The Rehabilitation Engineering Research Center on Technologies for Children with Orthopedic Disabilities (Tech4POD) is proud to announce the **Senior Design Tech4POD completion winners** for the 2014 academic year.

First place went to project B12: PROJECT DRESS UP. Members of the Senior Design Team for this project were Kaitlin Conti, Heidi Klancnik, Alia Mian, Natalie Profio, Cory Steinmetz, and Meghan Teich. First place team members received $100 each.

- The purpose of this project was to design and build a first generation assistive dressing device that would allow three "tween" girls with arthrogryposis multiplex congenital (AMC) to don a shirt independently. Aside from putting on a shirt and giving the girls more independence, the device was also required to be adaptable to accommodate for the broad range of abilities associated with AMC and to increase the speed of the dressing process in a safe manner.

- While the girls bend over and hang their arms in front of them using gravity, the "L-bar" arm of the device rotates, following the natural curve of the their backs as it pulls a shirt up the arms, over the head, and down the torso. A simple lever and cable system is used to open and close the grippers, which securely hold the shirt in place throughout the cycle. Levers can be accessed both before and after a full rotation to allow the girls to both place a shirt in the device and to free themselves once the shirt is on.

- The selected motor rotates at a speed of 1.8 rpm, which is fast enough to speed up the dressing process by 35-70% without causing safety issues for the girls. Any other sources of safety concerns, such as pinching points and sharp screws, were addressed by covering the device with foam padding, covering the screw ends with silicone, and adding a shield to the gear mechanism. The device also passed the Medical Device Review Board Inspection and the Electrical Safety Testing.

- Ultimately, the device satisfies all of the top customer needs. It successfully allows the girls to put on a shirt in an independent, quicker, and safe manner. It is also size-adjustable, which adds to its universal nature. The cost of one prototype is about $399.95 and the cost of prototype development was $1,031.31, which were within both the desired cost of the device suggested by the customers and the project budget.

Second place went to project B10: Adaptive Gaming System. Members of the Senior Design Team for this project were John Blonien, Dan Bohlin, Matthew Klein, Avinash Kumar, Brittany McGuire, and Chantel Newman. Second Place team members received $75 each.

- Quadriplegic patients do not have the ability to use video game systems such as Xbox 360 as they are intended when purchased. The loss of motor control in a patient's hands, fingers, and limbs prevent them from being able to pick up a video game controller, much less push the correct buttons in the correct sequence. Caregivers of quadriplegic patients, as well as the patients themselves, are both interested in finding a solution to this problem. There are various systems out on the market that attempt to solve this problem. The first item the team reviewed was a Broadened Horizon device called GimpGear, which is currently being used by the VA Spinal Cord Injury Center. A downfall of the GimpGear device is that upgrades are necessary whenever a new sensor device is added to the GimpGear system. With the requirement for wiring external devices to the user, setup and cleanup times for caregivers in the VA is about 20-30 minutes, which is unacceptable. The next system that the team looked into was the Quad Control adaptive video game controller. The problem which the team anticipated with this concept was that it would be tiring to exclusively use sip and puffs to play a first person shooter game, which is what the Quad Control utilizes. Additionally, by only using sip and puffs and small buttons, it would be difficult to adapt to all buttons necessary for game play in a complex game such as Halo or Call of Duty. The final device investigated by the team was the Microsoft Kinect. In the video game industry, the Kinect is only used in less than a handful of first person shooters, and those that do tend to only use the Kinect very lightly, instead of using the Kinect to completely replace the standard Xbox 360 controller.

- After conducting interviews with a sample of both caregivers and quadriplegic patients, the team organized and interpreted needs from the customer responses into a needs hierarchy. Many needs on this list were found to be of utmost importance and essential to the project, such as minimal device setup time, user friendliness, enough degrees of control, safety, and stable without the need for continual maintenance. The various parts of this project ensure that these customer needs are met. In a high-level description, the project and final device consists of an Xbox 360, a headset, a laptop, a controller routed through the laptop, a Kinect, and a stand to hold the system.

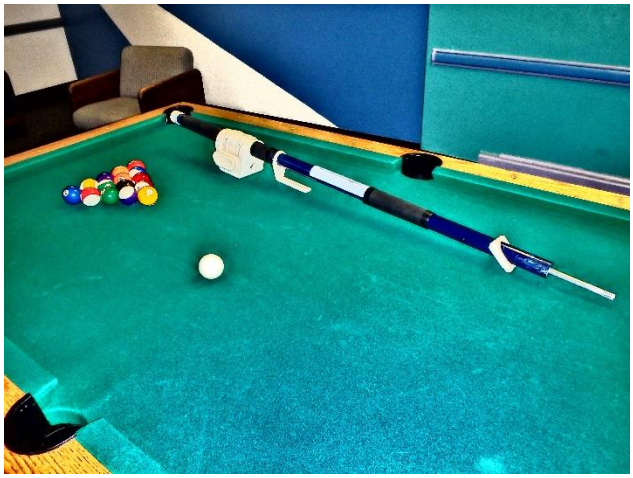
- After months of prototype development, the design team considered various methods for design verification. A test procedure has been specified in order to confirm the success of each of our project's target specifications. These methods were prescribed to ensure the success of our final product in delivering a high quality, safe product, and to achieve the

highest possible customer satisfaction. There were several test cases that were carried out including game play, customer satisfaction, and user safety testing. The results showed that most of the tests were passed and that the final device was found to be very user friendly, as well as showing that the device meets the applicable clinical adaptive standards for its intended use at the VA. It also meets all requirements for patient safety given that the bite sensor will be covered, sanitary, and secure for its users. The adapted gaming system in question has met all of the customer needs that are essential to the success of the project, and the success of the use of the adapted gaming system at the VA medical center.

Third Place went to project B16: Poolshark 1000: Adaptive Pool Cue. Members of the Senior Design Team for this project were Eric Bremicker, John Coleman, Joseph Dung, and Jodi Fails, Benjamin Tretow. Third Place team members received $50 each.

- Disabled users of adaptive, commercially available pool cues find that the manual reloading of the spring loaded tip is frustrating and labor intensive. All current implementations have mechanically spring loaded or compressed air actuated tips operated through a trigger release and reset by depressing the tip of the cue. Cue sticks that offer automatic cue tip retraction are often too expensive and bulky. Lastly, the current market devices are not user friendly, unstable, and often ineffective.

- The purpose of this project was to design and fabricate a new adaptive pool cue that addresses these limitations. This device will allow for physically handicapped and individuals with limited mobility in their hands and arms to play billiards/pool games. The device was required to have an actuating tip, adjustable force, non-slip surface, stabilization, and provide overall user friendliness. The PoolShark 1000 is comprised of several components: an outer tube, an inner tube, motor housing, and accessories. The outer tube encloses the inner tube, which is the actuating tip. The motor housing contains the mechanical mechanism, a rack and pinion, adapted to a motor that retracts and releases the actuating tip by depressing a trigger. The actuating tip acquires the energy through a spring. The spring compresses as the motor retracts the inner rod, increasing the potential energy, and pulls the actuating tip forward when fired. Unlike current devices, the PoolShark contains several accessories—a bridge, rubber grips, and a hand grip—that provide the user with a safe and friendly experience.



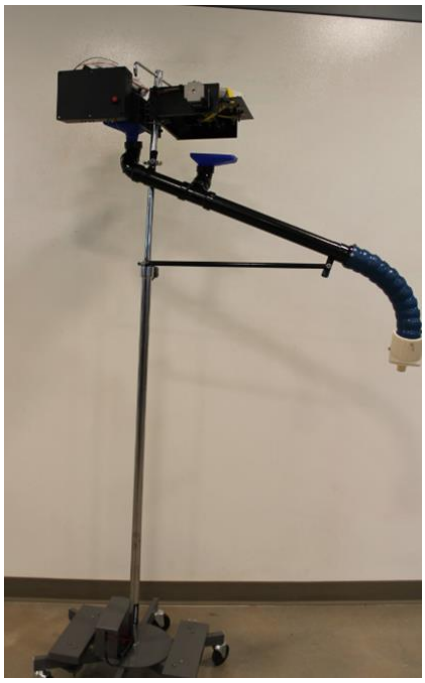
- Verification and validation tests were performed to show that the target specifications and customer needs were met. The design met these specifications, and performs as needed by the sponsor. The final prototype has adjustable forces and a gauge to indicate short, medium, long, and break shots. It also retracts by the touch of a button, greatly reducing

energy expenditure of the user. The PoolShark's final manufacturing cost was $200, which meets the target specification of $300 and is highly competitive with the other commercially available devices as a result of the increased functionality. The prototype is adaptable for numerous customers with varying levels of hand and arm disabilities due to the incorporated accessories and increased functionality of the adaptive pool cue.

Honorable Mention went to project B15: Adaptive Medication Dispenser. Members of the Senior Design Team for this project were Hugh Dales, Scott Gehring, Larry Kimmel, Alexis Krueger, and Carlos Marroquin. Honorable mention team members received $25 each.

- This project was pioneered to help a local veteran with a spinal cord injury. He has very limited mobility, which prevents him from doing basic everyday tasks without the help of caregivers, family members, or assistive technology. Due to injuries like this, people confined to a wheelchair without hand dexterity are unable to take their medication unassisted. This often requires medication to be taken off schedule or later than when it is needed (such as for pain medications). We developed a device for this veteran so he can regain the independence of being able to take his medication independently. This allows him to access pain pills when needed, always take medication at the proscribed times, and reduce his dependency on caregivers.

- The team adopted the use of commercially available MedSmart dispensers to provide secure storage and timed release of the pills. These devices are mounted in a frame at the top of an IV pole. There is one device for scheduled pills, one for on-demand pain medications, and one for peanuts to take with the medication as desired. A camelback system is also provided so water is available for swallowing. The device dispenses pills into a funnel and chute system down to a chinlock device, which holds the pills in place until the user presses down with their chin to release the pills into their mouth. The device is controlled by Infrared, and can be programmed to be used with the voice-control units that he and many other limited mobility patients use to perform functions like control lights and answer the phone. The device has been found to have 99.7% accuracy for dispensing pills and will be delivered to the client for his use.



Tech4POD congratulates all of our award winners!