

Results

ProgramName	NameofProject	ProjectDescription	Activities	SkillorCoursesNee	Major
ASPIRE					
ASPIRE	Activity monitor for manual wheelchair users	The project will be built upon the existing activity montiors developed at CMU and HERL including the wheelchair datalogger and the eWatch. These activity monitors were designed to track the activity levels of wheelchair users over time, enabling them to self-monitor their physical activity participation and serving as a motivational tool. Students will work on improving the hardware and software of the wheelchair datalogger and eWatch so that they can communicate with each other and also possibly communicate with a cell phone to provide real-time feedback to users.	Embedded programming and eletronics	Electrical engineering	
ASPIRE	Acute Mountain Sickness in Veterans with Disabilities	We have collected several years' data in Colorado at the Winter Sports clinic for veterans with disabilities where individuals participate in adaptive sports like skiing and snowmobiling. We have a very large database containing data such as medical history and symptoms associated with Acute Mountain sickness, which is an illness that occurs at high altitude. We hypothesize that individuals with neurological issues like traumatic brain injury have a higher occurrence of mountain sickness.	The student who chooses this project will not collect any new data but will analyze existing data and be responsible for data entry for all subjects who were tested in 2009, which involved converting paper records to electronic spreadsheet format.	Data entry requires familiarity with Microsoft Excel.	Any
ASPIRE	Computerized Assessments of Power Wheelchair Driving	This project involves two parts. The first part was a project in which a conventional power wheelchair joystick was compared to a novel isometric joystick in a computerized driving task in individuals with Cerebral Palsy and control subjects. Performance data was collected. The student working on this project will help to organize and analyze the data collected and will write an abstract on the results. The second part involves learing to use Real World Software which is a video gaming software used to create virtual environments for military training. The student will use the software to create a virtual environment that simulates power wheelchair driving.	Data analysis, statistical analysis, data entry, learning to use computerized environment software.	Experience with Microsoft Excel is required. Experience with C++ and/or Matlab is preferred but not required.	A student interested in programming or virtual reality/video games AND rehabilitation engineering

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ASPIRE	Design of New Speed and Acceleration Measurement Device for Wheelchair Testing	One section of ANSI/RESNA and ISO testing of powered wheelchairs and scooters requires the speed, acceleration, and deceleration of the chair to be measured on a horizontal surface, a 3 degree slope, and a 6 degree slope. Our current system requires a trailing wheel to be connected to a laptop, which the driver of the chair must operate. This is cumbersome and inefficient, and somewhat dangerous since the chair driver must divide his/her attention while performing the test. It would be ideal for the measurement device to record the data, which can be retrieved afterward. Alternatively, the device could have wireless capabilities, so a bystander can collect the data with a laptop while the chair is being drive by someone else.	Data collection, meetings, wheelchair testing, design, fabrication, programming	3D design skills (preferably Solidworks) Knowledge of electronics Programming skills (C or C++ preferred)	1.) Electrical engineering 2.) Computer Science 3.) Bioengineering 4.) Mechanical Engineering
ASPIRE	Development of an Online Data Collection For Wheelchair Activity	We recently recieved funding to record the activity of wheelchair users at five international sites, using our non-invasive manual wheelchair dataloggers (MDL). To streamline data collection, data processing, and results reporting, we are recruinting a student to develop an online data-collection and processing system. The system will require a user-friendly interface and simple instructions and methodology for uploading data. The back-end will include a database which stores pertinent information about the MDL data. A second front-end will need to be developed to allow convenient searching of the database and presentaiton of results.	The student will develop the front-end and back-end of the online collection system.	Proficiency in HTML & database development (e.g. MySQL) and other related programming skills (PHP). Knowledge of online data security methods is critical.	Computer Science or related field. Another field of study is possible based on the data-base development experience of the student.
ASPIRE	Development of Manual Propulsion Evaluation Tools	Develop and evaluate tools for manual wheelchair propulsion training, <ul style="list-style-type: none"> Knowledge gap: There are not any wheelchair propulsion monitoring and training systems available to provide the critical information necessary for evaluating wheelchair use in the user's natural environment. Our prior work has resulted in a propulsion monitoring system for manual wheelchair users. Anticipated benefit: This propose work is aimed at further development and testing so that the system can be subsequently used for propulsion training. 	data collection, bibliographic searches, administer questionnaires, weekly meetings with research team		Any engineering or Health science discipline.

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ASPIRE	Development of Person-Specific Therapies	<p>Develop mechanistic mathematical models of inflammation and healing to characterize secondary injury in SCI for development of person-specific therapies and for general technology/intervention evaluations</p> <ul style="list-style-type: none"> Knowledge gap: Agent-based models of inflammation exist, but they have not been applied to SCI nor have they been used to aid in the detection and prevention of pressure ulcers and musculoskeletal injury, or to evaluate bladder function. Translational gap exists between known cellular and molecular mechanisms of secondary injury and clinically relevant phenomenon that impact research and clinical intervention development. Anticipated benefit: Develop and provide methodologies (i.e., modeling) for researchers to bridge the above translational gap, with the subsequent provision of engineering platforms for therapy development and intervention evaluation. 	data collection, bibliographic searches, administer questionnaires, weekly meetings with research team		Any engineering or Health science discipline.
ASPIRE	Effect of Trunk Moment of Inertia during Lateral Wheelchair Transfers	<p>Peak Resultant Shoulder Force Rate of Loading: The soft tissues of the upper limbs wheelchair users are exposed on a daily basis to microtrauma from repetitive motion activities (e.g. wheelchair propulsion). Transfers are less repetitive but involve shorter bursts of activity with higher magnitude forces (30-40% body weight during transfer compared to less than 5% during each propulsion stroke). As the tissues are subjected to pre-loading from other ADLs, cuff tears and other serious shoulder injuries tend to occur more often during transfers. The slope of the resultant shoulder force yields the rate at which the soft tissues are forcefully loaded and may be a risk factor for injury during transfer.</p>	Literature research, program code development, and weekly meetings with research team.	Familiar with programming skills in Matlab, C/C++ language or statistical analysis(SPSS) are preferred.	Biomedical Engineering, Bioengineering, Mechanical Engineering, Computer Science or Computer Engineering.

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ASPIRE	Effectiveness of Upper Limb Exercise Devices in Spina Bifida	<p>Background/Objective: To determine the difference in health related measures of fitness in adults with spina bifida (SB) who participate in a 16 week exercise program, 3 times a week for 30 minutes a session, using either a GameCycle or an arm ergometer. To determine whether text messaging reminders through low cost mobile wireless technology improves compliance and motivation to follow a regular exercise program.</p> <p>Setting: Two residential living facilities at the Spina Bifida Association of Western Pennsylvania (SBAWP) in Wexford, Pennsylvania.</p> <p>Subject Population: A sample of convenience of two groups of adults with SB.</p> <p>Main Outcome Measures: Pre and post measures include VO2max measured by a Cosmed K4b2 breath by breath gas analysis system during submaximal exercise testing using a ramped protocol, resting heart rate (RHR) measured by a Polar monitor , blood pressure (BP), body mass index (BMI) adjusted for SB population using arm span and correction factor for muscle mass loss¹, waist circumference, Physical Activity Scale for Individuals with Physical Disabilities (PASIPD)², and the Groningen Enjoyment Questionnaire (GEQ)³. Measures to track compliance with an exercise program include tracking of duration of exercise and data gathered from the GameCycle Clinical Reporting Wizard.</p> <p>Expected outcomes: The GameCycle group will show greater improvements when compared to the standard arm Ergometer group with respect to main outcome measures. Text message reminders will increase participation and compliance with an exercise program.</p>	<p>*Student will be working with data collected from post exercise testing using a portable metabolic gas analyzer. Depending on the progress of the study, most or all of the data may be collected so the student may or may not be involved in the actual data collection process</p> <p>*Assist with data entry of results of exercise testing, anthropometrics, and questionnaire information</p> <p>*Student will learn basic statistics and fundamentals of data analysis</p> <p>*Student will learn the use of endnote to expand a bibliography for this project and for writing research papers</p>	Interest in exercise physiology, and some experience with Excel is preferred.	PT, OT, or any student interested in exercise physiology

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ASPIRE	Evaluation of a weight shifting approach to preventing pressure ulcers	<p>Evaluate a weight shifting approach for preventing pressure ulcers, and</p> <ul style="list-style-type: none"> • Knowledge gap: Involuntary weight shifting for the purposes of preventing pressure ulcers can be accomplished using implanted gluteal stimulators or with alternating pressure cushions. Their combined implementation may have benefits beyond either method implemented independently. • Anticipated benefit: Our work will quantify the impact of alternating pressure on weight shifting and compare it to the combined effect of gluteal stimulation and alternating pressure. 	data collection, bibliographic searches, administer questionnaires, weekly meetings with research team		Any engineering or Health science discipline.
ASPIRE	Evaluation of novel manual wheelchair propulsion devices	<p>Evaluate novel manual wheelchair propulsion devices for preventing shoulder injury,</p> <ul style="list-style-type: none"> • Knowledge gap: Ergonomic handrims have been design to reduce the incidence of cumulative trauma disorders (CTDs) among manual wheelchairs users. However, there is no evidence that they accomplish this objective. • Anticipated benefit: A determination of differences in metabolic responses of the upper extremities when using different handrims may provide relevant information on the acute responses of nerves and tendons to micro trauma and provide insight on CTDs and the benefits of ergonomic handrims. 	data collection, bibliographic searches, administer questionnaires, weekly meetings with research team		Any engineering or Health science discipline.
ASPIRE	Evaluation of Seat Cushion Effects	<p>Evaluate the effects of support surface active cooling and low shear followed by development and evaluation of a novel seat cushion incorporating these features.</p> <ul style="list-style-type: none"> • Knowledge gap: Positive effects of cooling for enhancing tissue tolerance to pressure have been demonstrated in animal model research. Comparable studies have not been performed in humans nor have the effects in people with SCI been studied. • Anticipated benefit: First of its kind demonstration of cooling effects in persons with SCI, population-specific design specifications for cooling cushions, innovative concepts for reducing shear, scientific knowledge on nature of shear in the seated posture 	data collection, bibliographic searches, administer questionnaires, weekly meetings with research team		Any engineering or Health science discipline.

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ASPIRE	Investigation of Carpal Tunnel Pathophysiology in Computer Keyboard Users	Using ultrasound, we will collect images of the median nerve prior to and following a one-hour keyboarding task in subjects with and without electrodiagnostically confirmed Carpal Tunnel Syndrome. We will quantify acute changes in the median nerve through image analysis techniques. These changes will be correlated to keyboarding biomechanics, and possibly to symptoms of median nerve entrapment.	<ul style="list-style-type: none"> - Subject Recruitment <ul style="list-style-type: none"> . Administer questionnaires . Have subjects sign consent forms . Assist in performing physical exam - Data Collection: <ul style="list-style-type: none"> . Ultrasound imaging . VICON motion analysis system . Typing productivity data . Forces and moments - Literature Search - Data Analysis - Writing Papers - Presentations - Meetings with research team and other researchers 	<ul style="list-style-type: none"> - Required courses: <ul style="list-style-type: none"> . Basic Human Anatomy . Physiology . First level mechanics - Preferred skills: <ul style="list-style-type: none"> . Proficiency in MATLAB . Advanced mechanics/biomechanics . Computer programming 	Bioengineering
ASPIRE	Iphone App for Vibration Monitoring	We have an ongoing project to understand the health effects of vibration exposure which occurs during wheelchair driving. We know high levels of exposure can cause serious injuries. Our past measurements have been focused on lab-based instrumentation to monitor vibrations while people maneuver wheelchairs through simulated road-courses. With the ubiquity of smart-phone technologies, many of which have accelerometers, we are investigating whether they are a viable option to collect vibration during community wheelchair use.	The student will lead the development of an iphone/itouch application which can monitor accelerations during wheelchair maneuvering. After developing the application, the student will perform a thorough evaluation of the device in a lab-based and community environments.	<ul style="list-style-type: none"> Computer Programming Experience or interests in developing mobile applications 	Computer Science

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ASPIRE	Longitudinal Study of Acute and Chronic Arm Pathology Following Spinal Cord Injury	The objective of this research study is to follow individuals with spinal cord injury (SCI) over time and determine if there is a relationship between arm pain and injury and the type of wheelchair used as well as if injury results from how a wheelchair is propelled. The onset and progression of wrist pain and shoulder pain will be evaluated through analysis of kinematic and kinetic measures of propulsion as well as ultrasound evaluation. For the study subjects propel over various surfaces while cameras record the location of infrared markers and pushrim forces are recorded. Key biomechanical variables which will be evaluated include cadence, pushrim force, and joint forces and rotations. Before and after propulsion ultrasound measurements are taken at both the shoulder at the wrist. Acute changes in ultrasound will allow us to evaluate how soft tissue structures of these joints are linked to propulsion activity and pain. There are multiple aspects of the project the student may be involved in which include analysis of: kinematic data collected with a Vicon Motion Capture system, pushrim kinetics collected using an instrumented wheel that can sense three-dimensional forces and moments, or ultrasound images of the wrist and shoulder.	Student may be involved with data collection which could include interfacing with Vicon Motion Capture, SmartWheel, or ultrasound technology as well as biomechanical data analysis. Student will complete a literature review based on the aspect of the project they are focusing on to familiarize them with the research area. Student will also have weekly meetings with the advisor and attend bi-weekly Biolab meetings at HERL.	Students should be familiar with MATLAB for writing and modifying programs to analyze data.	Engineering
ASPIRE	Single Motor Propelled Power Wheelchair (SIMPL)	We have developed and tested a power wheelchair with a novel drivetrain system which allows it to easily be switched (upgraded) from a manual to a power steering control system. At this stage of the development, the SIMPL operates as a manually-steered device. We are recruiting a student to perform the necessary mechanical design and control algorithm programming to develop and implement the power steering upgrade module for the SIMPL.	The student will perform mechanical design for the power steering module, and support the development of the control strategy to operate the power steering module.	Mechanical Design Control Theory Computer Programming Mechanical and electro-mechanical design and fabrication skills Robotics	Mechanical Engineer and/or Electrical Engineer with interest and experience with robotic systems.
ASPIRE	Technology to Motivate Compliance with Occupational and Physical Therapy	We are working with clinical organizations serving both children and adults with significant disabilities to identify ways that technology can be used to motivate people to perform occupational and physical therapy activities. Examples include using accelerometers to trigger music and force sensors to activate toys.	Software development, weekly meetings with the research team, occasional clinical observation.	Proficiency developing software using C/C++, Java or Visual Basic; experience with electronics design and fabrication	Electrical engineering, computer engineering, computer science

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ASPIRE	Testing and evaluation of Trekease device as a "Wii for Wheelchairs"	Testing and evaluation of Trekease device as a "Wii for Wheelchairs" YouTube uploaded videos of previous student efforts, "trekease"	Hands on testing of LabVIEW DAQ software & hardware, encoders, computer gaming interface, experimental determination of frictional coefficients and moments of inertia	Basic engineering and applied physics skills	BME with basic electronics, physics, dynamics and mechatronics understanding
ASPIRE	The impact of trunk level of impairment on transfer techniques and wheelchair propulsion	The objective of this research study is to investigate the impact of trunk level of impairment on transfer techniques and wheelchair propulsion. The proposed study will provide quantitative balance measures to gain conscious of the potentials and limits of current biomechanical analysis of trunk movement in wheelchair activities.	Literature research, program code development, and weekly meetings with research team.	Familiar with programming skills (Matlab, C++) to analyze data. Statistical analysis (SPSS) are preferred but not required.	Biomedical Engineering, Bioengineering, Mechanical Engineering, Computer Science or Computer Engineering.
QoLT	Adaptive Driving Program Chart Review	This project will look at what happens in an Adaptive Driving Program. The data collection effort will be completed before arrival of REU students. First, the REU student will have an overview of the research literature on driving assessment for people with disabilities and older Americans. Following a brainstorm session of how to visualize chart data according to concepts in the literature, the REU student will conduct exploratory data analysis on chart data (de-identified) from the Adaptive Driving Program at the Center for Assistive Technology. During this process, the REU student will learn about journal manuscript preparation and contribute a write-up for publication of the findings from data analysis. There may be an opportunity to visit the Adaptive Driving Program and try out a car with vehicle modifications.	exploratory data analysis, literature search, and journal manuscript	skills: Excel, Word, Power Point courses: no requirements	Biomedical eng, mechanical eng, electrical eng, occupational therapy, or pre-med

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QoLT	Advanced Sensing for Assessment of Parkinson's Disease	The goal of our research is to use robotic technology to develop methods to measure early symptoms of Parkinson's disease. These tools will speed the development of drug treatment and allow early diagnosis of Parkinson's once effective treatment is available. In this project, robots and force sensors are used to measure fine motor control in individuals with Parkinson's as they complete various tasks. The information collected will then be analyzed using data mining techniques to produce an objective, quantitative measure of the motor signs of Parkinson's disease.	data collection with human subjects, data analysis in Matlab, meetings with research team, literature review	At least one programming course (C++ or equivalent) - required Experience with Matlab - vastly preferred Statistics - preferred Machine learning/artificial intelligence - preferred	Biomechanical engineering Computer science
QoLT	embedded assessment of cognitive decline	We are using sensors to assess cognitive decline of elders, by tracking how well individuals perform everyday activities	Some combination of (depending on student's abilities) - running studies - building sensor systems and associated software - interviewing subjects - analyzing data - working with occupational therapists	nothing required preferred: either some hardware and software background, or an interest in working with elders, their clinicians and their data	CS, ECE, Psychology

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QoLT	Enhancement of Motor Cortex Activity in Persons with Spinal Cord Injury	<p>We aim to develop a neurofeedback paradigm to facilitate activation within the motor cortex of the brain in individuals with tetraplegia. Magnetoencephalography (MEG) will be used to non-invasively measure brain activity during observed, imagined, imitated, and overt upper limb movements in individuals with tetraplegia and an unimpaired control group. This baseline evaluation allows us to compare cortical activation during simple movement tasks between individuals with tetraplegia and in a group of able-bodied subjects. A training video showing the simple movements will be displayed while the subjects observe or imitate the action in order to engage the mirror neuron system, which is a potent facilitator of motor cortex excitability. Once we identify the cortical areas responsible for intended movement in subjects with tetraplegia, we will use MEG to provide neurofeedback by coupling the action of a virtual hand/upper limb display to MEG signal modulation in real-time. Similar to biofeedback, a physiological signal is being used to influence behavior, in this case cortical modulation. By coupling the MEG signals to a virtual hand, we activate the mirror neuron system which will map the observed action onto the subject's own motor representation. Half of the subjects with tetraplegia will receive neurofeedback during the second visit, while the others serve as a control group and simply repeat the baseline evaluation. During the third visit, all subjects in the SCI group will receive neurofeedback training.</p>	Data collection, data analysis, monthly research team meetings, bibliographic searches	Experience with Matlab-required Familiarity with signal processing, Fourier analysis-preferred	Bioengineering, Electrical Engineering, Computer Engineering, Neuroscience

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QoLT	Incorporating Semantic Information in Activity Recognition	We have a large data set of daily activities, such as cooking, for the purpose of activity recognition from multiple sensors. The data set includes video and audio from multiple locations in the space as well as a wearable camera and audio recording device, accelerometers, RFID tags, and motion capture data as ground truth. To goal of this project is to design machine learning algorithms which are able to generate sensible interpretations of sensor data and correct predictions of users behavior and motion. Due to the challenges this data set poses, we believe incorporating semantic information about the environment will be a crucial step toward robust activity recognition.	Programming, data analysis, algorithm development, weekly meetings.	Programming, preferably in Matlab, however C/C++/Java is ok, too.	Computer Science, Computer Engineering
QoLT	Interaction Design for HERB robot	Design form and interaction for the Intel HERB robot.	User observations, literature review, data synthesis and analysis, industrial design, interface design, weekly meetings with research team.	Industrial and interface design skills.	Design, HCI.
QoLT	Interaction Design for HERB robot	We would like an undergraduate student to help with observations of users and studies using the HERB robot.	Interaction design for the robot, data collection, weekly meetings with research team.	Communication or industrial design, survey design, able to operate a video camera.	Communication or industrial design, information systems
QoLT	Leveraging Machine Learning to Help Treat Chronic Illness	Help to enter data and develop machine learning algorithms to quantify how doctors decide about treatments in a complex chronic condition, lyme disease.	Help to enter data and develop machine learning algorithms to quantify how doctors decide about treatments in a complex chronic condition, lyme disease.	machine learning course already completed, familiarity with chronic illness, experience with lyme disease in particular preferred.	Computer Science
QoLT	personal informatics	We are interested in how well people can create knowledge/understanding from seeing and interacting with visualizations of their own health data. Just as Mint.com provides useful visualizations of financial transactions and offers some analysis, we are interested in doing the same for health data.	Some combination of (depending on student's abilities) <ul style="list-style-type: none"> - running studies - building visualizations - interviewing subjects - analyzing data 	nothing required preferred: either some hardware and software background, or an interest in working with elders, their clinicians and their data	CS, ECE, Psychology

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QoLT	predicting and planning driving patterns	We have developed novel technology that can monitor (using GPS) how people drive and can generate models of their preferences for driving. We have applied this to elders to show how we can plan routes to a new destination that better matches how they like to drive (compared to Google), and can predict where drivers are going when they don't supply a destination. We would like to develop and deploy web and mobile phone applications that leverage this technology: e.g., predict destination and route and text someone when they are going to run into a heavily trafficked area, ahead of time, or automatically identifying where someone parked their car.	Some combination of (depending on student's abilities) <ul style="list-style-type: none"> - running studies - building web-based and/or mobile phone applications - analyzing data 	nothing required preferred: either some hardware and software background, or an interest in working with elders, their clinicians and their data	CS, ECE, Psychology
QoLT	RERC on Accessible Public Transportation	<p>There are several projects underway within the RERC-APT (http://www.ercapt.org). The two parallel themes are (a) creating and supporting a feedback loop between riders and public transit providers and (b) rider information that is personalized to the user.</p> <p>For the former, the research will identify effective "citizen science" methods to engage riders with disabilities and others in improving public transportation accessibility by documenting and assessing problems and good solutions throughout the system. The goal is to empower riders, resulting in a greater understanding of the transportation system, and improve the feedback loop between rider and provider.</p> <p>For the latter, we are focused on mobile, real-time information access to assist riders in using the system. This effort involves determining rider location, activity, and information needs to provide tailored information in order to streamline the experience and reduce interaction demand.</p>	The student will be directly integrated into the research team. Depending on schedule and student skills, this may involve assisting project members with human subject experiments, software development, or interaction design. The team meets weekly and the student's desk will be in the same room as the bulk of the team.	We prefer students who are good team players. In terms of specific skills, we will pair the student with a project and detailed activity based on skills.	Ideal backgrounds are: computer Science, ECE, psychology, and design. Other possible backgrounds include, but are not limited to: ME, rehabilitation, anthropology, and architecture.

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QoLT	Sensing the environment	The goal of the project is to develop new approaches to sensing, such as "inside-out" vision in which the system experiences the environment and the user's behavior from the user's point of view, thus facilitating the analysis of her behavior and intentions. Information from the vision system will be combined with multiple other sensors to develop a robust system for identification of human actions.	Programming, data manipulation, weekly meetings with team.	Programming experience, preferably Matlab, but C/C++/Java is ok, too.	Computer Science, Computer Engineering
QoLT	The self-tuned wall system	We are developing a self-tuned wall system that can automatically tune the ambient environment (e.g. transparency, lighting, and sound) to the preference of individual users. It also features a suspended particle display that can be converted to a touch screen, a gesture recognition system and multiple interfaces for the control console to encourage interactivity. It provides easy expandability for additional sensors, displays, and controls. The goal is to create a platform technology for different applications that will improve the interaction between the living environments and people with different types of disabilities and older adults. Three types of applications will be developed based on the platform including multi-modal biometric monitoring, executive function assistance for people with cognitive disabilities, and virtual environment-based anxiety/stress management.	Programming or electronics, machining and construction, weekly meeting	Programming preferably in C++, basic electronics	Computer science, computer engineering or electrical engineering