1. Devices to assess and perform isometric (Isokinetic/Isotonic) strength (upper limb and/or lower limb) training independently.

Isometric (muscle length do not change during contraction) strength measurement is a common test performed by therapists to quantitatively measure muscle strength of patient. Traditionally, portable handheld muscle testers (figure 1) are used due to their portability and lower price tag compared to the more expensive and larger footprint Isokinetic dynamometers (figure 2).

As the portable muscle tester (figure 1) is handheld by therapist, they are subjected to movement, which might affect the reading and poses a danger for the therapist especially when testing the stronger muscle group such as the quadriceps.

Design a solution to secure the measurement device so that the measurement can be done without therapist holding the device. Solution should be usable for measuring most major muscle of both upper and lower limbs.

2. Devices/equipment to assess coordination and forces during wipe table task

One of the functional tasks done in daily life is doing a wiping motion to clean the table top. However, there are no standardized methods yet to assess the task. The completion and execution of task is also highly subjective to therapist judgement. Therefore there is need to standardize the task by designing and development of devices to help in quantifying the task in terms of motion and force used during the wiping motion. This will help in creating data to compare the motion and force of different people.
3. **Devices/equipment to assess coordination during folding towel task**

Folding towel task was used by therapists to assess the patient coordination by observing the subject arm movement and completeness of folded towel. The patient is required to fold a standard size face towel into two layers with the towel edges need to within 1.5 inch away from the end. While the patient is folding the towel, the therapist will observe the arm movement and range of motion of the patient. Once done, the therapist will also judge whether patient had fold the towel properly. This shows that the task is highly dependent on the therapist observation and the results are mostly non-quantifiable. Therefore, there a need of solution that can quantify the arm motion and the quality of the folded towel.

4. **Automated Occupational Therapy home assessment**

Occupational therapy home assessments are essential for a person’s safety and performance of activities of daily living. Home modifications are recommended, such as installing grab bars or as simple as removing loose floor rugs. Occupational therapists also look at how a person performs daily tasks or mobility in the house, and provide recommendation for changing the way a task is performed.

Home assessments can be time consuming as therapists need to travel to and fro the person’s house. They also spend time measuring dimensions and sizes of the spaces in the house. Design a solution so that the home assessment process can be automated.

5. **How to assess cognition through games**

A cognitive functioning assessment involves the use of psychometric tests to obtain an overview of an individual’s thinking skills. The tests look at the way a person processes information, reasons and learns in different ways. It gives information about their strengths and weaknesses in intellectual functioning. Design games that can get quantitative data during the assessment. Also, games can make this process more interesting and easier acceptable by the patients.

6. **Augmented reality for assessing of making a hot drink**

Pouring hot drinks is one of key activities of daily living. However, it can be a challenge for patients to manage it. It becomes very important if patients can practice this task and therapist can access this task in a safe way. Make this task ‘augmented reality ‘can prevent patients from hurting themselves when they practice. At the same time, it would create a way for therapists to access patients’ performance quantitatively. The quantitative results for example how fast the patient pour the water and the percentage of water they can pour into target are meaningful data for therapist and researchers to review.
7. **Easy crutch to walk up and down stairs**

Crutches are frequently used by persons with disability or mobility impairments. However, it is challenging to use crutches to mobilize up and down stairs. This is particularly difficult for persons who need to maintain a non-weight bearing status on one foot (not being able to place weight/ walk on one foot).

When going up the stairs, the person has to place weight on the crutches as he or she hops up the next step with the unaffected leg. The person then brings the affected leg and crutch up the stairs. When going down the stairs, the person needs to place the crutches on the lower step together with the affected leg (while still maintaining non weight bearing). The person then hops onto the lower step with the unaffected leg.

Design a crutch that is facilitates walking up and down the stairs.

8. **Sensorized spoon.**

Grasping an object (a cup of coffee, a toothbrush, or any other objects) becomes an integral part of our daily activities. One big challenge for patients with chronic stroke is the recovery of hand function. Inability to grasp eating utensils increases the dependence on the caregivers. This problem statement focuses on eating activity. We are looking for a sensorized eating utensil (a spoon) that can be used to record or track feeding activity of the patients. Such device would be useful for clinicians as part of an assessment or monitoring tool. In this project, students are expected to design a customized spoon with inertial measurement units and a force sensor. At the end of the project, students have to validate the sensors using a MoCap system that is seen as a gold standard.

9. **Investigating forces during a sit-to-stand task.**

For elderly and people with disability, standing up from a chair to walk or do an activity impose a challenge as they have to support body weight and maintain balance. In most cases, the process of standing involves exerting downward forces using one or both hands. Students first have to design a customized and sensorized chair that is able to monitor forces of three different body parts: downward forces of the two hands, as well as the force exerted to the back of the chair. Near the end of the project, students will run data collection that includes kinematics and kinetics measurement using the available MoCap system in the lab. Focus will be given to monitor how a person exerts forces in different phases of movement during a sit-to-stand task.
**Subject areas not restricting to the above statement problems**

**Access and Communication Technologies:**

Computer access and use: Innovation in software and hardware for access to computing technologies, integration of computer/computing technologies, alternative access, augmentative and alternative communication.

**Aging:**

Technologies, interventions, etc. specifically related to supporting aging; this can be for any age group.

**Cognitive and Sensory Impairments:**

Cognitive disabilities, learning disabilities, developmental disabilities, cognitive rehabilitation and aids to memory, low vision/blindness, hearing impairments, aging and cognition changes.

**Job & Environmental Accommodation:**

Including Ergonomics: Access to employment, education, or built environments, ergonomics, farming and other rural interventions, EADL systems, universal design of products, places & systems, home accessibility, liability and legal issues associated with home access and workplace modifications.

**Emerging Technology:**

Emerging technologies are new technologies and innovations with the potential to improve the health and well-being of people with disabilities.

**Seating and Mobility:**

Including Complex Rehab Technology (CRT): Seating and wheelchair interventions, transportation issues, vehicle modifications, user training, wheelchair features and client/diagnosis matching, objective tests, custom vs. off-the-shelf solutions, documentation and outcome measures for funding approval, mobility issues over a lifespan.