DIY Assistive Technology: Tool to Help Amputee Motorcyclists Shift Gears

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ABSTRACT
This is a do it yourself project offering assistive technology to a left leg, below the knee amputee shift a motorcycle using an inexpensive shoe attachment that they can create themselves. Below the knee left leg amputee cyclists tend to have a problem with traditional shifters. Pressing down on the shifter is not too bad, but lifting becomes difficult without an active ankle joint. One can spend a lot of time and money trying to find the perfect fix. We designed a shoe attachment that moves the modification aspect from the motorcycle to the cyclist. This allows disabled riders to get on a stock motorcycle without personalizing the bike to fit their needs. The design is ideal for instances like motorcycle renting, riding lessons, and test driving.

1. INTRODUCTION
Can an amputee ride a motorcycle? Ask profession motorcycle stunt rider Ryan Suchanek. He is a left leg, below the knee amputee and world record holding cyclist. His spring loaded prosthetic may be out of the price range of the casual rider but there are plenty of ways amputee riders can get back on their motorcycles. [1] This project will evaluate the flaws of the costly solutions available, and offer a budget-friendly solution that anyone can create on their own.

2. RELATED WORK
There are plenty of left leg amputees that have already found a way to ride motorcycles. Most of the popular solutions are reached by buying after-market parts for a motorcycle and having them installed at a repair shop. To overcome the obstacle of shifting a motorcycle with the left leg, riders have altered the controls to cater to their abilities.

The first example of existing solutions this problem moves the gear shifting to a hand lever. The most popular iteration of this concept is the Kliktronic K-Lever 2. It has a double lever that replaces the single hand lever on either side of the bike. With two levers, the biker can control gear shifting along with the clutch or break all with one hand. The concept is well adopted but comes with its set of flaws. Customers often complain about the assistance and education offered by Kliktronic. This high tech device tends to leave self installers lost and customer service has become an issue of concern. Beyond the lack of customer support, the price for the hardware is upwards of $1850. After installation, shipping and handling this becomes quite an expense. A cyclist that decides to try this out has made a large investment before trying out the solution.

Kliktronic Electric Button Shift

The next design concept is popular for riders with various left leg disabilities. This is another solution that moves the shifting controls to the hand, but this uses 2 electronic push buttons to shift up and down. The most popular after market button shifter is the Kliktronic Electric Shifter. Its compatibility with so many models makes it so popular. It is also praised for its response quick response times of 35-50 milliseconds. Once again, Kliktronic has gotten a reputation of having bad customer support for installation assistance. We came across a number of owners of this device that have difficulties when riding with the Electric Shifter. Finding the neutral gear takes good amount of finesse for any rider on a motorcycle. This Kliktronic device makes it difficult to softly lift the shifter and get the motorcycle into neutral. With an average price of $1,000, it does not seem like the perfect solution. A tool like this may be for an experienced rider wants to get back on the road and understands the pros and cons of the device before their purchase. [2]
We created a project for amputees to share their stories, with a focus on motorcycles. To improve the shoe attachment, the idea is to add a heel toe shifter inspired by our design, and we formed our阿皮at. The use of the footwear used in our project on are poor walking comfort, visually obtrusive, and the limited adjustments once created.

The motivation behind this design came from forum post made on Motorcycle-Amputee by Ken Player [5]. Motorcycle-Amputee is a website created for amputees to share their stories, experiences and inspire one another in the shared topic of riding motorcycles. Player, a below the left knee amputee, posted a DIY project of his own. He decided to screw a 4” flat metal brace to his left riding boot to more easily finesse the shifting pedal. Player was confident enough in his ability to press the shifter down. He needed help lifting the pedal when downshifting. The metal brace stuck out just enough to get it under the shifting pedal quickly and precisely. Most importantly, this gave Player the ability to hop on just about any stock motorcycle on the cheap. He could have spent hundreds trying out different solutions to find one that works. Instead he went out and created his own tool.

The creativity inspired our design, and we formed our project plans around improving this very design. The pros of Player’s design are inexpensive cost, easily available materials, and a universal design that works with most motorcycles. The cons that we focused our project on are poor walking comfort, visually obtrusive, and the limited adjustments once created.

The last existing design we will discuss is the most popular among the demographic this project is targeting. The heel toe shifter is much accepted among left leg, below the knee amputees. The design is the same as a standard shifting pedal for the rider’s toe, but it also has an additional pedal for the rider’s heel. The left leg amputees in this case do not have the springing ankle joint that would help lift a pedal using the toe of the shoe. Pushing down is simple enough. The heel toe shifter allows the rider to push down to shift up or down. Pushing down with the heel replaces pulling up with the toe. The idea behind pushing down to do all shifting is so comfortable, that the heel toe shifter is quite popular among able-bodied riders. With high demand of this customization comes reasonable pricing at about $100. [3]

There are heel toe shifters that will fit almost any motorcycle. Overall, we believe this is the ideal solution for some riders; however, it still has its downsides. The heel toe shifter still requires a customized and permanent change to the rider’s motorcycle. Along with its great utility, all bike modifications bring a barrier to entry for new riders and limitations that prevent left leg amputees from just hopping on a motorcycle and taking off. We made sure we could create an experience that allows disabled cyclists use loner bikes during riding lessons. They will be able to take test drives before buying, and renting a motorcycle if they wish. We took all of these ideas into consideration when designing our shoe attachment. [4]

3. DESIGN
3.1 Design Inspiration
The motivation behind this design came from forum post made on Motorcycle-Amputee by Ken Player [5]. Motorcycle-Amputee is a website created for amputees to share their stories, experiences and inspire one another in the shared topic of riding motorcycles. Player, a below the left knee amputee, posted a DIY project of his own. He decided to screw a 4” flat metal brace to his left riding boot to more easily finesse the shifting pedal. Player was confident enough in his ability to press the shifter down. He needed help lifting the pedal when downshifting. The
3.2 Supplies and Building Instructions

The core design of the shoe attachment is a DryGuy GripOn. This is a device designed to improve traction when walking on snow or ice. The GripOn is a rubber harness that is stretched to fit on the shoe. There are metal studs attached to the bottom that we will remove for this project. With the metal studs removed we have an all rubber harness that attaches to the exterior of any shoe or boot quickly. During the design process we went through a serious of alternatives that did not work as well. We made this decision because the materials in the GripOn were designed to make contact with the ground and were already in their natural environment when placed on top of footwear. Other items would not have a low profile, causing discomfort when walking. The GripOn also provided a firm cradle for the metal brace. We needed a solution that would hold the brace in place and not give too much when pressure is applied. Velcro strips and fabric straps would give too much because of their elasticity. Overall, the GripOn is in its element when put to use for this project and it the rubber allows for low profile and simple adjustments for the user’s custom fitting.

We realized the properties of black rubber worked well in the GripOn. So the Plasti-Dip was used to coat the metal brace in a material that provides not only appeal, but function. Applying black colored Plasti-Dip to the metal brace makes the chrome metal concealed and look less obtrusive. This multi-purpose rubber coating is very flexible, which makes it tough to break or tear. Plasti-Dip also has a gripping texture that prevents a cyclist’s foot from slipping.

We chose to keep the 4” flat metal brace that was used in Ken Player’s inspiring design. A user can opt for a 3” brace if that fits better for smaller shoe sizes. We decided to use the flat metal brace because of its solid structure and seamless fit in the design. The brace fits snug between the sole of the user’s footwear and the GripOn harness. The brace holds up well enough to perform even before being secured into position with the final piece of the design.

A 1” brass metal fastener is applied to each end of the metal brace. The fasteners reinforce the brace to the GripOn keep everything in place. As mentioned before, one of the toughest design challenges was maintaining a low profile. Placing the fasteners button up and split facing down reassures that the brace will stay in place and still unnoticeable when standing.

4. FUTURE WORK

The design phase of the project came together, but the project as a whole still leaves some work to be done. In the future we plan to get more comments and spark interest in the design. We created a DIY instructional video and posted it to YouTube. It explains the details of the project and how to create your own shoe attachment. Within a month it nearly got 100 views. We are looking to spark more comments and feedback that would help improve the design.

We worked with a handful of web forums for amputees and motorcycle riders. We found plenty of conversations and comments about the design, however willing participants were tough to find. When we did get a volunteer that is willing to help, the response time through web forums was not quick enough. Another factor may be the privacy of mailing the materials to their residence. Revealing their home address may cause resistance in volunteering. On the other hand if privacy is a concern, they would have to overcome the inconvenience of buying the items themselves.

We created a design that allows a natural feeling when stepping on the ground. The rubber feels comfortable when impacting the ground and does not feel off balance with the bare shoe. It seems the weakest part of the design would be the brass fasteners. We had in mind a low profile button sized rivet. This was tough to find, maybe in the future we will be able to find a sturdy fastener to replace the brass ones. .

5. CONCLUSION

Overall, this project offers a solution for left leg, below the knee motorcyclists. We have offered a do it yourself instructional video that helps them get on almost any standard motorcycle and take off without the investment of changing the vehicle itself. This freedom opens barriers for amputees to try out motorcycles as a hobby because the cost of modifications is removed from their decision making process. The experienced rider can try this out before spending thousands of dollars modifying their motorcycle.

6. REFERENCES
