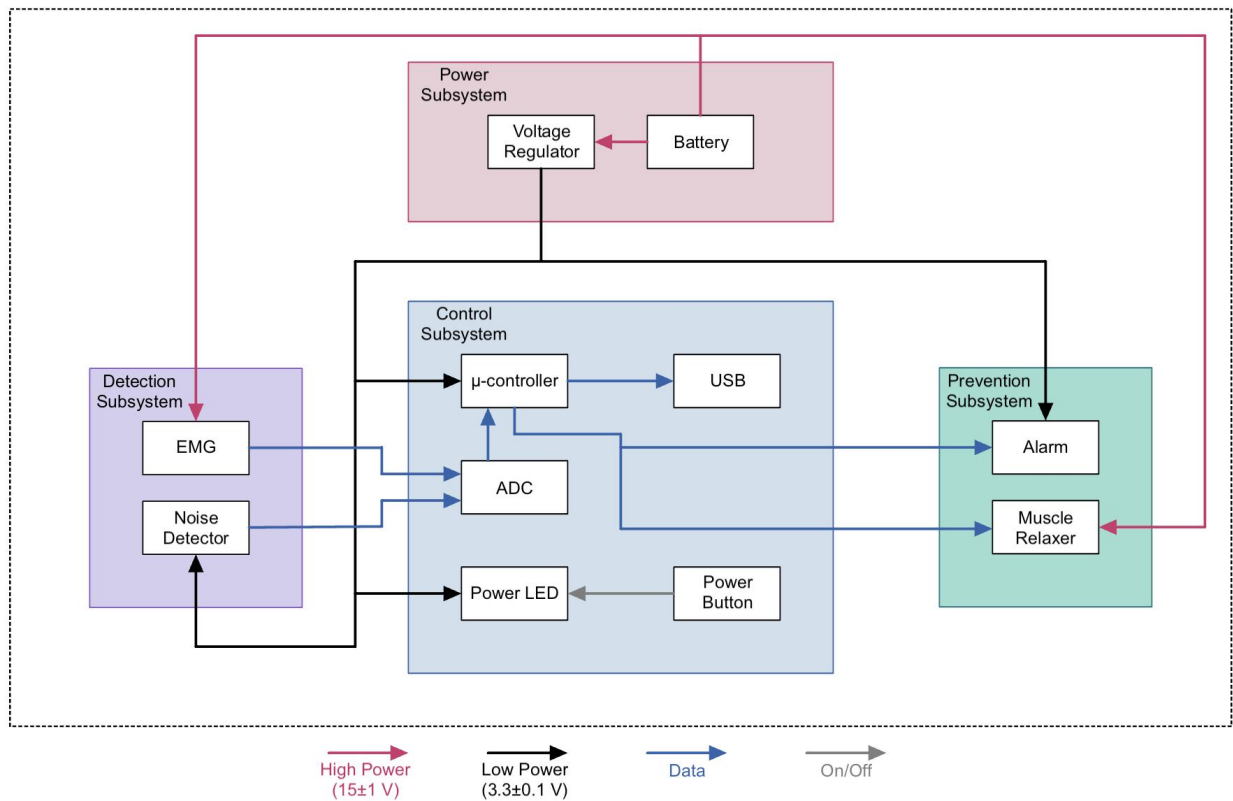


## High-level Requirements List

- Detection section detects teeth grinding and sends appropriate signals to control circuit
- Prevention section responds appropriately according to input from control circuit
  - Appropriate response would include an alarm going off (auditory feedback) and the muscle relaxers activating (haptic feedback)
- Data section collects data appropriately and allows for retrieval for later viewing

## Design

### Block Diagram



### Subsystem Overview

#### *Power*

This subsystem will provide the entire project's power via Li-ion batteries.

#### *Detection*

This subsystem will detect teeth grinding and send the appropriate signals to the control subsystem. It will be powered by the Power subsystem.

#### *Prevention*

This subsystem will prevent the user from grinding their teeth through two avenues: an alarm system as an auditory cue and a muscle relaxer as a haptic cue. It will be powered by the Power subsystem.

### *Control*

This subsystem will process data received from the Detection subsystem and be accessible via a USB port and will stream it to the Prevention subsystem. It will additionally have a power button that either turns on or off the entire project. It will be powered by the Power subsystem.

## Subsystem Requirements

### *Power*

This subsystem will consist of a battery module and a DC/DC voltage regulator. The battery module will supply high power with an output of  $\pm 15$  V and supply a maximum current of 500 mA. The voltage regulator will be a DC-DC step down converter and will supply 3.3 ( $\pm 0.1$ ) V and supply a maximum current of 500 mA.

### *Detection*

This subsystem will consist of an EMG circuit and a noise detection circuit. The EMG circuit will be responsible for detecting muscle movement and will output analog voltage signals to an ADC within the Control subsystem. Similarly, the noise detector will detect teeth grinding sounds and output analog voltage signals to the ADC. The EMG will be supplied with  $\pm 15$  V while the noise detector circuit will be supplied with 3.3 V.

### *Prevention*

This subsystem will consist of an alarm module and a muscle relaxer. Both modules will receive data from the microcontroller in the Control subsystem and then output auditory and haptic cues respectively. The alarm module will be supplied with 3.3 V and the muscle relaxer will be supplied by  $\pm 15$  V.

### *Control*

This subsystem will consist of a microcontroller, an ADC, a USB Type-A port, a power button, and a power status LED. The microcontroller will receive data from the ADC and output the data to the Prevention subsystem. Additionally, the data will be accessible via the USB port. The power button will control whether the entire project is powered and will be coupled with a status LED to indicate the power status. Both the microcontroller and the LED will be powered by 3.3 V.

## Tolerance Analysis

The greatest risk to the successful completion of our project lies in the implementation of the microcontroller within the Control subsystem. Simultaneously handling the inputs from the

Detection subsystem and then streaming the data both to the Prevention substem and the USB flash drive poses a significant challenge. Specifically for the USB port, verification of a flash drive insert and then writing the processed data can be challenging.

## **Ethics and Safety**

Overall, we intend to follow the IEEE Code of Ethics and the ACM Code of Ethics and Professional Conduct.

This project contains an element of human testing that should be scrutinized over for the safety of the user. As such, we intended to uphold §7.8.I.1 of the IEEE Code of Ethics wherein we “hold paramount the safety, health, and welfare”. §7.8.I.2 of the IEEE Code of Ethics also applies to us, as we seek to improve the understanding of “emerging technologies”, as Electrical Muscle Stimulation is still being researched for beneficial uses.

Regarding data collection and usage, we will follow §1.6-1.7 of the ACM Code of Ethics and Professional Conduct. There will be no identifying information related to the user other than the actual teeth grinding data and the data will not be saved or shared with any other parties or entities without the consent of the user.

## **Citations**

### Visual Aid Images Used

Teeth: <https://www.riverfrontdental.ca/how-crooked-teeth-can-impact-your-health/>

EMG:

<https://ucmscdn.healthgrades.com/4b/08/4a94d6ff46aab993d40e07b7204b/image-getty-112260674.jpg>

Microphone: <https://www.dpamicrophones.com/handheld/2028-vocal-mic>

Flash drive: <https://www.amazon.com/Flash-Drive-Memory-External-Storage/dp/B081TFP1VM>

Alarm: <https://www.freepik.com/vectors/alarm-clock>

Muscle Stimulator: <https://www.rehabmart.com/product/pm555-ems-digital-25145.html>