

## FOLD-AND-GO SINGLE KNEE SCOOTER

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### INTRODUCTION

Single lower leg injuries such as a sprained ankle or a fractured foot area common occurrence. According to the Cleveland Clinic there are over 23,000 reported ankle sprains in the United States each day [1]. The patients may be recommended to use a wheelchair, rollator, crutches single knee scooters or other types of assistive devices based on their age, nature of the injury and the general health of the user.

There are many products on the market to provide mobility to people with single leg injuries or conditions. According to medical device distributors [Binson's, Livonia MI] however; there is a shift from conventional mobility devices like crutches and canes, to more mobile and innovative devices like single knee scooters [Figure 1].

Although there are more single knee scooters being used today than ever before, many patients do not choose this device because it is expensive, heavy and difficult to place in the vehicle when not in use. This project focuses on improving the portability of the single knee scooter.

*"There is a need to create a single leg mobility device that is lightweight, compact and inexpensive, giving all users the ability to handle and store the device when not in use."*



**Figure 1 –A common knee scooter has four wheels and weighs approximately 30 lbs.**

### PRODUCT DESIGN

The "Fold-and-Go" scooter design was developed in order to create an innovative new solution that reduces weight, cost, and bulk of current scooter designs while adding an increase in portability. While some current designs on the market are labeled as "folding," the

space saving is minimal and the devices often only include features such as collapsible handlebars. As shown in Figure 1, the "Fold and Go" knee scooter features a fully collapsible frame as well as retractable handlebars which allows the device to easily fold into a compact shape.

In addition to the folding frame, the device is constructed from lightweight aluminum tubing while featuring a significant reduction in size and weight achieved by the simple and compact design. This allows the device to be easily folded and carried or stored in the back of a vehicle, for example.

In order for the device to be easily foldable and user friendly, a four bar linkage system is used to allow the main lower wheel platform to fold up while simultaneously folding the knee rest and vertical support post up. The design features a foldable knee pad located above a vertical tube that supports the weight of the user as well as aid in the folding mechanism of the device. At the base of the main vertical handlebar post, a simple two position locking mechanism allows the user to transfer the device from the open to folded position. Once the locking mechanism switch is pressed, the user simply folds the knee brace upwards which utilizes the four bar linkage system to pull up the base of the scooter and lock it in position. From there, the handlebars can be collapsed for additional reduction in package space. The device features a knee pad height adjustment option allowing the user to adjust the height in one inch increments. This adjustment will be achieved by a series of mounting holes spaced 1" apart in the vertical support sections of the device. See Figure 2 below for a profile view rendering of the knee scooter in fully open, half folded, and fully folded position.

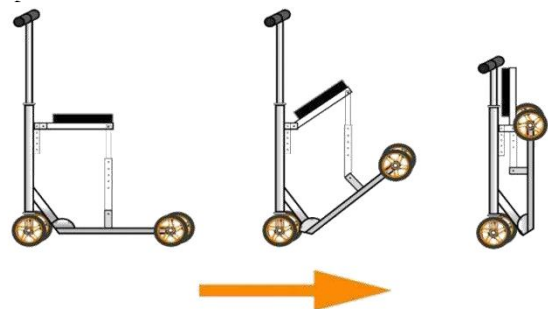


Figure 2 - Side profile progressive image showing how the device is going to fold flat when not in use.

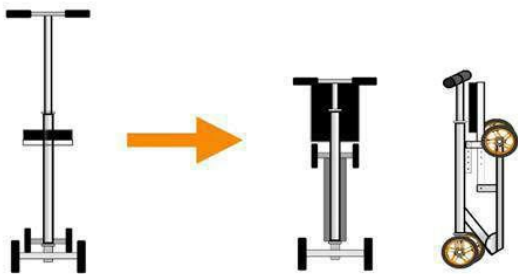


Figure 3 – Front profile progressive image showing how the device is going to fold flat when not in use.

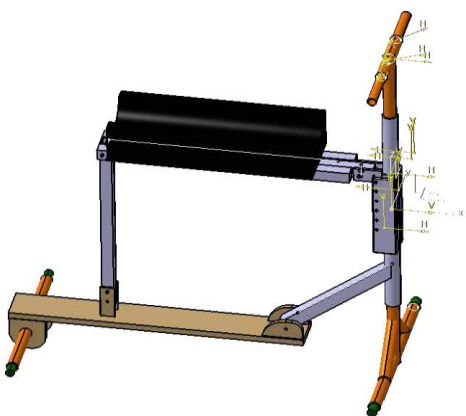


Figure 4 – Preliminary prototype CAD model of the device.

Figure 5- Estimated market broken down by current mobility devices

Below is an itemized budget with justification for each item. [Table 1].

Table 1- Itemized budget for development of this product.

Senior Design Budget Break Down			
Item	Break Down	Cost	Justification
Materials	Aluminum Tube	\$200.00	Enough aluminum tube to account for multiple iterations of the final design
	Aluminum stock	\$75.00	Enough aluminum stock for multiple iterations of the final bracketry design
	Welding rods	\$25.00	Package of aluminum welding rods
	Casters w/ bearings	\$50.00	4 polyurethane casters with bearings
	Hand Grips	\$25.00	Ergonomic hand grips
	Paint	\$25.00	Finish
	Razor Scooters	\$100.00	Used razor scooters for evaluation and scrap parts
Machining	Machine Shop Labor	\$150.00	If necessary to source out the machining of brackets due to time constraints with our equipment. If sourcing is required, request for donations from the machine shop (in the form of materials, labor or both) would be made.
	Machine Shop Parts	\$200.00	
Testing	Additional Sensors / Markers	\$100.00	Any additionally markers or sensing devices to collect data accurately
	Testing set up	\$50.00	Material for making any testing fixture or stand that will be needed
Other	Fasteners	\$25.00	High grade fasteners for assembly
	Bushings	\$25.00	Bushings and or bearings to decrease handle bar turning efforts
	Weld Fixture	\$100.00	May be necessary to ensure the components do not warp during the welding process
	Gas Mileage	\$100.00	Gas mileage for picking up parts, materials etc.
<b>Total</b>		<b>\$1,250.00</b>	

### MARKET ANALYSIS & BUDGET

Currently, Over 6.8 million people use personal mobility devices and of those, 40% are estimated to be unable to perform their desired daily activities. We are looking to target any patient 12 years and older who has a single lower leg injury or condition. This device is specially designed to aid in the recovery from injuries, conditions and surgical procedure of the lower limb. Unlike Crutches this device allows the affected limb to be supported which is a key part of the healing process. Furthermore, this device helps to keep the patient from straining the knee of the uninjured leg.

According to the Cleveland clinic, 23,000 people in the United States sprain or strain their ankle every day[1]. According to twin city press, ten million sets of crutches are sold in the US each year. According to Grandview Research, the market for premium rollators and scooters is going to grow nearly 15% from 2014 to the year 2020[3]. This projected growth is greater than the growth expected in walking aids over the same time frame. This growth is estimated to increase from 4.5 billion in 2012 to roughly 8 billion in 2018 [Figure 5].

Global personal mobility devices market, by product, 2012 – 2020 (USD Million)



### ACKNOWLEDGEMENTS

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### REFERENCES

- [1] Cleveland Clinic, "Ankle Injuries," Web, October, 2015
- [2] Twin City Press, "Bloomington Startup committed to building a better crutch." Christopher Snowbeck, October, 2012.
- [3] Grand view Research, "Market Research & Consulting". Web. March 2015.