

Individual Project

2023.3-2023.4

Product Design / HCI Design



 yoRider

The project aims to improve the self-care ability of people with serious disabilities, by using EMG to construct a system that enables them to achieve mobility control through small movements of their movable body parts, trying to provide a more comfortable experience for the users.

Background

In our daily life, we can see people with disabilities who often have to rely on wheelchairs to get around. However, the number of people with disabilities we see is actually much smaller than the total number of people with disabilities, which raises a thought of whether there are many people with disabilities who do not even be capable to use a regular wheelchair.

Inspiration

My grandmother used to love dancing in the park. However, last year she fell off a bench causing a serious injury while cleaning. This caused a loss of muscle control over most of her body. During the year, her hair also turned grey much faster than before.....

Loss of mobility has caused millions of **disabled people** to age more quickly than normal ones.



Data



Serious Disabled: **16%**

Visual Disabled
13%

Physical Disabled
64%

Hearing Disabled
10%



Facts:

- An estimated 1.3 billion people (or one in six people globally) have a severe disability.
- People with disabilities find it 15 times more difficult to use and afford transport than non-disabled people.



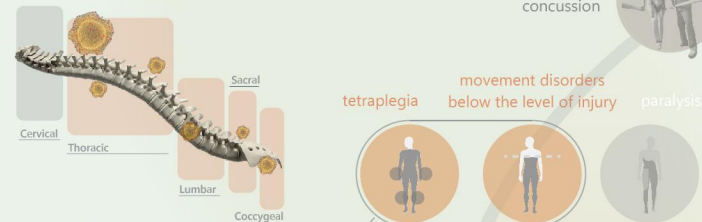
However, among these disabled people, some with **spinal cord injuries** even are **unable to use a wheelchair** as an alternative for travelling, as they have lost control of most of their body parts.

Data Resource: www.who.int/zh/news-room/fact-sheets/detail/disability-and-health

Research

Brief Introduction

Spinal cord injury is a serious complication of spinal fractures, usually results in permanent changes in strength, sensation and other body functions below the site of injury:



Design Direction:

According to the reearch,my design shall aims primarily at people with tetraplegia and movement disorders below the plane of injury and the goals are as follows :

enable users to control through small movements of their **movable body parts**

Severity of Effect

Questionnaire



Please prioritise your **needs** for wheelchairs and rate them as the user and the user's families separately.

Rates for Needs



Please list the **types of wheelchairs** you have had access to

Rates for Styles

Simple & Warm
50.6%



Please list the **scenarios/situations** in which you have got in touch with any wheelchair.

Medical Scenario

87.7%

Transportation Scenario

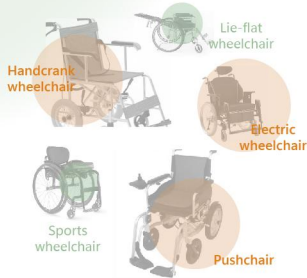
32.1%

Entertainment Scenario

8.64%

Living Scenario

59.3%



Through research, I identified the primary needs of the product as stability and convenience, and positioned the tone of the exterior as warm and comfortable.

Interview



I interviewed some of my family members, centred on my grandmother, and asked for some of their views about using wheelchairs.

[Patient]
Grandma
Age : 73

I haven't been able to move, even just sitting up, for a long time since the fall. It took almost **a year of recovery** for me to gradually start using a **wheelchair**, which isn't as convenient as it used to be, but it's much better than lying down.

Since the injury, she can't be without someone around so I no longer go to the park to work out. But now things are much better, sometimes I push her wheelchair along for walks in the park.

Grandpa
Age:75

Now mom goes out less, as she was used to being bedridden during her injury, and now she barely goes out, even with a wheelchair.

Dad
Age:47

Card-sorting

I made some researches about the basic functional modules on the wheelchair and sorted with the cards:



Simulation

I found an actor to simulate the main movements in a day of a quadriplegic 's life :



Persona



Mr.Liu

Tetraplegia
Patient

Age:60

Five years of illness

Live with daughter

Retirement from work

Hobbies

- walking
- reading
- calligraphic
- playing poker

Pains

Since the illness he has basically stayed in bed, and for fear of **troubling** the daughter he seldom asks to **go out**.

Motivational Capacity

Muscle Strength



Mr.Smith

Movement Disorder
below the Waist

Age:28

Five years of illness

Live with parents

Work as a writer

Hobbies

- readng
- clubbing
- hiking
- photography

Pains

After his injury he felt so **overwhelmed** in his recovery that he often longed to do things he used to be able to do.

Motivational Capacity

Muscle Strength

Summary

According to the existing research, the gap between the wheelchairs that currently exist in the market and the needs of the target users mainly exists in the points on the right :

Convenience

Dependence

Comfort

Brainstorm



Function Selection

Through screening for brainstorming, I have identified the three functions on the right :

Lifting

Non-physical Control

Stablization Aid

Folding

Detecting

.....

User Feedback



Patient



Maybe it's helpful when I want to get some stuff...



This would have been very helpful in days I couldn't move... Also it sounds fun!



It 's the most fundamental and important part.



Famly Member



It sounds not that necessary when I'm around...



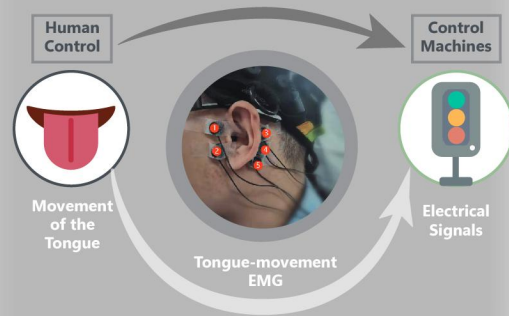
Sounds interesting...In this case moving would be available when I 'm not around.



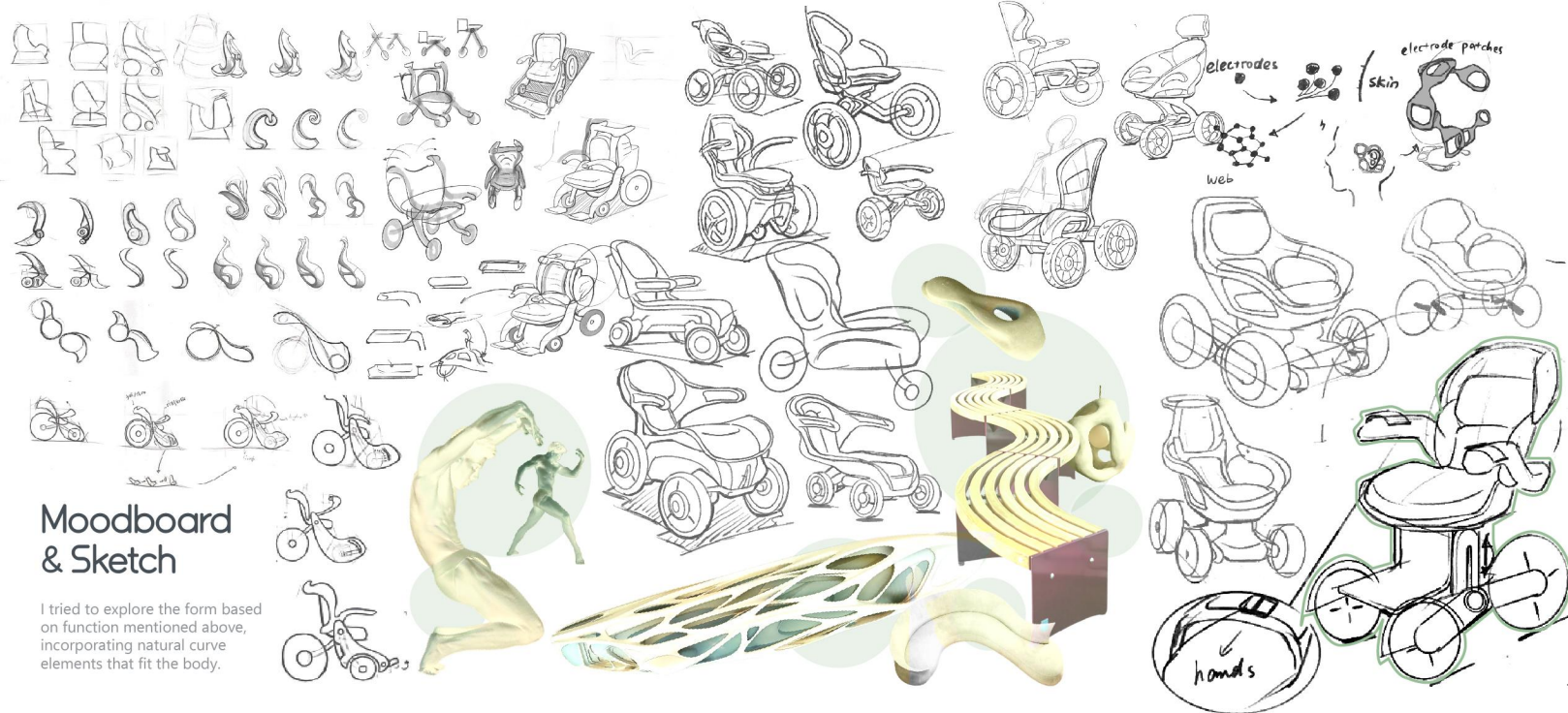
Safety is always the most important thing.

Technology Research

According to the research result of Tianjin University, TCI based on tongue-generated **EMG signals** to control external devices has a promising future, and by the same token, in the future, it can be considered to try a variety of EMG signal decoding to achieve the conversion of electrical signals and used in the **control of machines**, such as wheelchairs.



It has been demonstrated through existing theories that we can detect EMG (Electromyography) at specific locations in the muscle by means of **suitably positioned electrode patches** to enable groups of people paralysed in commonly used for control parts of the body to control a wheelchair by means of minute movements of the movable parts.



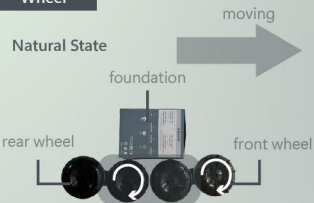
Moodboard & Sketch

I tried to explore the form based on function mentioned above, incorporating natural curve elements that fit the body.

Modelling

I carried out a quick simulation of how achieve the lifting function of the wheelchair, with the materials available to me, and chose one of the simpler ways:

Wheel



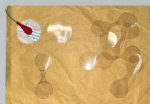
Lifting State



Patch



Determine the patch size on the basis of electrodes



Select the model material (real material : rubber) and cut out shapes



Presentation of how to fix the electrodes



Presentation of how to fix the patches together

Seat



In order to better define the dimensions of the product, I made some models out of corrugated cardboard.

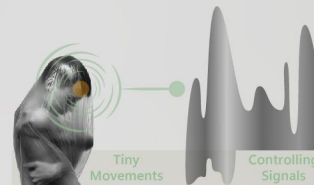


I invited four people of varying heights and weights to test it out and try to come up with a range of sizes that make people feel safe and comfortable.



Prototype

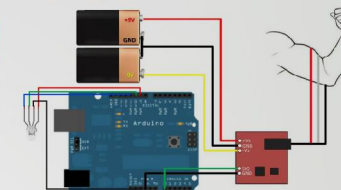
The core idea about achieving control of the machine by transforming the EMG signals. I modelled this process using a simple Arduino EMG signal module. The **switch of the RGB light** colors was achieved through tiny muscle movements.



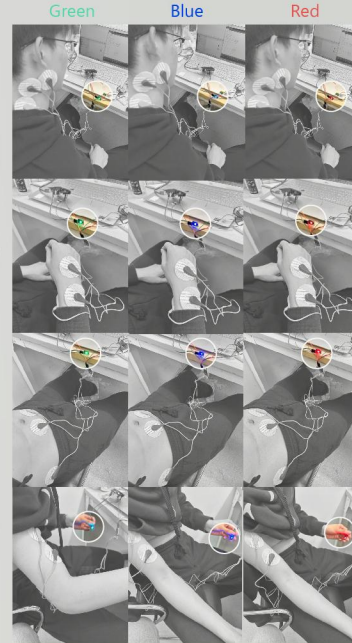
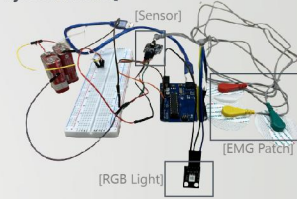
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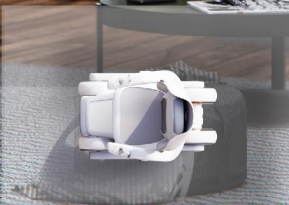
[Circuit Diagram]



[Physical Pattern]



Rendering



Usage Scenarios

Lifting

Standby Mode

Go up

Go up

Go down

Top Mode
(Light Warning)

Used when
moving/checking/interacting
with patients /.....

Moving

Wrap-around
seat back
protects users
from accidents

Gloves to fix
the hands ,
adjustable in
size



Display the status of Myochair to alert people around