CS486C – Senior Capstone Design in Computer Science
## Project Description

Project Title:	Telerehab Patient Portal – A Web-Based AWS Database Visualizer and API
Sponsor Information: biomotum	**Zachary F. Lerner, Ph.D.** Assistant Professor Mechanical Engineering Northern Arizona University biomech.nau.edu CTO Boimotum, Inc Biomotum.com Zach@biomotum.com

Project Overview:

Do you want a capstone project with tangible outcomes that can improve people's lives? There are over 7.5M individuals in the United States who have difficulty walking and engaging in physical activity. These patients may have acute or chronic conditions that impair their mobility. Our focus is on assisting children with cerebral palsy, the most common cause of pediatric disability worldwide. Help us change the trajectory of their lifelong disability that incurs a financial burden of over $1 Million per affected child.

The current approaches for treating these individuals include physical therapy (PT) and prescription of passive leg braces. While physical therapy can be effective, it can be difficult to get enough PT to lead to improved mobility. Biomotum is working to help solve mobility and rehabilitation challenges through exoskeleton technology with remote therapy delivery capabilities to increase the amount and effectiveness of clinical care.

Figure 1. The Biomotum ankle exoskeleton device and our existing user interface iOS app
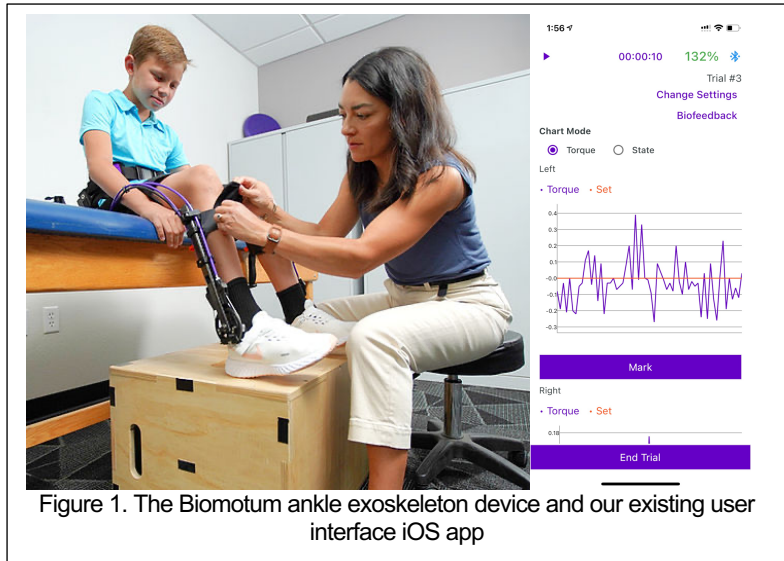
Biomotum needs your help. Biomotum, Inc. is an NAU spin-off assistive technology company with a long-term business objective to provide rehabilitation professionals and patients intelligent products that increase independence and mobility. We have developed connected wearable robotic devices to be used in rehabilitation. Our device transmits a rich dataset to an Amazon Web Services (AWS) noSQL database. This dataset holds critical information regarding how our device is working and how our patients are recovering.

The Problem. Where we are and what we need. We have created a functional prototype of the battery-powered ankle exoskeleton system and are planning on starting clinical trials in 2022. We contracted with a software development firm to create a mobile phone (iOS and Android) app that controls the device (enter patient details, sets

up a session, calibrates the device, sends torque control commands) and streams sensor data (number of steps, battery data, torque set points, etc.) to the AWS database. The AWS database is organized by a device ID, and then by a participant code. For each participant, session and trial summaries are recorded. We currently use a simple Python script to pull down the session files.

However, we do not have an effective way to view and visualize data in the database. Therefore, we do not know how much or how well the device is being used. We need your help in creating a secure Web Application to visualize and interact with our AWS noSQL database.

To address this shortcoming, we envision a secure web portal in which we can track deployed device usage, easily monitor which patient devices are active and sending data, and conduct simple preliminary analysis of that data. In particular, some key functions of the portal will include the ability to go to a website, select a named device (e.g., Phoenix Children's Hospital Device #2), view which patients have used it and summarize (e.g., number of steps taken). Below, we outline the minimum viable product (MVP), and the project's stretch goals:

Minimum Viable Product -- We need a web portal and database visualizer tool that has:
- A basic Web2.0 portal with the ability to create admin and regular user login accounts
- Ability to pull down device and user session data from the AWS noSQL database (select a device, select a patient, select a trial)
- Ability to save the device data to a google drive account
- Display high-level device analytics, including a running counter of total number of walking trials completed across all devices, and total steps taken
- Ability to track how our devices are being used, any device errors, or battery issues

Stretch Goals:
- A visualizer with interactive graphs and plots, and summary statistics
- Generate a "smart" tool to score and track a user's rehabilitation progress (steps taken, training time)
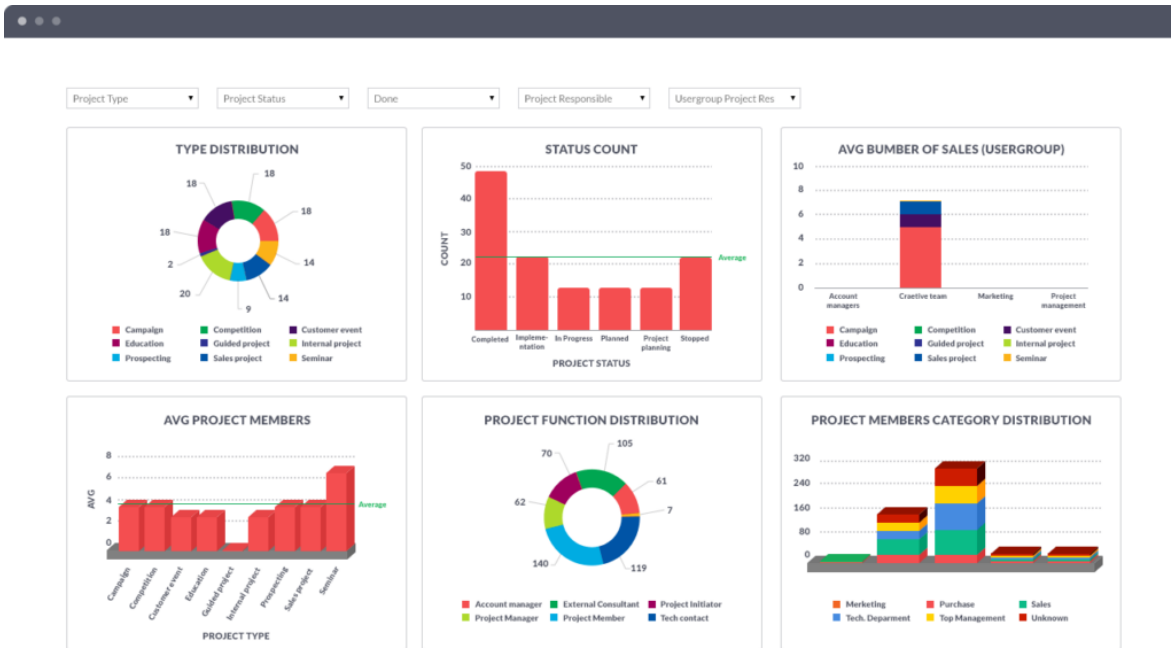- Generate Clinical Trial summary reports

Figure 2. Example data visualization portal to give you an idea of what we are looking for.

What if you are successful in this capstone project? You will create a valuable tool used by researchers and clinicians advancing the treatment of neurological disorders. You will gain insight into handling de-identified patient information, and creating interactive and easy to use web GUI with tracking algorithms under the hood.

Do you want a capstone project that gives you experience in a hot CS industry? Telerehab/Telemedicine, including remote monitoring and control of wearable assistive devices, is going to transform medicine in the coming years. This project would give you valuable experience to join this exciting and well-paying CS field.

Knowledge, skills, and expertise required for this project:
- Algorithm development
- GUI design and usability
- Database management (noSQL)
- Basic web programming techniques

Equipment Requirements:
- Software/tools freely available online

Software and other Deliverables:
- Selection of the programming language (e.g., Python)
- Creative yet intuitive data visualization design
- The functioning web portal/data visualizer tool
- API documentation
- A report detailing the design and implementation of the product in a complete, clear and professional manner.
- Complete professionally-documented codebase, delivered both as a repository in GitHub or BitBucket.