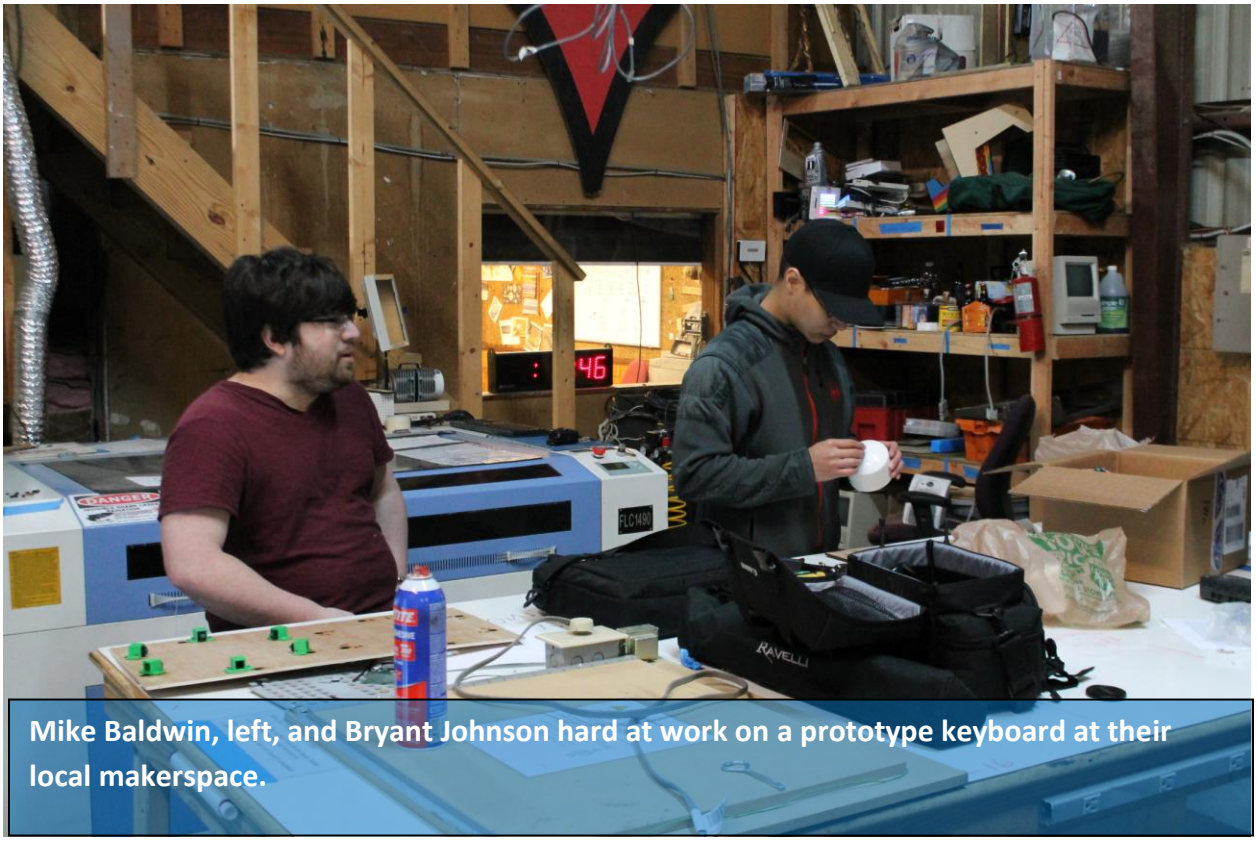
Senior Design Team Achieves Affordable AT Alternative



Mike Baldwin, left, and Bryant Johnson hard at work on a prototype keyboard at their local makerspace.

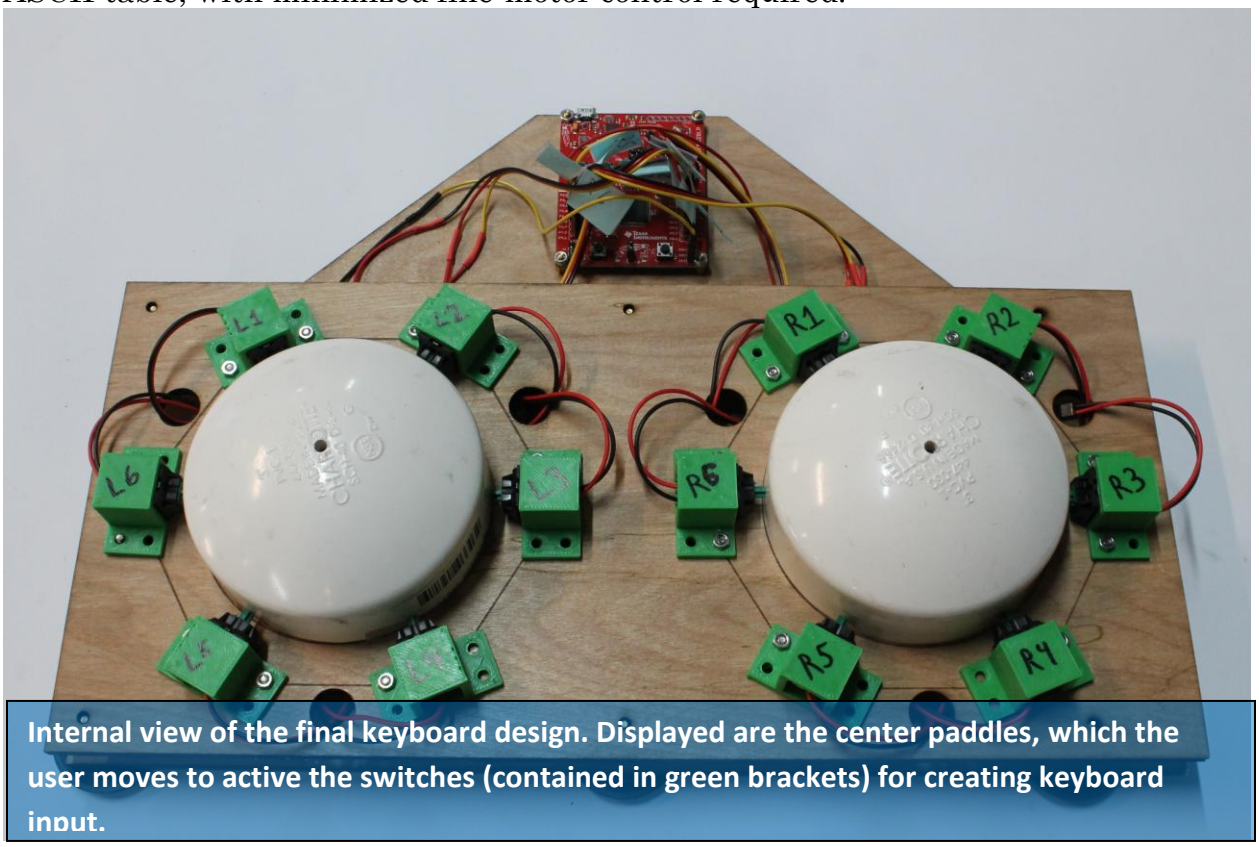
First, a little background: adaptive technology (AT) is a device or component which is specifically designed for persons with disabilities. A Human Interface Devices (H.I.D) is any tool by which a human interacts with an electronic information system either by input or output. The past few years have seen spectacular growth for computers and computer systems, yet the AT field has lagged behind.

Many existing AT solutions suffer from rather steep pricing due to the relatively low demand. For families seeking AT alternatives, a high price point can be tragically prohibitive to acquisition. Addressing this issue is where the senior design team comes in.

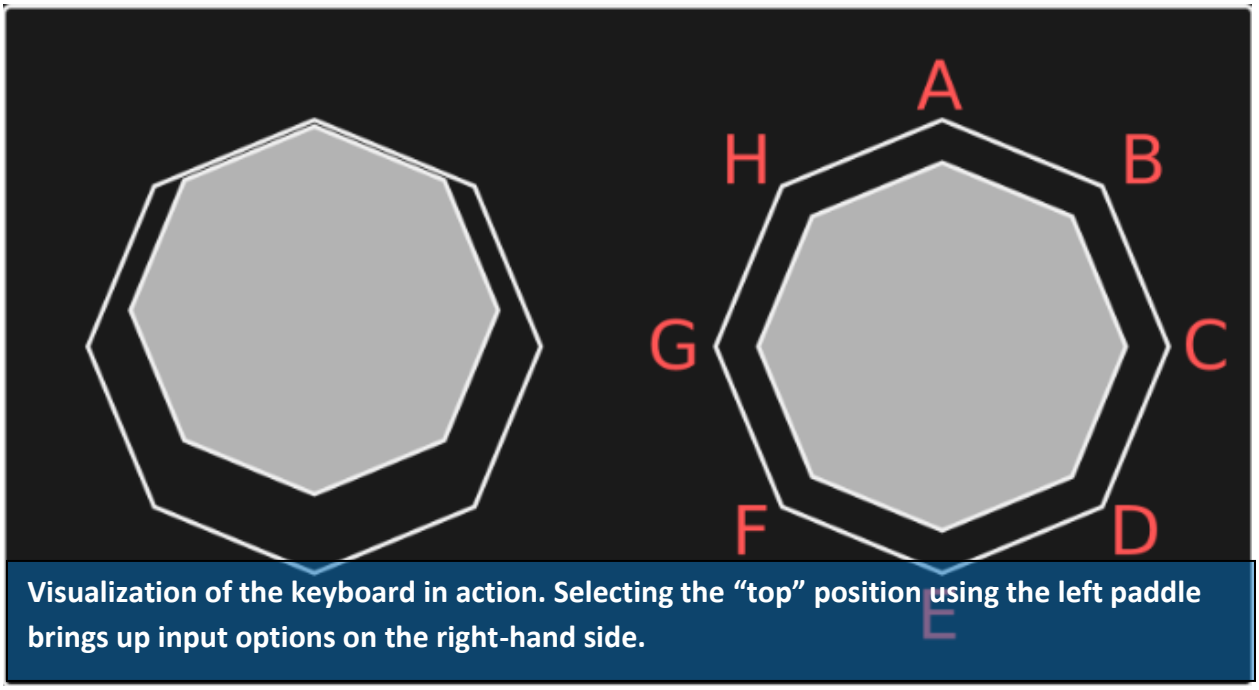
The students focused on assisting users with motor control disabilities. The most common alternative to such an issue is an enlarged print keyboard: although it does improve the situation, it does not really address the issue at hand.

The sliding keyboard features a two paddles (one for each hand), each of which is surrounded by six switches. To create input, the user slides the left paddle into one of the six valid areas: doing so brings up a selection of six characters to be selected

by the right paddle. In this way, the keyboard emulates full support of the standard ASCII table, with minimized fine-motor control required.



Internal view of the final keyboard design. Displayed are the center paddles, which the user moves to active the switches (contained in green brackets) for creating keyboard input.

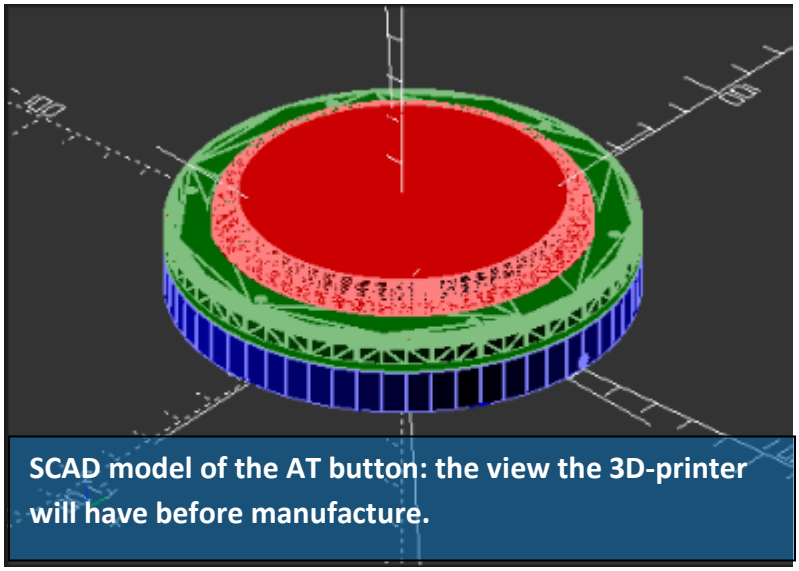


Visualization of the keyboard in action. Selecting the "top" position using the left paddle brings up input options on the right-hand side.

Of course, just improving the hardware aspect of the problem wasn't enough for the design team. To further aide the users bridge the gap towards a default keyboard, the team pursued a supplementary software package to augment their keyboard. The program is designed to help users by suggesting word completion when a word is being typed. Two versions of the software were released: one as a stand-alone application meant to be run with the keyboard or any other input device, and another version was released as a Google Chrome extension. The program is designed to refine its suggestions to each user over time, using a database with the frequency of common words to improve the accuracy of its predictions.

The final segment of the project was aimed at reducing the cost of AT buttons. One of the most common adaptations the AT community faces is converting the interface for devices (such as children's toys) to have a more helpful triggering mechanism. Regrettably, likely due to the small market, the cost of such models ranges from about $60 - $160: a massive additional "tax" to acquiring AT products.

Once alerted to the dilemma by UCP of Huntsville, the senior design team set out to create the most reliable button for the least cost. The "button" is essentially a basic switch, designed for easy integration with whichever product the user needs to interact with. It has an easy to press surface with a 100mm button diameter (about average palm size) that responds to pressure from any angle or point on the pad, and sports a standard 3.5mm mono jack common to AT integration efforts. After numerous prototype phases, the team derived the final button design: the structure for the button requires only the use of a 3D-printer, and the button is capable of handling approximately 200 lbs of force before suffering from stress fractures while only requiring about 120 grams to press the button for input. The designs are open and freely available online as the team strove for a solution easily re-creatable by the community.



SCAD model of the AT button: the view the 3D-printer will have before manufacture.

In keeping with the axioms of the project, cost and easy of construction were the driving factors behind the designs. To that effect, the AT button costs a mere $9.00 to create, undercutting most existing products by an order of magnitude. The keyboard totaled to approximately $42 for all supplies: a powerful reduction in cost for outfitting a computer. As for the other main priority, the designs for each product are freely available online, and are intended to be constructible by users with minimal access to 3D-printers and modest tools likely available at local makerspaces.

AT Keyboard—$41.50		AT Button—$9.00	
16 x Cherry MX Switches	$16.00	1 x Cherry MX Switch	$1.00
2' x 4' Plywood	$6.00	1 x 3.5mm Mono	$0.50
2 x Handles	$10.00	0.3kg PLA	$7.50
1 x MSP430F5529	$12.00		

Approximate cost portions for each of the hardware solutions.