

## Adaptive technology to play the piano (piano adaptation)

### Product Design Specifications

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**Function:** Mary loves to play the piano and the organ at her local church and in her community; however, Mary suffers from rheumatoid arthritis (RA). RA is a long-term disease that leads to inflammation of the joints and surrounding tissues. With the amputation of her right foot, a knee replacement, and a fused left ankle, there is a significant barrier for her to operate the three pedals on the piano. This device will apply a necessary force (8-12 lbs) to the piano pedal mechanically to enable Mary to play the piano despite the effects of rheumatoid arthritis.

#### Client Requirements:

- A device to enable piano playing without flexion in the ankle
- Easily set up and removed, portable
- Must be compatible with client's prosthetic leg
- Compatible with multiple piano models

### 1. Physical and Operational Characteristics

**A. Performance Requirements:** The device must be able to withstand repetitive use with the ability to provide varying degrees of force. It will likely be used continuously for five-minute increments, multiple times over the span of an hour. It must be operable with a minimum amount of 8 lbs of force applied.

**B. Safety:** The device should not have any sharp edges or constricting pieces since it will be utilized on the client directly. It must be able to withstand excess force to avoid failure and damaging the client's prosthetic leg.

**C. Accuracy and Reliability:** The client should be able to control the amount of force applied to the pedal over a force gradient of 8 to 12 pounds (3.6 to 5.4 kg). The device should apply a consistent level of force each time it is activated.

**D. Life in Service:** The product should maintain function for at least 5 years.

**E. Shelf life:** Since the device is to be portable, it may be stored in a vehicle and be exposed to varying temperature extremes.

**F. Operating Environment:** Primary use of the device will be indoors with room temperature of 20-25 C. It will be transported to multiple locations and therefore will be exposed to a wide range of temperature and humidity. It will be placed on the floor and may be exposed to dirty surfaces.

**G. Ergonomics:** The device will interface with a prosthetic leg and should be positioned to allow the client to sit comfortably with minimal leg movement.

**H. Size:** The product must be portable as it will be used in multiple locations. The size will also be limited by the amount of space available underneath the piano, between the pedals, and between the piano and the user.

**I. Weight:** The device should be light weight so that it is portable because the client will need to move it independently. Ideally, the device will weigh no more than 10 lbs.

**J. Materials:** The device should be constructed so that it is durable, but not heavy. It should also be made with materials that are not harmful to the client since some parts of it will have direct contact with the prostheses and/or clothing.

**K. Aesthetics, Appearance and Finish:** The finished product should be aesthetically pleasing given that it will be utilized in public. It should also be as inconspicuous as possible.

## **2. Production Characteristics**

**A. Quantity:** We will be constructing one device.

**B. Target Product cost:** The target product cost will be between \$100 and \$200.

## **3. Miscellaneous**

**A. Standards and Specifications:** The device should comply with applicable ADA regulations.

**B. Competition:** There are two known current devices for consumers with limited mobility in the lower body. One uses lateral movement of the leg to press the pedal, and the other uses a wireless device to sense the movement of the mouth which in turn, applied force to the pedal.