



Trine University
Biomedical Engineering

Scooter-Bicycle & Communication App

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Introduction:

To improve Dr. John Shank's quality of life after a stroke, our team designed and manufactured a more efficient scooter-bicycle hybrid for Dr. Shank to compete with in paratriathlons and an Augmentative and Alternative Communication application to give Dr. Shank the ability to communicate to his loved ones again.

Scooter-Bicycle:

Dr. Shank, a hemiparetic stroke patient, currently uses a scooter which is too heavy to obtain his maximum potential velocity and limits the range of motion of his stride leg. Our team designed a lightweight, safe scooter-bicycle hybrid to utilize the maximum function of his left lower extremity with a mechanical reliable steering mechanism.

Materials & Components:

The Scooter-Bicycle consists of a Biria bicycle frame, steering mechanism (Figure 1), two 20" front wheels, a 700C rear wheel, 80/20 aluminum supports, Catrike spindle assembly, TIG welded aluminum footrest rods (Figure 2), a handlebar, bicycle headset assembly, seat post, saddle, and a disc brake mounted on the rear wheel.

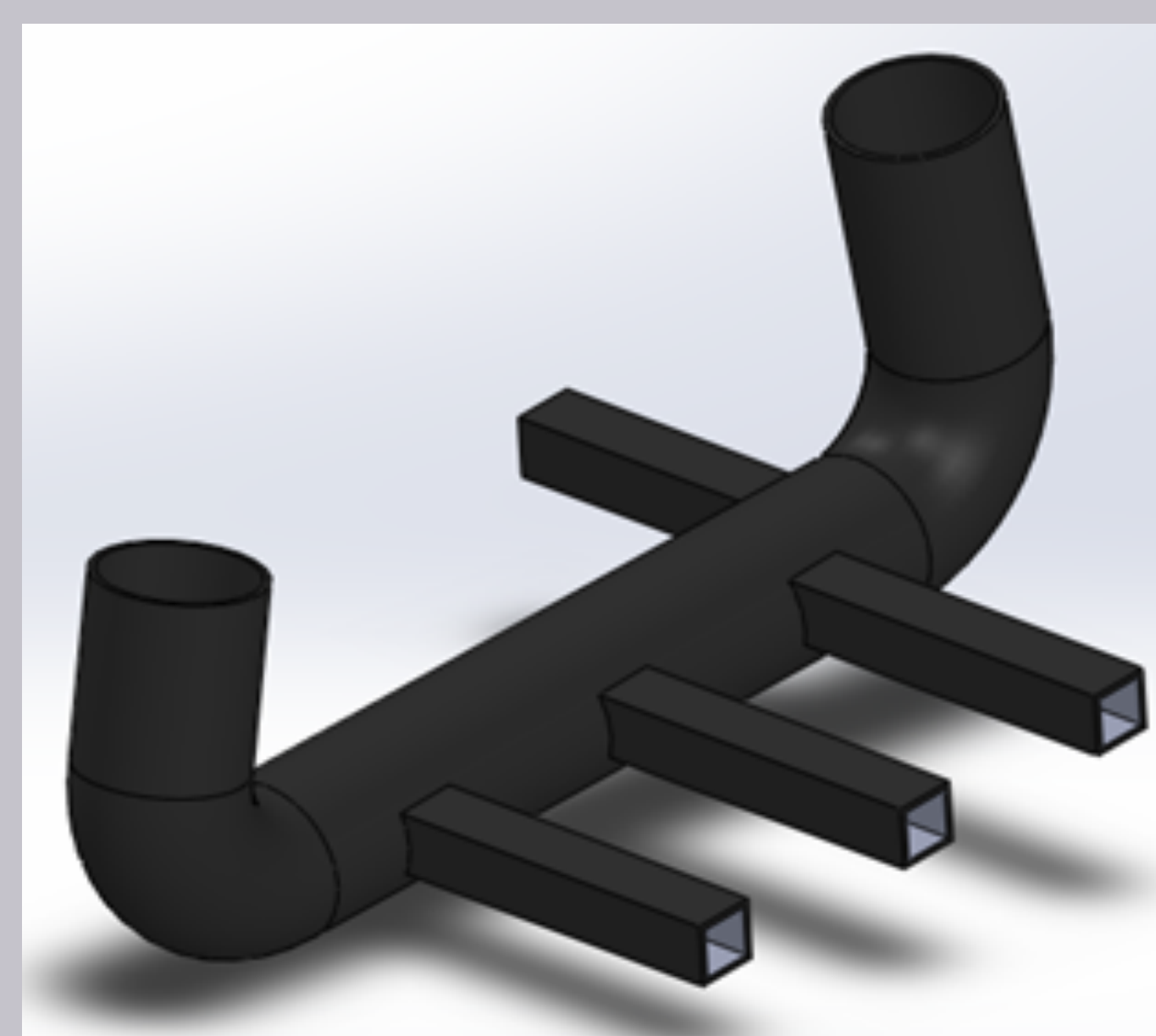


Figure 1: Scooter-Bicycle Steering Mechanism Figure 2: Scooter-Bicycle Footrest Design

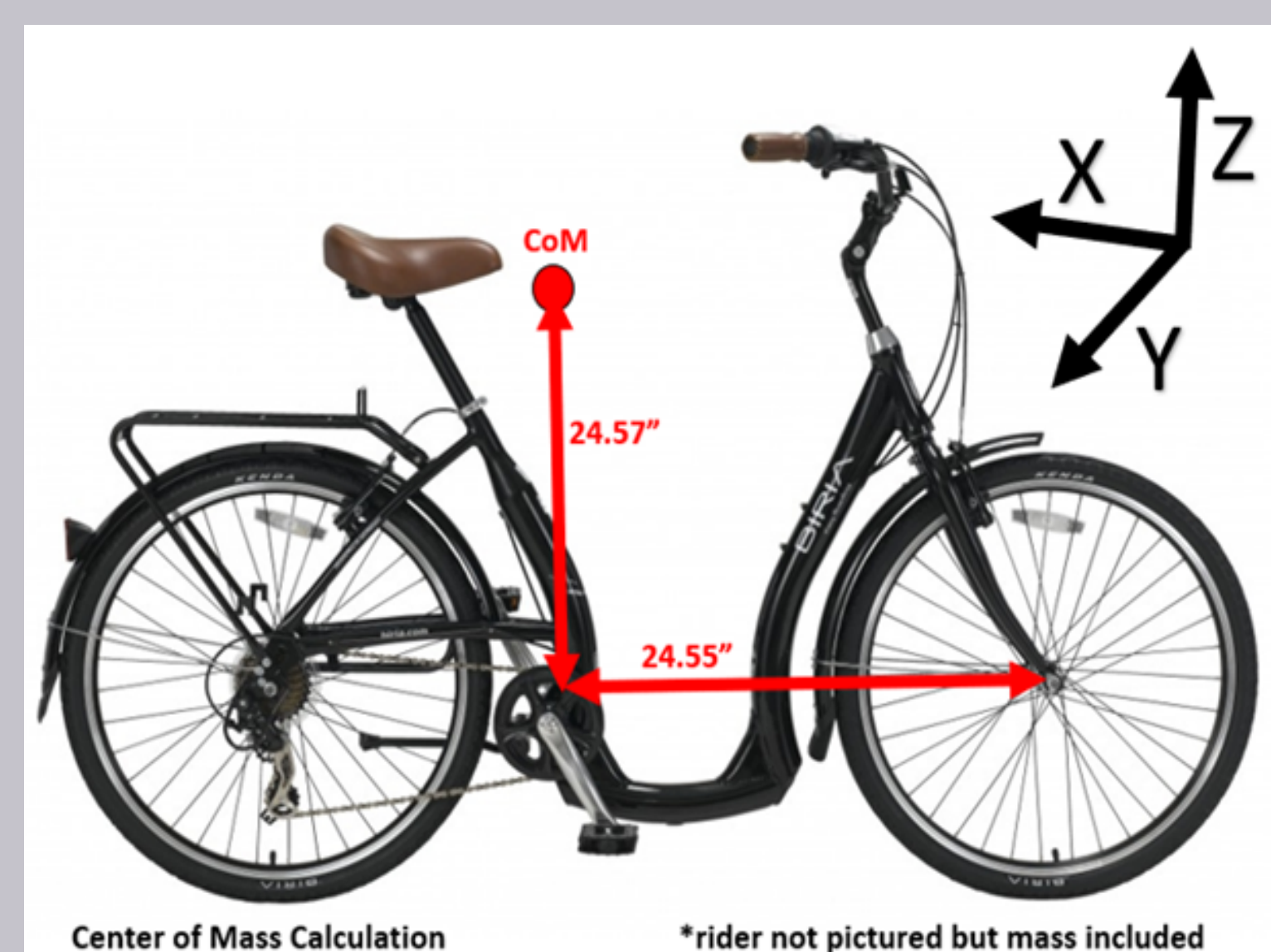


Figure 3: Scooter-Bicycle Center of Mass



Figure 4: Scooter-Bicycle Manufacturing

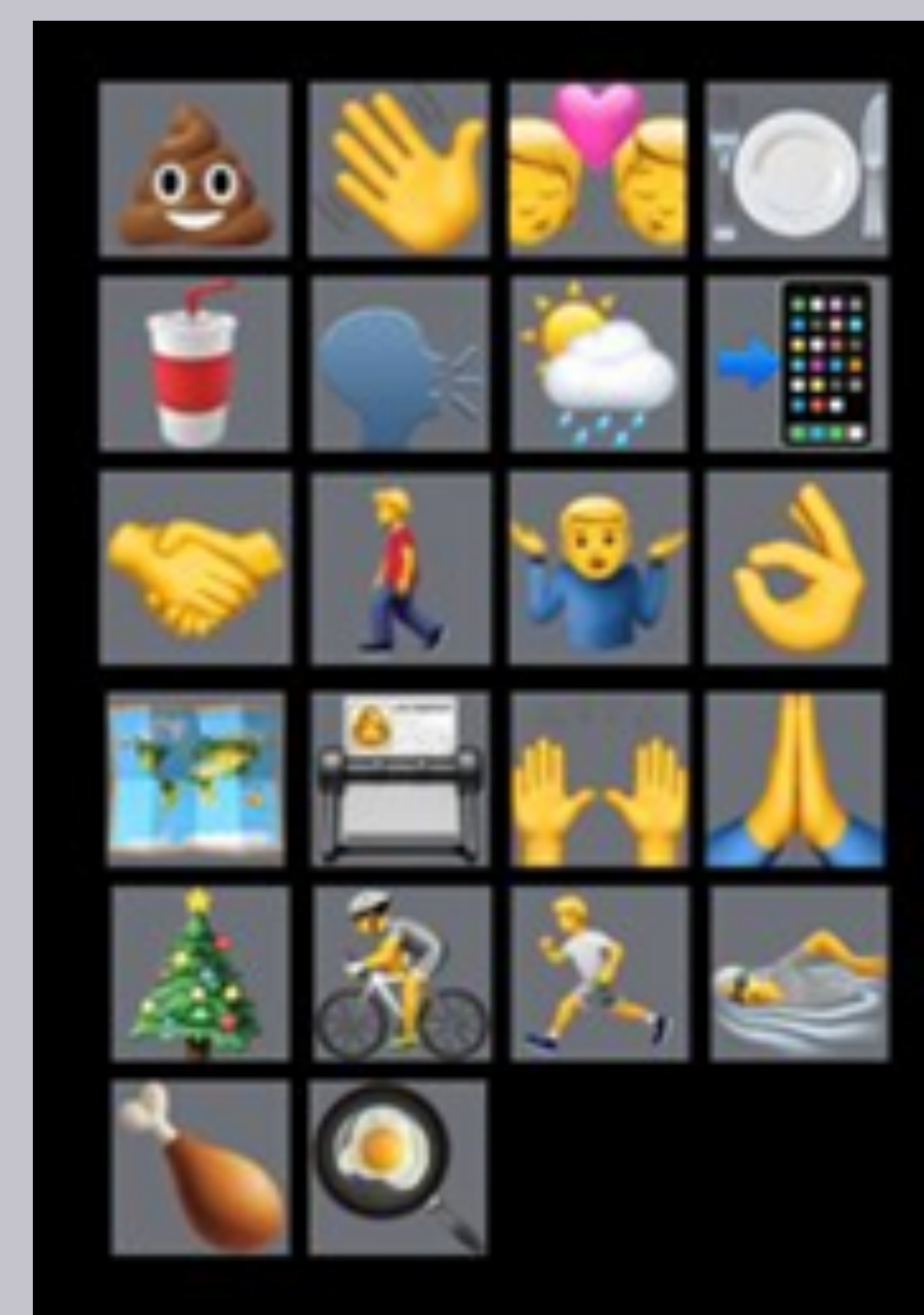


Figure 5: Communication App Screen



Figure 6: Innovation One Challenge

Communication App:

Dr. Shank's stroke limited his communication abilities to only a few words due to Broca's area damage. With a functional visual cortex and Wernicke's area, we plan to utilize his recognition of emojis and pictures to allow vocalization of common phrases. Dr. Shank will be able to select an emoji paired to a memorized phrase outputting an audio file from the iPhone speaker.

Design Methodology:

The communication app was coded using Xcode, an iOS software. Emojis were paired with common phrases to augment functional communication (Table 1). The app home screen displays 22 emojis with a hierarchy option (Figure 5). A hierarchy design allows a new set of buttons to display after an emoji is selected to create complex phrases. Our team pitched the app at the Innovation One Challenge winning 2nd place and the People's Choice Award (Figure 6).

Table 1: Emojis and Associated Phrases

	Biking		Thank you.
	I need to go to the bathroom.		What's the weather today?
	I love you.		I have to go to...
	Hello, how are you?		I don't know.
	I'm doing well.		I would like to drink...
	Call me when you can.		Talk to you soon.
	I would like to eat...		What is your name?
	Nice to meet you.		Where are you from?
	Running		Swimming
	Chicken		Eggs
	Merry Christmas.		You're welcome.

Design & Manufacturing:

The Scooter-Bicycle was designed to have a center of mass that closely resembles a traditional bike (Figure 3), allowing for a safer ride. An Ackermann steering mechanism was designed on Solidworks utilizing a bicycle handlebar and quill assembly paired with a steering post attaching to a bearing and tie rods, allowing independent wheel rotation (Figure 1). The steering mechanism will be assembled using MIG welding. Pieces of 80/20 and square tube aluminum were cut using a circular saw. Those pieces, the frame, and the head tubes will be assembled using TIG welding. The tires and disc brake were purchased at Bike and Soul, where assembly will continue (Figure 4).

Future Work:

The following are ideas to further complete the project:

Scooter-Bicycle

- Complete manufacturing process
- Conduct safety and performance tests
- Determine optimal seat height in biomechanics lab for maximum propulsion force

Communication App

- Code 100 total phrases with hierarchy
- Conduct emoji recognition test with Dr. Shank

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