BME 484 Biomedical Engineering Capstone Design

Project Proposal

Model House for Assistive Living: A prototype for a handicap accessible house which implements new biomedical technologies that allow for decreased hazard and an improved quality of life.

Team: Amy Harmon, Project Manager
Ahmad Randall, Hardware Engineer
Alexis Welch, Software Engineer

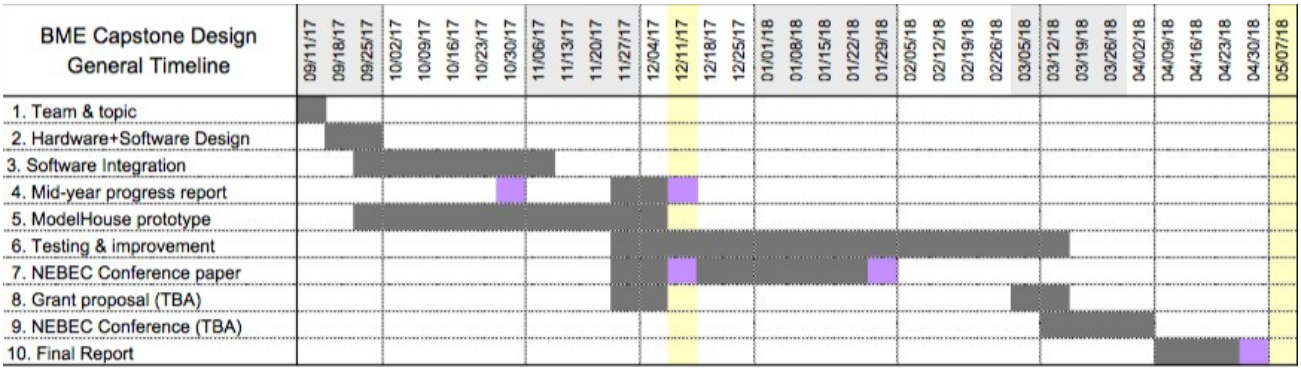
Abstract: There are many aspects of home life for disabled individuals that may pose issues which cause both emotional and physical struggles. Current designs for handicap accessible houses and ambient intelligence assistive technology aim to reduce these limitations. Although these advancements have made homes much more wheelchair accessible and technologically advanced, there are many possible accommodations for a wider range of disabilities and target demographics related to cognitive and physical decline that we would like to explore. Our goal is to further mitigate the physical and emotional stress caused by paraplegia, short stature, hemiparesis, or hemiplegia, stroke, deafness and many chronic age-related diseases. We aim to do this with new software and hardware designs incorporated in common household objects and pathways that will appease to a wide financial scope. Also, we want to appeal to the aging adults experiencing cognitive decline and may be less adapted to and overwhelmed by the ever-advancing evolution of modern technologies. However, we also want to ambient-assisted living (AAL) options that will appeal to individuals who are more comfortable with and adapted to these advancements. This model will simulate on a small scale how users with different disabilities can either manually or automatically perform difficult tasks with safety and ease. and provide an option for receiving important alerts through a Bluetooth connection to the individual's smartphone. The desired result we want is an improvement in the quality of life in the patient through the elimination of the dependence on a caregiver and hazards of independently performing tasks that would normally be strenuous or impossible for them. Overall, our design aims to accommodate the needs of disabled individuals to ultimately provide them with the freedom of independent living and a heightened sense of control of their own environment.

Innovation: Our group has innovated an idea for mechanical systems in a handicap accessible house that do not rely on electrical components in order to appeal to many different financial demographics. We will create a dollhouse-sized prototype that will include primarily two purely mechanical systems. One of the mechanical systems provides a lever for opening doors that simultaneously turns the handle while pulling the door open. The lever will be placed at a convenient distance from the door and ground to allow the user to pull the lever and wheel through the door without having to stop. The other mechanical system consists of rotating storage shelves which can be rotated to lock the desired shelf at an accessible height by a crank gear controlled by the user. We will also include infrared motion sensors around doors to assist blind individuals which will detect objects blocking the path and then send an alert to an app on the user's smartphone through a Bluetooth connection. The app will also help deaf individuals by also being connected a small doorbell and a timer to represent various home appliances such as ovens, laundry machines, microwaves, etc. The app will also include a Bluetooth controlled automatic door opener for a pathway to a room specified by the user through their smartphone to lessen the tediousness of travel within the home for paraplegic individuals.

Materials: The materials we will need for the mechanical systems include a dollhouse, 3D-printed gears, crank arms, ball bearings, chain wheels, levers, and linear bearings. The materials needed for the app include a Bluetooth chip connecting to the sensors located in the doll house, an Android tablet, and access to MP Lab for the software coding. The mechanical systems consist of a combination of gears, linear bearings, and pulleys, and weights

Subtasks:
1. Create blueprint for layout of house
2. Build the structure of the house
3. Implement the gear systems and electrical hardware in the specified parts of the house
4. Add Bluetooth chip to the hardware that connects to the Android tablet
5. Use C++ coding to create the app and create the algorithms to link the various buttons with their designated actions in the house

Timeline:



References:

[1] Seplaki C.L, et al. “Environment and Use of Assistive Devices for Mobility.” *The Gerontologist,* vol. 54, No. 4, 651-660
[2] Castillejo E, et al. “Modeling Users, Context and Devices for Ambient Assisted Living Environments.” *Sensors (Basel, Switzerland).* 2014;14(3):5354-5391
[3] Manton JD, et al. “Development of an open technology sensor suite for assisted living: a student-led research project.” *Interface Focus.* 2016;6(4):20160018
[4] Vincent C., et al. “Examination of New Environmental Control Applications.” *Assistive Technology*. 2002;14(2):98-111
[5] Ruijiao Li., et al. “Cognitive assisted living ambient system: a survey.” *Digital Communications and Networks.* 2015:1(4):229-252