Engineering Assistive Technologies for Disabilities: E-Trike, Nasal Spray Assist, Seizure Detection System, AFO Accelerometer

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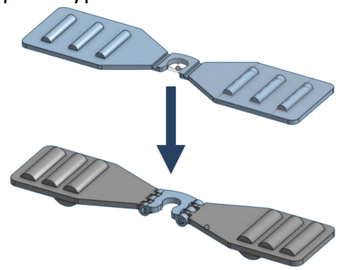
Introduction

The Volunteers for Medical Engineering is a student organization affiliated with The IMAGE Center of Maryland, a non-profit organization dedicated to designing and testing assistive aids/devices for community members with disabilities within the greater Baltimore area.

Low-Cost Nasal Spray Assist

Goal: Develop a mechanical assist device allowing individuals with hindered grip strength or tactile sensation to dispense a nasal spray bottle.

Description: Taking inspiration from current products that allow individuals with weak or arthritic fingers to easily grasp and dispense ophthalmic medication, we reconfigured the hand configuration of dispensing from a vertical "pinching" motion to a horizontal "clenching" motion. Being 3D-printed allows for the device to be low-cost and accessible. Future steps involve designing a scissor-like dispensing mechanism to address the shortcomings of this prototype.



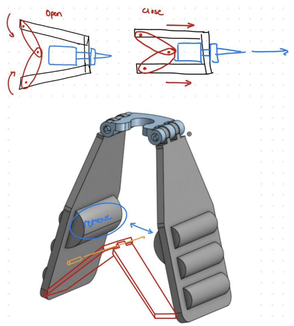


Fig. 1. Device Ideation of the Nasal Spray Assist

Ankle-Foot Orthosis (AFO) Accelerometer

Goal: Develop an instrumentation device attachable to ankle-foot orthoses (AFOs) and capable of measuring the acceleration of foot/ankle movements in three-dimensions while a patient is walking to determine the effect of adding weights to AFOs.

Description: AFOs function as a brace to provide stability to the lower leg, ankle, and foot region, as well as correct for weakness and asymmetry in patients with conditions leading to lower leg instability (e.g. cerebral palsy, spasticity, an uneven gait, etc.). The device mainly consists of an Arduino Nano with an on-board accelerometer that writes data to an SD card for later review and is enclosed in 3D printed housing.

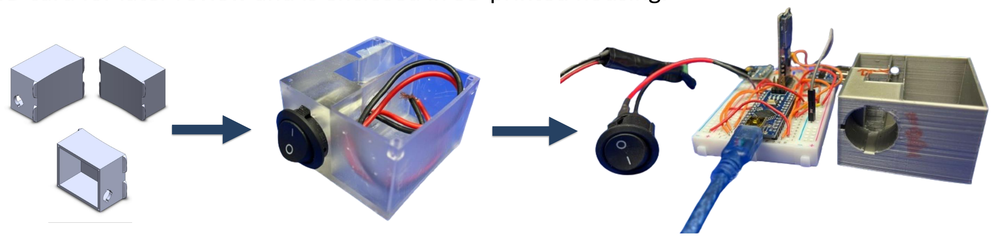
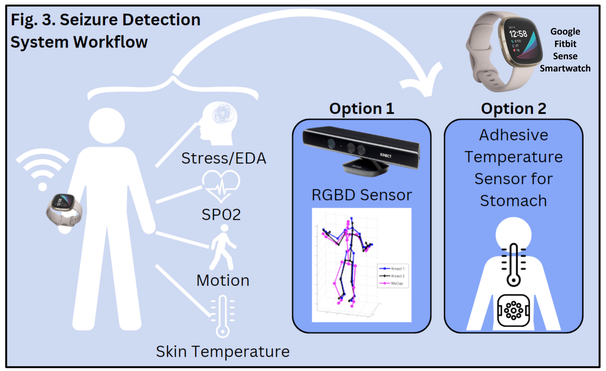


Fig. 2. Fabrication Workflow of the AFO Accelerometer

Seizure Detection System

Goal: Design a wearable seizure detection system to alert guardians of oncoming seizures.

Description: Commonly observed indicators prior to seizures include lowered blood oxygen level, increased skin temperature, and fever symptoms. The use of the Google Fitbit Sense smartwatch with integrated sensors for each indicator (as well as an onboard accelerometer) allows for precise and sustained measurements to assess for potential seizure events. Additional sensing modalities can ensure proper measurements in the event of interrupted contact between smartwatch and wrist. Future steps involve beginning work on app development using the Fitbit Sense software development kit (SDK) to allow for measurement of the above parameters and develop a custom-fit, soft, and washable wristband.



E-Trike for Degenerative Joint Disease

Goal: Assemble an adapted and inexpensive electric trike with trunk support according to protocol used by UMD's VME branch.

Description: For adults with disabilities, stability and required pedal torque may be significant detractors to riding a bike. However, market e-bikes are prohibitively expensive and still lack sufficient stability. To make a suitable bike for our client, we adapted a standard adult e-bike frame. A torque adjuster controlled by the pedals and a set of handlebar controls sends power to the front powered wheel. The bike is fit with an LCD display, and all electronics are enclosed in a waterproof rear case. Additionally, a more-stable bike seat will be added. The E-trike makes bike riding newly accessible to a patient who may not otherwise be able to, at a reduced cost.

Fig. 4. Fully-Assembled Adaptive E-Trike with Trunk Support

Torque Adjuster

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