DESIGN FOR EACH ONE

POLITECNICO
DI TORINO

HANDICAP

In the context of health, a handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual. [1]

MANEGGEVOLE ← **HANDY CAP** → RIFUGIO

Starting from the word handicap, we realized that the division of the same creates a completely different meaning and that it is and represents what is the final result of this project and of our thesis.

Handy Cap is the name that we have given to our project, it was born with the aim of being an aid for the protection of environmental factors for people in wheelchairs.

1 World Health Organization. (1980) International classification of Impairments, disabilities and Handicaps. A manual of classification relation to the consequences of desease. Geneva. P29.

POLITECNICO DI TORINO

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Master's Degree Program in
Systemic Design

2018

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SPECIAL THANKS

This thesis has been the result of a long life project, during which we had the opportunity to always count on people who are part of our lives. This is why we want to thank them, because without them the culmination of this project and our thesis would not have been possible.

To begin we want to thank God, for giving us the opportunity to have had this cultural and academic exchange that has been enriching in every way. To our families who have always supported us unconditionally and have shown us all their love.

To life for having put us in the AISM, since the fact of coinciding in this place is what allowed us, to live one of the most beautiful experiences of our life, during this volunteering service and as a result the realization of our thesis.

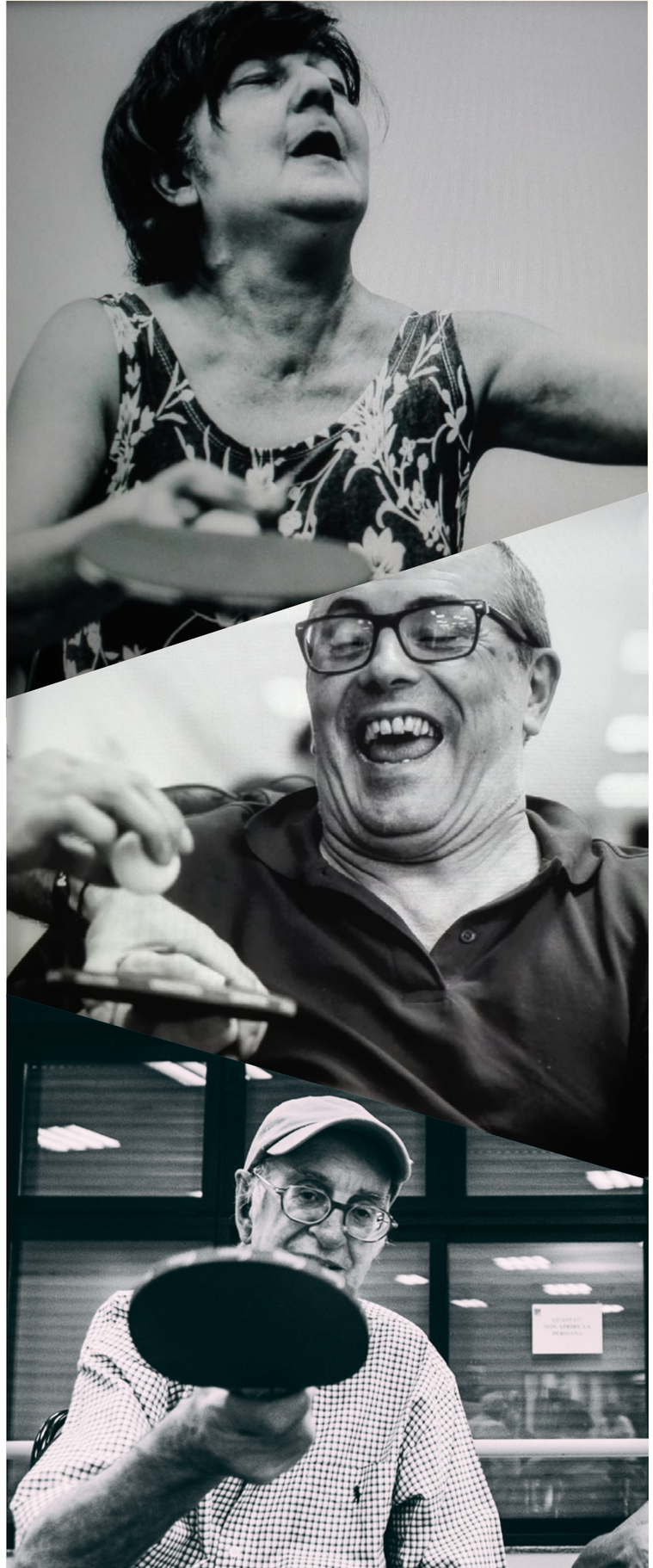
Thanks to Professor Cristian Campagnaro for guiding us and always being available throughout the development of the thesis.

Thanks to Cristina Navone for her support throughout this time both civil service and during the thesis. To Enrico Giunta for becoming our ally and adviser during the creation of this project. To Marco Canario for giving us a hand in the realization of the prototype and the photographic production.

Everyone in the AISM, Andre, Anna, Palma, Giovanna, Mattia for making us feel part of something so beautiful and always being there for us. Thanks to all the users of the association for everything they gave us during this year.

Finally, and most important we want to thank Rudy, for making himself available for the realization of this thesis, for always being willing to collaborate with us and make feedback on the results obtained.

And thanks to all the people, friends, relatives, new colleagues that we did not mention but to whom we surely owe a little of this achievement.



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ABSTRACT

Project of a help for the protection of environmental factors for people in wheelchairs

KEY WORDS:

Design for each one, multiple sclerosis, degenerative disease, rain protection, autonomy, Co - Design.

This thesis project was born as a result of our participation in 2017 in the workshop “Design for Each One” that takes place every year in the Italian Multiple Sclerosis Association with students who are taking courses in Communication Design visiva or developing a Master in Systemic Design as is our case.

This is an enriching experience, both academic and personal, that generated in us, the interest in volunteering in this association, after the culmination of the workshop.

This is how in January 2018 we started the voluntary civil service, given our constant presence in this association, we participated for the second time in the workshop of this academic year. Reinforcing our position as industrial designers in a context that starts from the individual to understand the particular difficulties they face in their daily life as a result of their condition as people with a degenerative disease.

In this last workshop, one of the projects was directed to the difficulty of Rodolfo Greppi , who has to leave his house to the AISM or other places when weather conditions are not optimal. This is how this thesis project arises.

We seek to give Rudy the opportunity to carry out activities outside his home even when it rains, returning him a certain degree of independence and autonomy that he lacks, and that is so important to him.

We take as a first reference the feedback and the analysis of the workshop Design for each one, and our methodology is based on the Co - Design projection model, where the user is participant in many of the phases and design decisions.

ABSTRACT

MULTIPLE SCLEROSIS

2.1 PATHOLOGY

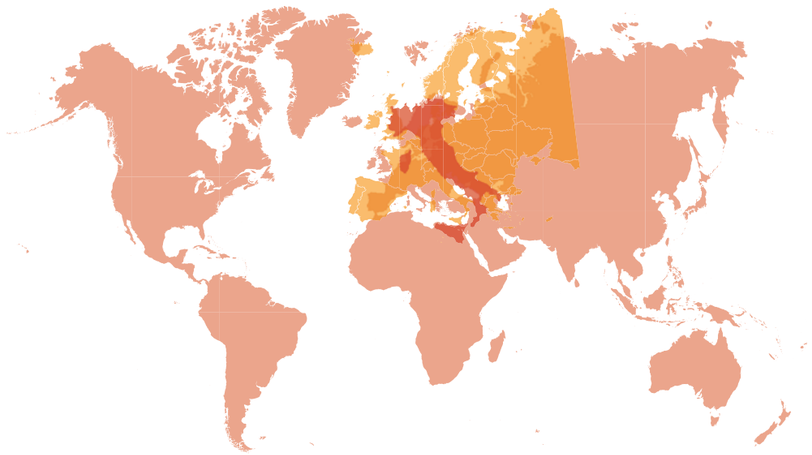
What is multiple sclerosis ?

Multiple sclerosis is a disease characterized by demyelization of the Central Nervous System (CNS) and inflammatory lesions disseminated in the associated white matter, neuronal degeneration.

Is directly related with the central nervous system that affects the myelin that covers the nerve fibers and the nerve cells themselves, preventing proper transmission of the nerve signal along the body.

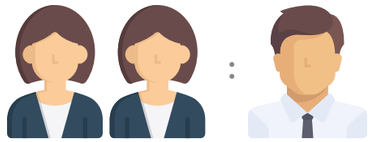
The SM is considered an autoimmune disease, which means that the immune system, instead of protecting the body from diseases and infections, starts attacking the healthy cells of the body by mistake.

The causes of multiple sclerosis are unknown and no definitive cure has yet been discovered, but today there are pharmacological therapies able to slow down the course of the disease and improve the quality of life of those living with it.



Epidemiological research estimates that today there are 3 million people worldwide with MS, 600,000 in Europe and around 113,000 in Italy.

MS can begin at any age of life, but is diagnosed mostly between 20 and 40 years old and in women, who are twice as affected by men. For frequency it is the second neurological disease in the young adult and the first of a chronic inflammatory type.



Women on average are affected twice as much as men

MS is a chronic developmental disease that produces needs that affect the whole person, thus involving not only the physical, but also the psychological and social aspects.

Problems and needs start from the time of diagnosis and accompany the patient throughout the duration of the disease. Symptoms of the disease have a negative impact on functional, social and work activities and consequently on the quality of life of the person.

Diagnosis

At this time, there are no symptoms, physical findings or laboratory tests that can, by themselves, determine if a person has MS. Several strategies are used to determine if a person meets the long-established criteria for a diagnosis of MS, and to rule out other possible causes of whatever symptoms the person is experiencing. These strategies include a careful medical history, a neurologic exam and various tests including magnetic resonance imaging (MRI), evoked potentials (EP) and spinal fluid analysis.

Generally, a variety of tests have to be done to evaluate mental, emotional and language functions, movement and coordination, balance, vision, and the other four senses.

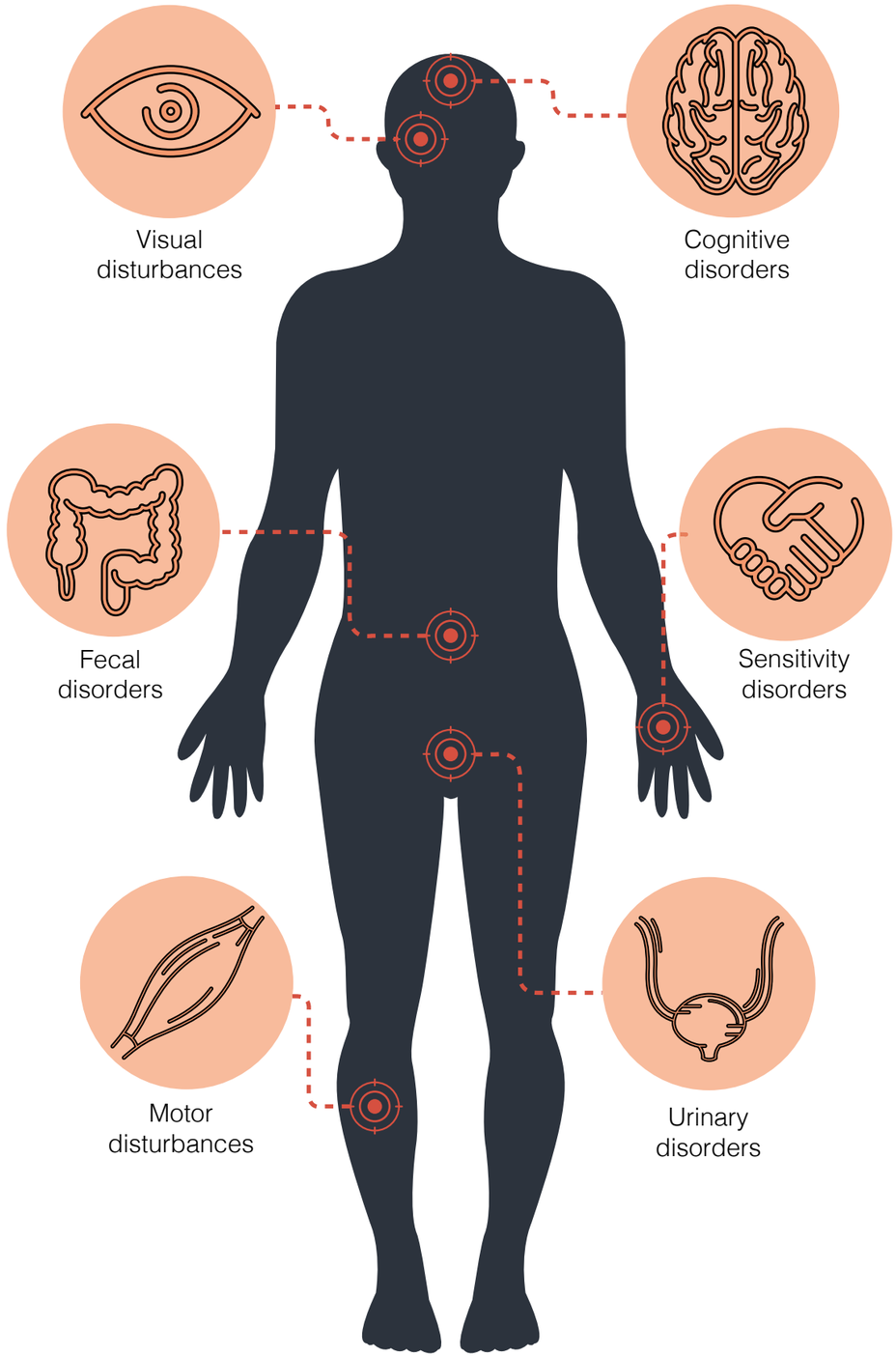
In many instances, the person's medical history and neurologic exam provide enough evidence to meet the diagnostic criteria. While there is no definitive blood test for MS, blood tests can rule out other conditions that cause symptoms similar to those of MS, including Lyme disease, a group of diseases known as collagen-vascular diseases, certain rare hereditary disorders, and AIDS.

Even the fact that the diagnosis of this condition is complicated there are a variety of symptoms that facilitate the establishment of the possession of the disease or not.

Symptom

Multiple Sclerosis produces different symptoms by gravity and affected site, which may occur singly or in association, leading to the emergence of complex clinical pictures. This variety of manifestations depends on the fact that the diabetic lesions typical of the disease can affect different areas of the CNS (Central nervous system) and, therefore, different functions can be affected.

Most affected body areas



Most common symptoms

Fatigue

95%

Is the ack of physical and / or mental energy perceived by the person who interferes with the usual and desired activities. There are two types of fatigue. The primary fatigue is a feeling of exhaustion without premonitory signs, is persistent and does not depend on effort.

On the other hand, secondary fatigue is related to the emotional state, to the presence of sensory and motor symptoms, to isomance, etc.

Impact on daily life: Has a significant impact on patients' autonomy and quality of life; can therefore entail risks in terms of maintenance of work, difficulty in sustaining long mental functions such as reading, memory, attention and concentration.

Motor disturbances

90%

Reduction of muscle strength, often associated with spasticity (increased muscle tone)

Impact on daily life: Disorders in walking, in postural passages, in transfers and impairment of the manipulative capacity of surrounding objects.

Sensitivity disorders

90%

It is also known as hypoesthesia (reduced perception of sensitivity up to anesthesia), it can be superficial or deep tactile, which can affect important motor difficulties.

Impact on daily life: Manipulation deficit. In the case of the lower limbs turbe of balance and walking. This symptomatology has a strong influence on work capacity.

Visual disorders

85%

Optic neuritis characterized by bulbar pain worsened by the ocular movement itself, changes in the visual field, and loss of visual acuity, difficulty in the distinction of colors.

Impact on daily life: These disorders are not correctable with lenses and have an important impact on the daily life of the person. They can affect walking, computer use, reading and driving, among others.

Coordination disorders

80%

The person presenting this symptoms has a sense of instability, impaired balance, felt as a feeling of subjective vertigo.

Impact on daily life: Impairment of the manipulative capacity and use of the upper limbs, with consequent limitation in the autonomy of the activities of daily life (feeding, dressing, washing, writing) also the lack of walking with a high risk of falling.

Urinary disorders

80%

Irritative symptoms (urinary urgency, increased voiding frequency, urinary incontinence), obstructive symptoms (urinary hesitation, multiple urination, incomplete bladder emptying, urinary retention).

Impact on daily life: This symptom represent an important cause of limitation of functional, social and working autonomy, can cause complications such as recurrent urinary tract infections. Urinary infections can also lead to worsening of the symptoms related to the disease, emotional stress, sleep disorders and risk of social isolation.driving, among others.

Cognitive disorders

65%

Deficit of memory, reduction of learning capacity, deficit of focused and sustained attention, impairment of executive functions and problem solvinng.

Impact on daily life: Difficulty in the study activities and in the maintenance of the study activity and in the working environment. Risk for social isolation.

Communication disorders

60%

Dysphonia (qualitative problems of the voice due to alteration of the pneumo-phonoarticulatory system), dysarthria (dysfunction of the articulation of verbal sequences programmed for alteration of the neuromuscular system).

Impact on daily life: Both the verbal expression and the understanding of the interlocutor make it difficult and tiring, therefore there is a risk of social isolation due to the difficulty in personal and lavorative relationships.

Faecal disorders

60%

Constipation, incontinence and fecal urgency, difficulty in defecating and pain.

Impact on daily life: Social isolation; worsening of the quality of life; difficulty with work-related activities if the same does not allow individual management of the breaks.

Mood disorders

60%

Mainly anxiety and depression.

Impact on daily life: Social isolation, loss of motivations that can deeply interfere with the ability to manage illness and care, in emotional and social relationships, and in general on interpersonal dynamics with colleagues, friends, family members.

Pain

40%

Nociceptive pain (response to painful stimuli described as intense, continuous, pulsating pain), Neuropathic pain (burning pain, continuous, subcontinuous, intermittent)

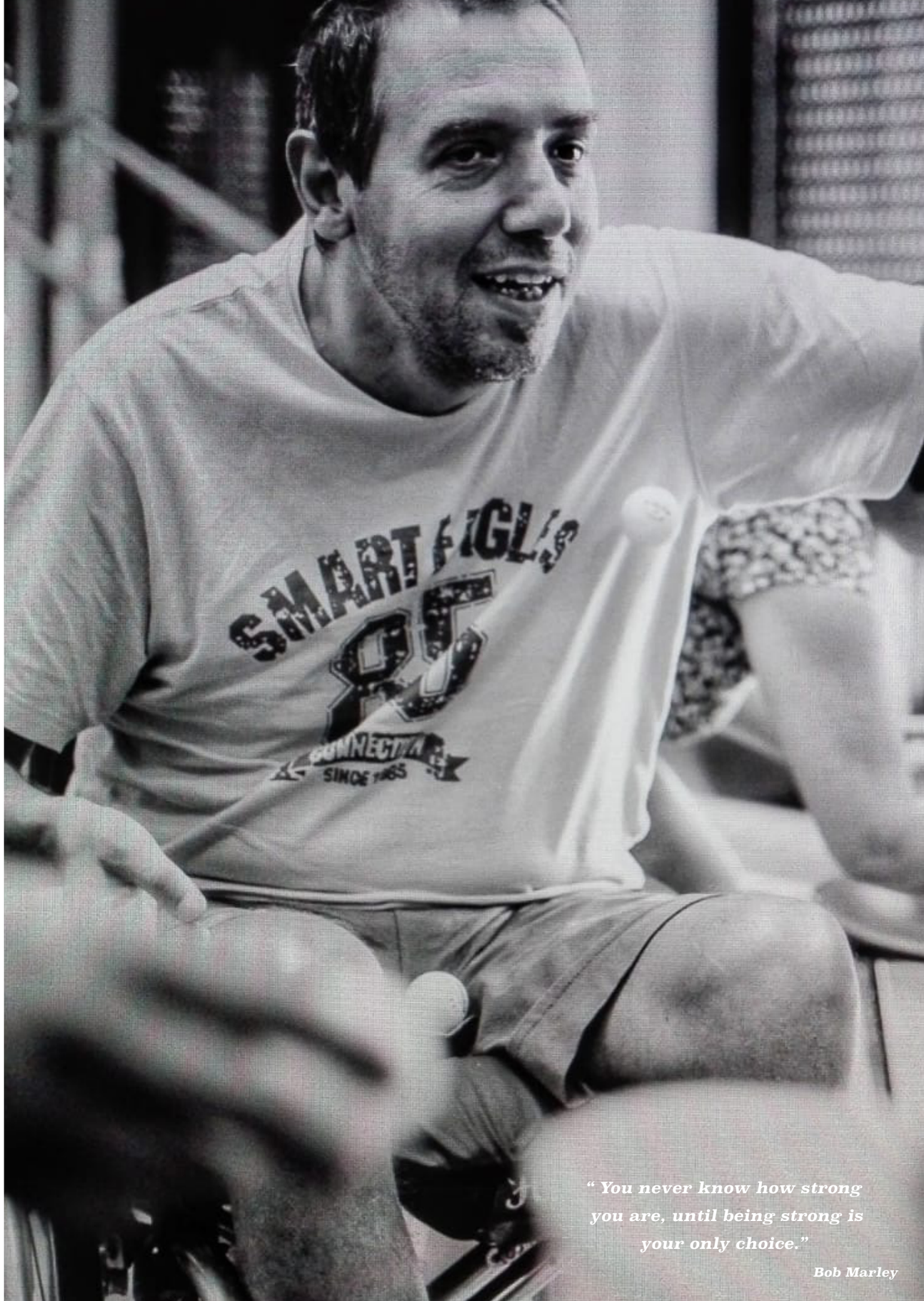
Impact on daily life: Possible serious impact on the autonomy of the person, involving important functional limitation, affects all activities of life.

Swallowing disorders

30%

Dysphagia for liquids and solid foods.

Impact on daily life: This condition implies a change in the patient's eating habits with an important impact on the quality of life of the person with MS and those close to them. There is a risk factor for the respiratory system as a cause of ab-ingestis pneumonitis.



" You never know how strong you are, until being strong is your only choice."

Bob Marley

Respiratory disorders

30%

Due to deficiency of the respiratory muscles (especially of the diaphragm) and of the automatic control of the breath. In some cases where the disease is advanced, asisititic ventilation may be necessary.

Impact on daily life: Difficulty in doing physical activity and efforts, risking the autonomy of the person.

Vascular disorders

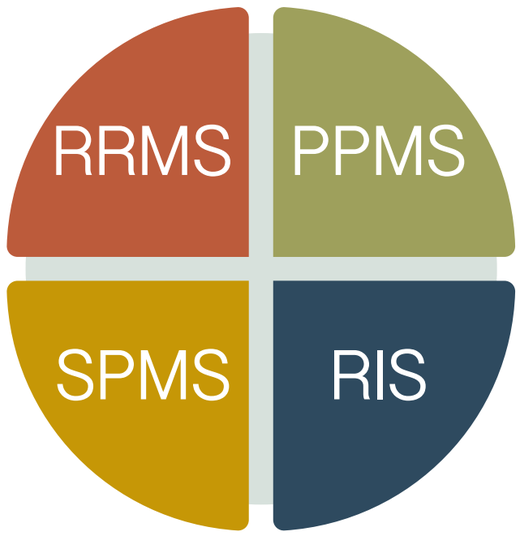
11%

Venous edema, lymphedema, deep vein thrombosis.

Impact on daily life: Difficulty in reaching or maintaining the erected station; reduced autonomy in the activities of the daily life; mostly associated with lodging and / or sedentarism.

There are currently four types of Multiple Sclerosis, however it is necessary to consider one important syndrome that is:

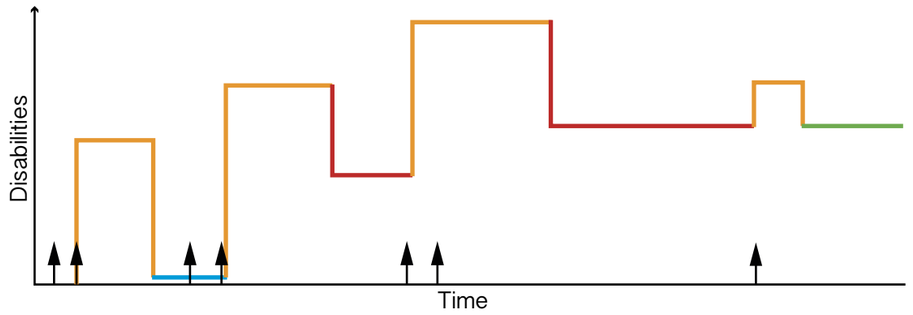
CIS (Clinically Isolated Syndrome), this is characterized by the appearance of a neurological episode (symptom or sign), which lasts at least 24 hours and is due to a demyelinating process of the central nervous system. People with a CIS will not necessarily develop MS.



Types of MS

Multiple sclerosis with relapsing-remitting course (SM-RR)

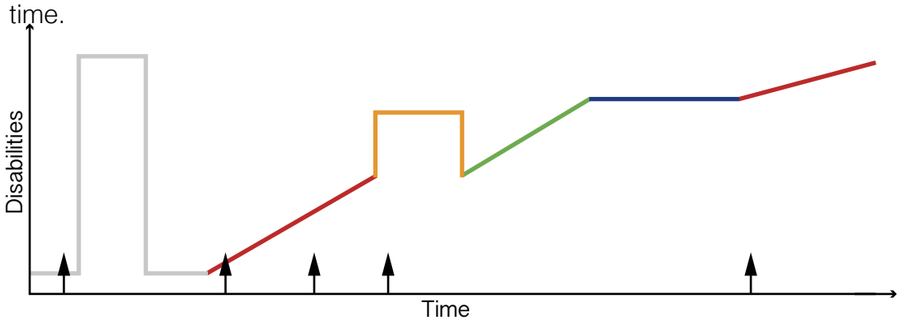
The most common form of multiple sclerosis. About 85% of people diagnosed initially have this form, characterized by acute episodes of illness (‘poussè’ or ‘ricadute’) alternating with periods of complete or partial well-being (‘remissions’).



- Relapse
- Active disease without worsening
- Worsening (incomplete recovery after relapse)
- Stable without activity
- New activity on magnetic resonance

Secondarily progressive multiple sclerosis (SM-SP)

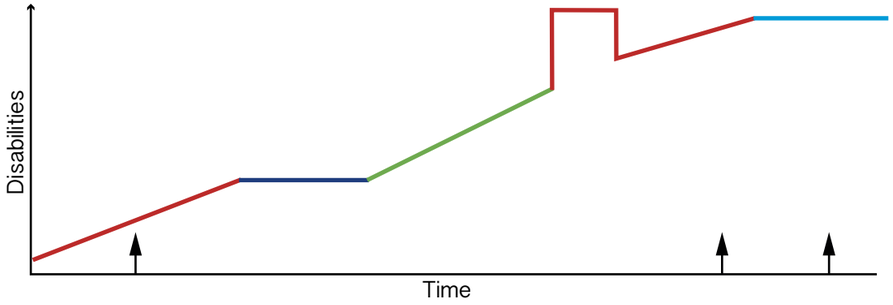
It is the evolution of the relapsing-remitting form, many of the pacients initially diagnosed with the RR form will be able to move to a secondarily progressive form, characterized by a persistent disability that progresses gradually over time.



- Recurrent-remitting multiple sclerosis (SM-RR)
- Active disease with progresion
- Active disease without progresion
- Disease not active with progresion
- Disease not active without progresion (stable)
- New activity on magnetic resonance

Primary progressive multiple sclerosis (SM-PP)

Characterized by a deterioration of neurological functions since the appearance of the first symptoms, in the absence of real relapses or remissions. These forms can be distinguished into active forms or non-active, as well as progressive or non-progressive. About 15% of people with multiple sclerosis have a primarily progressive form.



- Active disease with progression
- Non-active disease without progression (stable)
- Non-active disease with progression
- Non-active disease without progression
- New activity on magnetic resonance

Radiologically Isolated Syndrome, RIS

This name is used to identify the cases of people who carry out an MRI scan for reasons unrelated to multiple sclerosis, in the absence of symptoms characteristic of the disease, from which, however, there are characteristic lesions of MS on the cerebral cortex or the white matter of the brain. Specific studies are trying to clarify and improve the understanding of these cases, but further information is still needed.

2.1 AISM

The Italian Multiple Sclerosis Society (AISM) is the only organization in Italy that addresses every aspect of multiple sclerosis (MS), through advocating for the rights of people with MS and providing services and through orienting, promoting, and financing scientific research.

AISM was founded in 1968 with the objective of advocating and fight for the rights of people with MS, over time has become the principle resource not only for people with MS, but for families, healthcare professionals and anyone involved with this disease.

The association wants to assure that people with MS can achieve their life goals, this by providing accessible information, support and services to every one of them as well as their families.

Today there is a network of 100 local branches and regional coordinating centers present throughout Italy, and over 13,000 volunteers.

AISM has made a significant contribution to achieving results through identifying research priorities that require excellence and innovation and by being a leader in MS research nationally and internationally.

AISM places great importance on the rights of people with MS in order to assure their full inclusion in society. Through a continual dialogue with key stakeholders, including government representatives and legislators.

Plan that promotes programs and actions to improve the political, social and healthcare landscapes. The plan directly focuses on bettering legislation in order to improve the quality of life of people with MS and those with other illnesses and disabilities.

AISM invests in a tangible advocacy plan that promotes programs and actions to improve the political, social and healthcare landscapes.

The plan directly focuses on bettering legislation in order to improve the quality of life of people with MS and those with other illnesses and disabilities.

Rehabilitation day care center

The Turin Day Center is a rehabilitative social structure designed to accommodate adults with multiple sclerosis or similar neurological diseases, in a situation of severe, medium and mild disability.

The day service provides hospitality, assistance and services to help with daily activities; offers opportunities for community life, incentives and opportunities for occupational and recreational / cultural activities, retention and social / rehabilitation activities.

The following activities are carried out in the Center AISM:

- Assistance to protect and help in the activities of daily life (meals, personal care, external accompaniment)
- Socialization activities
- Activity of maintaining functional skills
- Health care and nursing
- Catering
- Cleaning of the environment
- Transportation
- Artistic activities activities.

DESIGN FOR EACHONE

3.1 The workshop

Our thesis project, was born as a result of the activity developed by the students during the workshop proposed by the Politecnico di Torino, which is called Design for Each one.

In 2013 the IN-RETE project that involves the disabled service for the Turin city, was carried out with the aim of creating a network of contacts and exchange of experiences for collaboration between different associations of the Piedmont region, this is how a delegate of the municipality of Turin proposes to the Italian Association of Multiple Sclerosis (AISM) to contact the closest contact of the Politecnico di Torino, the teacher Cristian Campagnaro who was already cooperating with the Cooperativa Animazione Valdocco Onlus.

The AISM work team: Cristina Navone, Enrico Giunta and Andrea Vairo meet with the previously mentioned professor to talk about topics that could interest both, this is where the idea of creating a laboratory for the students of the Politecnico di Torino was born, where a social project with a duration of one week would be developed with the aim of co-constructing together with the people who frequent the day-time centre and the students a series of aids to meet specific needs and facilitate actions of daily life.

The human experience in the artistic journey

An artistic and experiential travel through the world of motor disability. From the construction of the relationship, to the creative ideation of an aid for the development of small and large daily gestures. The path is carried out through a journey laboratory experiences in group with the latter goal of trying to find the specific needs ofzthe individual.

This project arises with the idea of being able to face a different type of design, the design that allows us to work from a requirement and a need of a specific person, taking into account that each person is different, depending on their particular condition, they have different difficulties from others, seeking to improve their quality of life and helping them to develop autonomy in the actions they carry out on a day to day basis.

3.2 Our experience

We have had the opportunity to part cipate twice in the workshop, the most representative and impressive for us was when we had the first approach to the day center, a different and cozy environment that captivated us from the first moment, there was when we committed ourselves to develop a GREAT project; that with the passing of the day allowed us to realize that the design goes beyond industrial production, user-centered design allows the designer to develop more specific capabilities, allows to recognize and observe situations that we would not see in the current industrial design, allowing us to develop creativity at a different level where the person is always at the center of the project.

For us Maria Camila and Andrea Alejandra, the most interesting part of this experience is having the possibility to have contact with the user, create a relationship and empathy with a person that we have never seen, in the short time of a week, and the fact of know that the project that is to be developed, is going to be a reality and was going to be designed and used by a person who really had a need.

This is how through the Co- Design model we developed a project with and for the people of the AISM day-time center.

WORKSOP DAYS

1

Relationship creation
Reception and visit of the structure, promotional video of the association. Team presentation and first approach with the user.

2

Difficulty analysis
Participation in a daily activity.
Analysis and brainstorming to solve the problem.

3

Co-Construction, Co-Design
Relationship to build with the user a solid idea (including case studies, search of the state of the art and drawings). Ending with a feedback of the day.

4

Prototyping: Taking of measurements, list of materials, prototype construction with the relative participation of the user, realization of the final presentation and graphic aspects such as 3D modeling and rendering.

5

Final phase:
Finished and verified prototype
Workshop presentation at the university.

3.3 WORKSHOP RESULTS

The results of the workshop were very important for us, since they would be the guideline of our thesis and an important reason why we decided to continue the Rudy's project.

The project process model of the students was decisive in order to achieve the desired result in such a short time, and although the prototype arrived only at the first stage of development, (prototype that only described the definition of the form and relevant aspects of the design and materials), being participants in this workshop from another point of view allowed us to realize that in fact **the most interesting thing of the whole process was to involve Rodolfo in many of the project phases, do co-planning and co-design with the user at the center of the project.**

The render on the right represents the final result of the workshop, the students raised the protection of two critical zones for Rudy, the head and the electric part of the wheelchair where the joystick is located, giving greater relevance to the part of the head .

The prototype was made in a thick plastic and for the construction they decided to open holes in the plastic to pass a metal wire that gave shape to the curve. This model was tied with Velcro adhesive to the back of the wheelchair.

On the other hand, for the protection of the joystick, they just left the idea, with a thinner plastic of protecting the whole electric part and a large part of the arm is evident in the design.

TO BE CONSIDER:

The material of the prototype, was too opaque, which impeded the visibility to Rudy, in addition that due to the technique that they used to insert the metallic wire, the holes allowed easily the entrance of the water.

On the other hand, the arches that they designed to protect the head did not have the appropriate measures, allowing the entrance of water easily by different angles.

The anchorage system to the wheelchair with velcro did not work completely well, so they had to complement it with other types of adhesives to reinforce the union.

CO-DESIGN PROCESS

The creation of trust in a process of co-design is essential, since it's there where designers extract ideas of great value from the information that the user is giving, great empathy is created and the beginning of a completely different artistic journey is carried out, different in comparison to the process that designers usually develop, where there is an important added value since the user will be part of the decision making.

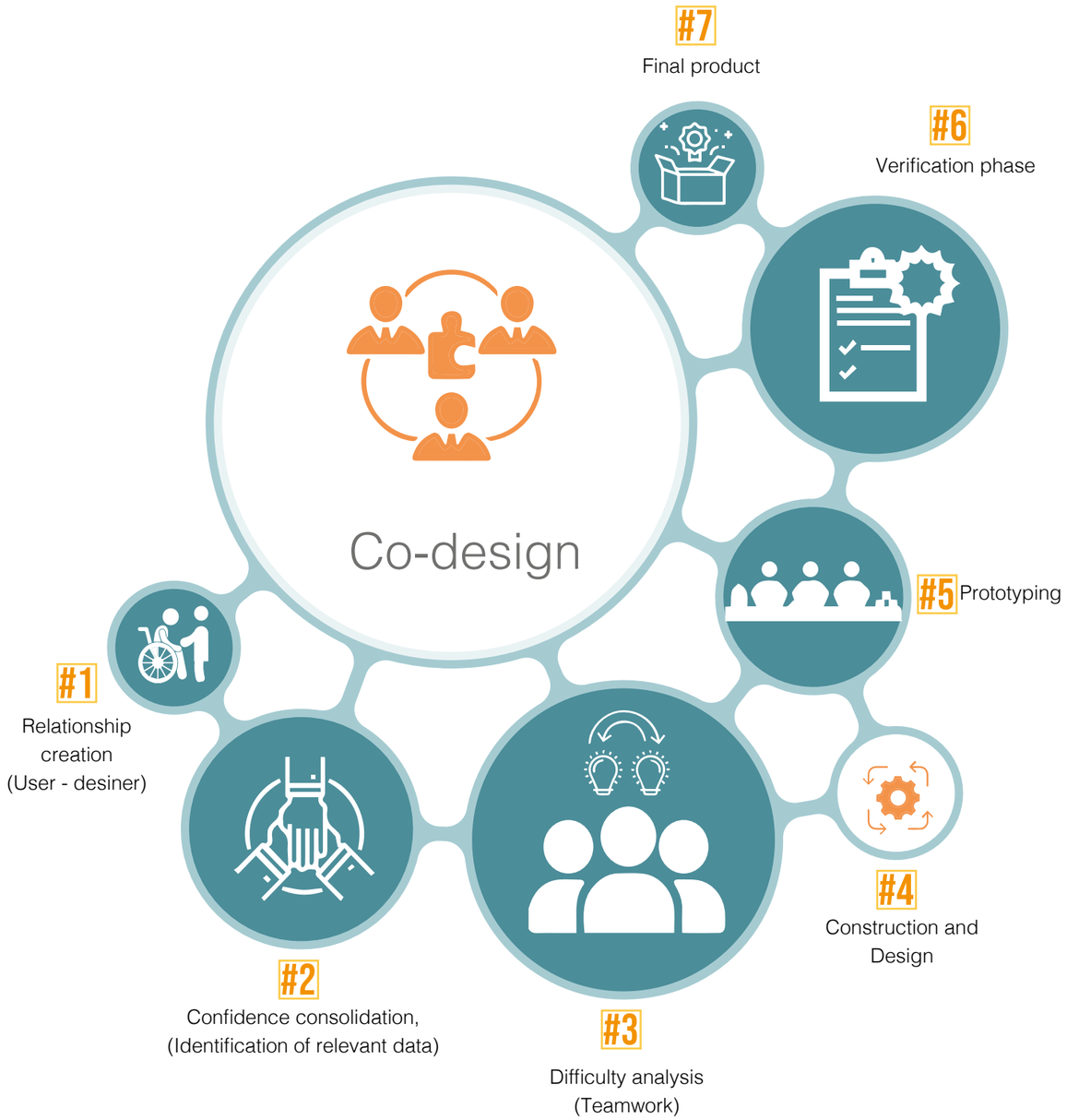
The limits and the ideal of the project are then defined, in order not to extend the process and allow the desired result in a short time, managing the main goal of the project: to protect Rudy from the rain principally and other envirnonmental factors.

After establishing the requirements of the project, the creative phase began, in which, through benchmarking analysis, a great brainstorming was carried out that allowed designer to start creating important aspects of function and form. To then come to consolidate the idea by choosing the materials needed to build the prototype.

In the prototyping phase Rudy's participation was again crucial, and his attitude was always kind and the way the students interacted and integrated him was very significant to him, due to the fact that he had a different week. A week where he was part of of an experience that he has never lived, where he was the main protagonist and where he would give the key points to reach the best result, being a recirpocal relationship, where a group of people thought about a very important difficulty for the first time and on the other hand he collaborated to complete the workshop in a satisfactory manner.

After the prototype was almost finished, the working group was divided into two, one part was devoted to specify the graphic part, render and presentation to the university, while others gave the final finishes to the prototype that should be presented.

The co-design model suggested by the workshop Design for each one, allows establishing the seven main phases of the participatory design process, where following the design thinking, the user is always at the center of the project and where it is involved in many of the creative stages and relevant decision making.



WORKSHOP FEEDBACK

As students we could realize the importance of creating a relationship with each person, once they know you and feel the confidence they are able to reveal important data that could be of great help for the project, once they become more spontaneous and allow themselves to be involved in the project you are able to decipher the real need day by day (the real background of the problem). Being a project that must be developed so quickly, the results are seen almost from the third day, that's where a brainstorming and creativity arises to find a solution as quickly as possible and start prototyping.

As observers we had the opportunity to see from another point of view which is, the user's point of view.

How the days of the user change, when the students are for a whole week sharing with them the activities they were used to doing with their colleagues or friends.

We realized the potential of the results of the workshop, and the opportunity to continue this project.

THESIS CHOICE

First of all, the experience we have had to sharing a week and developing this laboratory left an important footprint in our lives, so much, we decided to apply as volunteers to continue contributing with projects from our profession and giving an aid in the life of these people. After being accepted to develop civil service we hold the second workshop (this time as observers) and the feedback we had at the end of the workshop was:

Due to the short duration of the workshop the prototypes were at a low level of usability and it was possible to develop high-level projects based and inspired by the results of the workshop. So we decided to continue with the project of one of the users that had the highest priority, in terms of need to obtain a result in the shortest time possible in order to satisfy a difficulty that he is currently facing.

RODOLFO GREPPI

We chose the project of Rodolfo Greppi, a user who frequents the AISM since November 2011, has multiple progressive sclerosis 33 years ago, with significant deficit of force movement of arms and hands, called hyposthenic deficit.

The user lives in the municipality of Volpiano, located 17.7 km from the Italian Multiple Sclerosis Association, 40 minutes by public transport, he approaches the association two days a week using an inter-municipal bus that transports him to the Torino entrance, were then he takes the tram number 4 that allows him to get to his destination after 10 minutes of self driving.

RUDY'S TRAVEL ANALYSIS

The analysis of the route that Rudy makes from his house located in the municipality of Volpiano to the Italian association of multiple sclerosis, allowed us to understand each of the important phases of the route and analyze in detail key factors such as: schedules, distances and means of transport used.

CRITICAL POINTS

Positive aspects
Negative aspects
To be evaluated

We analyze the critical points of the route, as well as the positive aspects and points to evaluate. The above in order to take into account when making important design decisions such as dimensions, practicality, comfort and evaluate the degree of autonomy of Rudy.

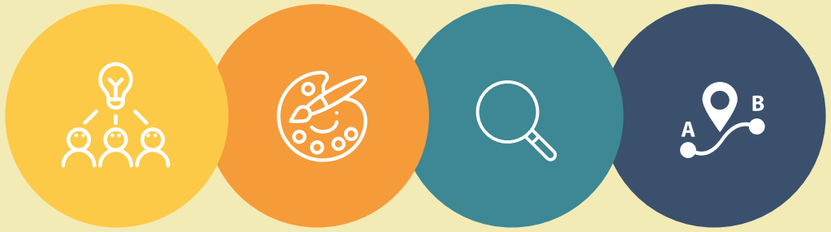
We conclude that although the user can be helped to install the device in his wheelchair, it is important that once installed it is easy to open and close it when desired.

The total journey is 6km round trip, so Rudy should be able to use the electric protection part autonomously, and to open and close the cap easily, realizing that to install and uninstall both he needs a hand.

METHODOLOGY

OUR PROCESS

We established as a reference for our project, a model scenario based on the analysis of four different factors, which allowed us to obtain indications that would help us to set up the limits and requirements of our design. The results of this stage of analysis allowed us to open a new panorama, encourage creativity and give us inspiration and key points that we could use to start designing.



1. WORKSHOP

We participate twice in the workshop Design for Each one, one as students and the other as observers and reviewers.

2. RUDY'S TRAVEL

We accompany Rudy on the journey from his home in Volpiano to the AISM, observing in detail every part of the road and the most important critical points.

3. STUDY CASES

As part of the inspiration process we look for different study cases that allowed us to eliminate barriers and awaken creativity

4. STATE OF THE ART

We did an research of the state of the art of existing rain protection systems for wheelchairs.

GUIDE LINE

KEY MEASURES

Maximum measure to protect Rudy from the back until a little more from the front of his nose.

80 cm wide maximum from elbow to elbow so that Rudy is completely comfortable and can move, 70 cm minimum distance, and 15 cm each side to enter in the bus.

Diameter of anchor point to the wheelchair.

Limit measure of hight for enter in the inter-municipal bus.

60 centimeters distant from the joystick to the elbow, 30 from the joystick to the hand.

DESIGN CONCEPT

Valuating the results of the workshop we decided to make an analysis of the movements that Rudy can and can not do with his left arm without having to make so much physical effort

90 DEGREES

From the front side view Rudy has the ability to make a movement with his left arm from the top of his head to his legs, making an almost perfect angle of 90 degrees

180 DEGREES

From the front view Rudy has the ability to move his left arm from the bottom of his right elbow making an almost perfect angle of 180 degrees to reach the same position on the opposite side.

CRITICAL ZONES

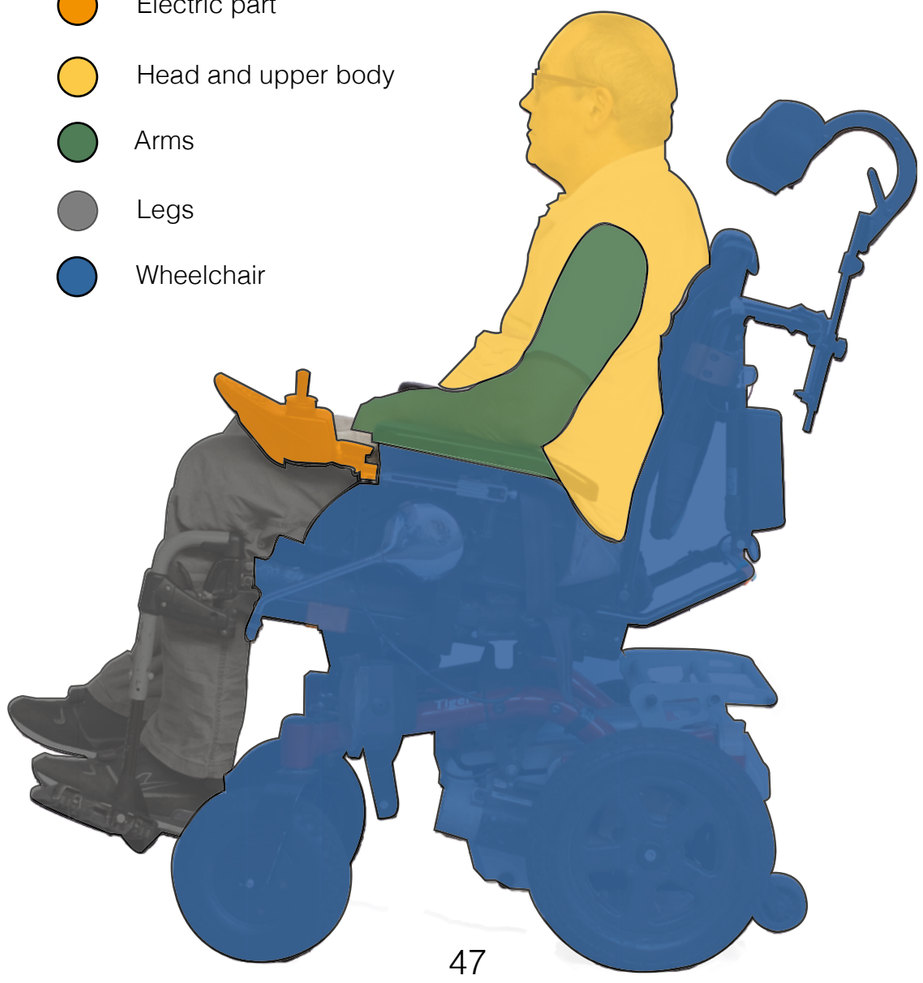
Analysis of important areas

During the process of co-design with Rodolfo, important information emerged, as the priorities for him in terms of protection, being the first and most essential one, the protection of the electrical part of the wheelchair, since he has the perception that this could suffer significant damage with rain.

In second place is Rodolfo's head, since what bothers him the most when it rains is the water in his glasses.In third place and always with less relavance are the legs.And finally the other parts of the wheelchair.

All these parts have been identified with different colors in the following images of the side, front and top views.

- Electric part
- Head and upper body
- Arms
- Legs
- Wheelchair



This is what Rodolfo considers to be the most important part to cover from the rain

In second place is his head and upper body.

STUDY CASES, STATE OF THE ART

CASE STUDIES

Before starting our project with Rodolfo, based on the result of the workshop, we allowed ourselves to do a research to find projects, objects, designs that were related in some way to our project or better what we wanted it to become.

This process allowed us as designers to explore areas that in some cases away from the theme of our thesis, but at the same time gave a different vision, becoming an enriching exercise.

To begin and seen that Rodolfo currently uses a common raincoat to protect against the rain, we began the search for “dresses” or “clothes” not only for the rain but in general fashion that had something in particular.

We also took into account the fact that the mobility in both arms of Rudy has been compromised by the disease, therefore we look for protectors where the need of the hands was almost not necessary.

Then we went to the search for existing elements for wheelchairs, where we find several that fit the wheelchairs, however none of these adaptable to the type of wheelchair of Rodolfo.

And finally structures that could be applied or that could inspire us for the development of our project. We find examples of overlapping structures, flexible materials, even structures in which the air introduced is what gives shape to the object.

Case studies for the body

SERPENS

Description

This designer of Chinese origin, creates a collection of coats as a tribute to reptiles where he uses large-dimension fabrics to achieve complex and structured shelters.

Who

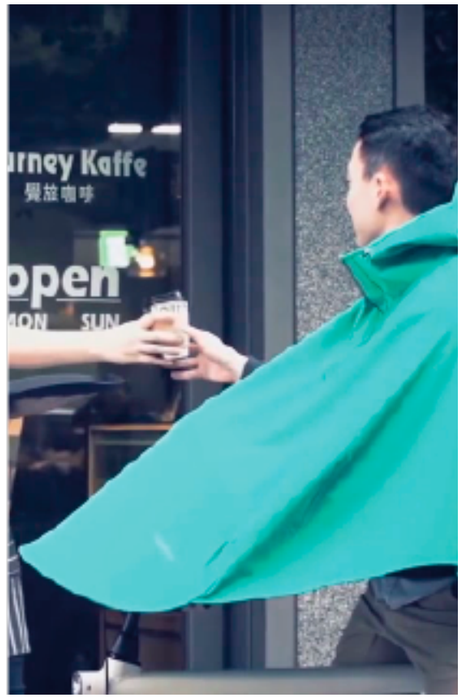
Qiu Hao

Year

2001

Relevant features for us

- Clothing as a shelter
- Structural fabrics



BONCHO BY VANMOOF

Description

Boncho is a shelter that protects from rain, especially designed to be used when riding a bicycle. The shape of this, is made on purpose to protect the person at the bicycle while using.

Who

Shane Liu and Vicky Lin

Year

2016

Relevant features for us

- Hands almost free
- It is designed to protect the person and protects the bicycle
- It has a mechanism for easy opening
- Waterproof fabric

HANDSFREE UMBRELLA CARRIER SYSTEM

Description

Walimex pro swing hands free umbrella was intended for photographers and climbers. It consists of two parts, a lightweight umbrella, made with polyester and an adjustable system to carry it.

Who

Not available

Year

Not available

Relevant features for us

- Hands free
- It is an existing object that is given an added value

NUBRELLA

Description

Nubrella is an umbrella or protector of environmental factors, it is easy to use since it fits the person directly as a backpack would, it is adjustable and has a belt for greater stability. It allows, among other things, for the person to have two hands free, to carry out other activities or to hold anything.

Who

Alan Kaufman

Year

2003

Relevant features for us

- It can be used by anyone
- It serves to protect from the rain but also from the sun
- Hands are free

State of the art for wheelchairs

DRY&GO, UMBRELLA HOLDER

Description

One of the alternatives to protect the person who is in a wheelchair is to adjust to the chair a support for the umbrella, which has the advantage that it is adaptable to different types of umbrellas, as well as different types of wheelchairs, taking into account the diameter of the metal structure.

Who

Deki

Year

Not available

Relevant features for us

- Hands free
- It is an existing object that is given an added value
- It can be adjusted to different types of wheelchairs
- Easy to use

WHEELCHAIR CANOPY

Description

Among the different alternatives that exist in the market to protect people in wheelchairs from rain, there are different types of pavilions, which adjust to these depending on the characteristics of the same. Since wheelchairs are in their majority built under the requirements of each person, which makes them different from each other, the design can vary.

Who

Not available

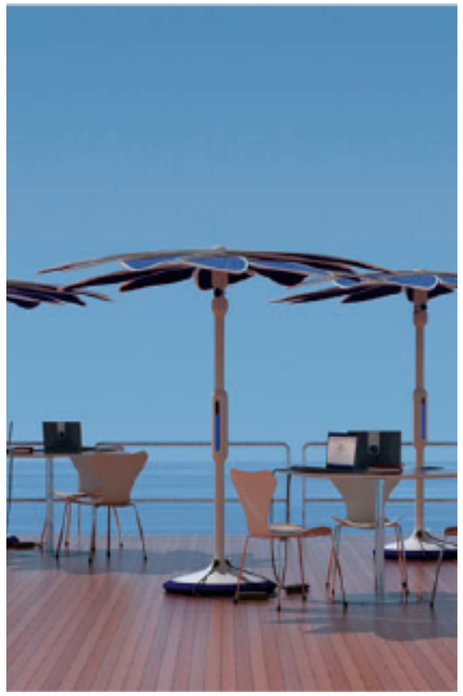
Year

Not available

Relevant features

- Hands free
- It is a structure that is added to the wheelchair (specific type)

Case studies of structures



SOLARIS SUNSHADING

Description

The Solaris i s a sustainable sun shading system designed by industrial designer José Vicente. The Solaris sun shading system i s equipped w ith photovoltaic panels allowing users to charge t heir gadget gear w ith renewable energy.

Who

Jose Vicente

Year

Not available

Relevant features

- The shape allows to have the adequate protection and the compact closing system makes t he design interesting

PO'LIGHT

Description

Umbrella with a height of two hundred centimeters. It consists of a central mast with interior lighting system LEDs and a parasol m ade o f waterproof textile fabric. When disassembling it is stored i n a specially designed case. The metallic foot conceals the electrical system.

Who

Jose Manuel Ferrero

Year

Not available

Relevant features

- Flexible upper part made of waterproof fabric
- It can be disassembled
- The flexible structure allows a wide variety of alternatives

TENT 2 SECONDS

Description

In just two seconds, this tent is armed. This is due t o its design t hat w ith a structure already p re-established by unfolding i t, i t remains open w ith the desired shape. It has a fabric with high waterproof capacity and SPF 3 0 sun protection.

Who

Quechua

Year

2012

Relevant features

- The m ain characteristic of t his case study i s the structure that a llows t his tent to bend and unfold, obtaining the pre-established form.
- Practical

SHIELD

Description

Air Shield Umbrella it's a n inflatable design without any wires or flimsy rods. It consist o f a pump built i nto the handle that i nflates the supporting structure of the canopy with the touch of a button, it's transparent so you can maintain v isibility w hile underneath it. To stop the use with the same button activate the pump and the canopy collapse.

Who

Kevin Lee

Year

Not available

Relevant features for us

- Not additional s tructure parts are needed
- The transparent m aterial allows a good visual
- Very light

DESIGN PROCESS

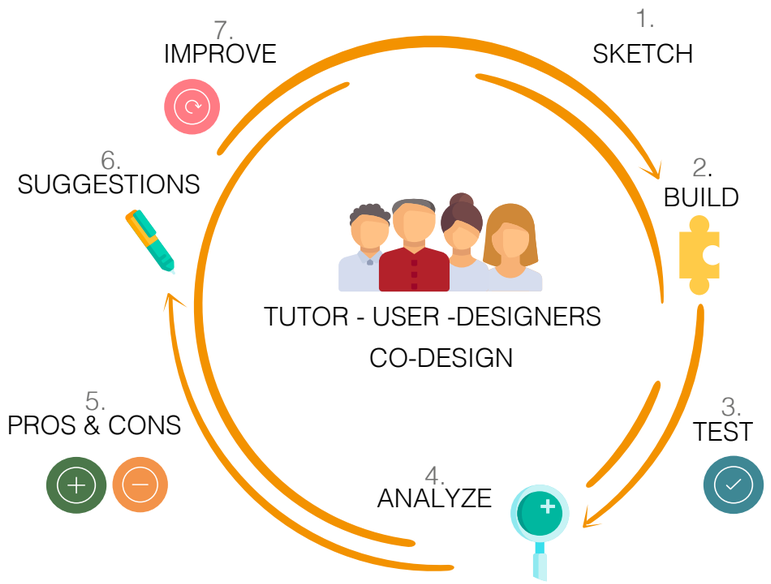
Based on the analysis of the critical areas and the design process carried out with the constant participation of the user, **we realized that it is completely essential for Rudy to protect the mechanical part of his wheelchair**, the part where the joystick is located, since it allows him to have complete **AUTONOMY** on his travels. Being the **AUTONOMY** a key concept in our project route, and one of the main needs that we want to satisfy.

Understanding the above, allowed us to know that **what Rudy really fears** when it rains is to being stuck in the middle of the road because his wheelchair stops working when the joystick gets wet, or that his only way to mobilize "the wheelchair", which represents a great part for him as a person and is important for his life get damaged.

This is how we started making the first design decisions and we decided to divide the four main critical zones in order of relevance.

Giving 100% importance to the joystick, 60% to the head, 30% to the arms and 10% to his legs, which represents the area that does not have great importance if he receives a little water.

The creative journey



Our design process started from the moment we were participants of the workshop, we could find positive aspects and aspects to improve in the design part, from there the ideas were emerging.

After making the first design decision, we decided to start sketching, while we share with Rudy the days he attended the center, we asked about favorite colors, shapes, even remembering the concept of “mimesis” of the case studies integrating the form of the penguin (his favorite animal) to the design of the prototypes.

This stage allowed us to realize that we were ready to begin to materialize the ideas since that was where we would prove if the concepts we were thinking would work.

So we decided to make a creative journey with Rudy through the construction of the prototypes, which were built from Friday to Monday. On Tuesday and Wednesday due to the fact that we had the presence of Rudy, we tested the prototype, we verified measurements and then made a review and a feedback.

The pros and cons of each prototype were born from the meetings with the tutor and the user, a space where we could make a list of suggestions to continue with next prototype or simply discard an idea completely after reviewing each important point in detail.

MATERIALS

Plastic:

Polyvinylchloride PVC
PV01551 Transparent film
Thickness 0.75

Fabric:

100.00% Polyester (PES)
It protects from a thin rain, thanks to the polyurethane-induced polyester fabric.

Wire:

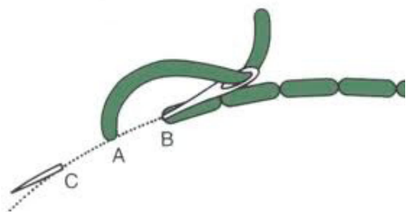
Cias galvanized steel wire
Ø 2,0 - Ø 2,3 mm

ASSEMBLY TECHNICHE

Nylon wire Ø 3 mm

Sewing by hand

Back stich



The back point simulates the stitching of the sewing machine, makes a stitching of the seams just as a machine would do in order to keep them strong and not loose easily.

1 JOYSTICK PROTECTION

DESIGN

The prototype was made only using plastic and thick metal wire. We made 3 main rings that were strategically placed to cover from the joystick start to the elbow of Rudy, covering the entire arm.

We join the wire to the plastic overlapping it and making double seams with nylon thread, leaving the space of one centimeter between seam and seam to then introduce the wire and form the curve.

The curves were of different diameters, they were growing progressively, the smallest located in the part of the electrical command, the next located in the part of the hand and the last in the part where the elbow ended.

PROS

– The thickness of the plastic was adequate to make the prototype.

– The sewing technique was correct, sewing the plastic on the opposite side and overlaying it allowed us to understand that the system was protected from water and that there was no risk of the electrical part getting wet.

– The measurements were correct, even if there were several factors to improve with the diameter of the curves.

– The user felt comfortable with the protection part of the electric command.

CONS

– The plastic of the hand to the elbow was too uncomfortable and did not allow Rudy to move easily.

– The curve located on the hand did not allow good visibility to the remote control, and needed a little more space to allow the hand to move better.

– The attachment system with Velcro material on the top did not work well.

SUGGESTIONS

The plastic was cut in three molds of different sizes, and after sewing leaving the space to insert the metal wire, this system worked correctly which allowed us to understand that we could use it as a method of sewing and assembly.

We thought it would be ideal to keep the part of the joystick protection in plastic, which worked quite well as a material. But the part of the wrist of the hand to the elbow was better protected with a waterproof fabric that allowed Rudy to move correctly.

The diameters of the curves should be larger, allowing more space to control the control, on the other hand the system of attachment to the bottom of the joystick had to be rethought, it could not be joined with Velcro.

2 JOYSTICK PROTECTION

DESIGN

This prototype was designed based on one of the previous case studies, where they used a rigid material curved like the material of a cap to protect the handlebar part of a bicycle.

The first part was designed with the same plastic of the previous prototype and we decided to only protect the upper part of the remote control and leave the lower part free, as an alternative. In this case we place a metallic wire around the plastic with a different sewing technique, sewing around the wire as we formed the curve.

The part of the arm was protected with a waterproof and flexible fabric that facilitated the movement of the arm of Rudy and allowed him to be autonomous at the time of removing or putting on the protection system. This part was joined to the plastic part by means of needle and nylon ..

PROS

– The waterproof fabric was ideal to protect the arm compared to the previous prototype.

– The case study technique was interesting and could work but not in a context where the user must have full visibility.

CONS

–The protection dome was too small and did not cover the entire joystick, and the fact that it was discovered underneath did not create satisfaction in Rudy, it was almost certain that water would enter.

– The sewing method allowed the entry of water between the holes.

SUGGESTIONS

The joystick protection dome system must be completely closed to ensure that water does not enter in any part.

The idea of making the user completely autonomous in the way of inserting the protection system in his arm was very interesting, so much so that we decided to take it into consideration for future decisions.

The combination of plastic and water resistant fabric was ideal, and covers the goals we were looking for, but it must be completely rethought, regarding measurements, protection against water and ensuring user comfort.

3 JOYSTICK PROTECTION

DESIGN

We decided to isolate, through the creation of a transparent plastic capsule, the joystick of Rudy's wheelchair and protect it against water, it should be a structure that he could install autonomously, for which his use should be very intuitive.

We created three circumferences of different diameter from the front of the control, to the back central part of the hand in order to cover the total diameter leaving the space adequate for Rudy to have total control of his movements.

The transparent plastic was joined by overlaying the different molds and sewing them with double seams that left space to insert the wire. On the other hand, a kind of protective sleeve was created in waterproof fabric that protected a large part of the user's arm.

PROS

– The user stated that it was easy to place, intuitive and perfectly set to the joystick measurements.

– The location of the curves was adequate and allowed fair visibility.

– The way to fit the arm with the waterproof cloth sleeve to the plastic structure allowed the user to move easier and be protected.

CONS

– The anchor system on the bottom of the joystick was not yet defined, it was not known whether to finish it with seam or another curve.

– It is necessary to consider the space so that the sleeve of Rodolfo's jacket enters completely, since when he leaves his house in winter he always wears a thick winter jacket.

SUGGESTIONS

Bearing in mind that this prototype is the closest alternative for the construction of the final prototype, we decided to make a solution that satisfied all the design requirements that arose as we prototyped and managed to reach a more or less successful solution

The curves that we gave to the circumferences were adequate and are well positioned, the seams do not allow water to enter, but absolutely the plastic snap system to the electric control must be improved.

The part of the sleeve must be reinforced from end to end allowing complete fixation to the arm and generating tension to keep it always in the right position.

4 JOYSTICK PROTECTION

DESIGN

Considering the measurements of the previous prototype, we decided to create a new one, this time we built it with a thicker PVC sheet, 5 mm caliber, and a 2 mm metal wire. The above with the aim of providing a completely rigid structure, and having the possibility of eliminating one of the curves that was not necessary from our point of view.

Once we had the prototype with the appropriate measures, we began to trace exactly the shape of Rudy's joystick to start assemble the second prototype.

The analysis before its construction allowed us to understand that we could create a single structure in wire, structure that followed the path from the front of the joystick to the back of the armrest of the wheelchair.

PROS

– This second prototype, fitted perfectly in the joystick, and provided the correctly space to the user for its proper handling.

– Creating a unic metal wire structure, gaves more rigidity to the transparent capsule.

– Through this model we tested the wheelchair binding system, since the user is not completely autonomous, the system of union using the magnets worked properly, gave stability to the structure and were located in the right place.

CONS

– The user again expressed the need to include a sleeve or a protective closure system on the back of his arm (where the plastic part ends), although his jacket is thick, he considers that there may be spaces where water can enter. Therefore we should consider this aspect.

SUGGESTIONS

The shape of the prototype was in accordance with the objectives we had set, not only we eliminated material but also we were able to fit the transparent cap to the exact shape of the joystick with the appropriate measures, which gave us good perspective for the construction of the final prototype.

On the other hand we understood that we should correctly consider the plastic joining system, being a very vulnerable area, it should be completely protected against water, the space where the metal wire was inserted should be completely closed, which made us hesitate to use sewing as a way of union.

We understood that the user is not fully autonomous in their movements and does not have much force, and will surely have the need to be helped to install and remove the capsule whenever he wants.

MATERIALS

Plastic:

Polyvinylchloride PVC
PV01551 Transparent film
Thickness 0.75

Fabric:

100.00% Polyester (PES)
It protects from a thin rain, thanks to the polyurethane-induced polyester fabric.

Curves:

100.00% Glass fiber (FG)

Cias galvanized steel wire
Ø 2,7 mm

Others:

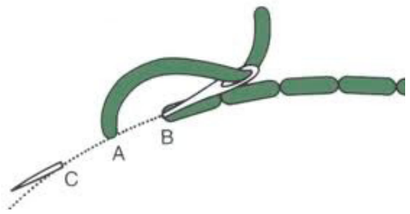
White polyurethane fabric
Red crepe paper
Wood sticks
Framing tape
Transparent tape
Glue
Cardboard laminate
Plastic unions
Scalpel

ASSEMBLY TECHNICHE

Nylon wire Ø 3 mm

Sewing by hand

Back stich (Double stitch)



The back point simulates the stitching of the sewing machine, makes a stitching of the seams just as a machine would do in order to keep them strong and not loose easily.

1 TOP PROTECTION

DESIGN

This prototype was based on the analysis we did that indicated the movement capacity of Rudy's left arm without making the most effort.

We wanted to cover the concept of total protection, that means try to protect with a single design both the critical zone 1 (joystick), critical zone 2 and 3 (head and arms) and give partial protection to the legs.

We made the curve in a rigid cardboard, and then simulating the movement of a rail, we folded paper like the identical fold of hand fan (from end to end), allowing him to understand the concept and the movement that he had to carry out.

This structure could be opened starting from the left side and moving along a guide rail that allowed to pass all the paper that follows the curve until reaching the opposite side.

PROS

– The movement that he had to perform was very intuitive, which made it very easy to understand the path of the paper on the rail.

– The first impact that Rudy had towards the design was positive, he felt that it was a solid structure that provided total protection to the rain.

– The color of the design was an important factor since it was the color that he had suggested to us from his request and we verified that for him was relevant this aesthetic aspect.

CONS

– The material of the paper with which we decided to show the route of the rail was not very stable, and allowed us to understand that we needed a more rigid material that managed to stay firm during the curve without losing the shape.

– The dimensions of the curve were very large, the angles could have been more closed.

– The remote control was not completely protected, which does not satisfy the expectations of the user.

SUGGESTIONS

The concept of creating a curve that could completely cover the upper part of Rudy's body was not easy, the dimensions were always very large and we were afraid that it was a very uncomfortable structure both for him to move and the people surronding him.

Furthermore during a meeting with the tutor, Rudy again explained the importance to protect the electrical part of his wheelchair, highlighting several positive qualities of the prototype but was not possible with the long distances he had to do back and forth from home to the AISM and with factors such as the wind, the rain could easily reach the electric command.

We tried to analyze the idea of separating the parts and protecting the joystick independently, but the structure was still very large and uncomfortable for the expectations that we wanted to satisfy.

2 TOP PROTECTION

DESIGN

This idea was born with the concept of completely revolutionize the shape and create a unique lateral structure, creating a curve that ran from the lower left side of the wheelchair to the top right of Rudy's head.

The concept was born after the analysis of different case studies, where we implemented a new and resilient shape. The whole structure was made with thick gauge wire and we used a stitching technique of double stitches with nylon, always leaving a space of one centimeter between the superimposed waterproof fabric to carefully insert the wire and give rigidity to the shape.

PROS

– The concept was innovative, and the user's interest to the form was obvious.

– The idea of being able to assemble and disassemble the structure was very interesting for him, although not always someone can help him install the protection system.

– It was a light structure, comfortable and did not generate visual obstacles

CONS

– An important factor is that the structure should be too strong to withstand the wind that could enter from the right side.

– Surely the water would enter and wet much of Rudy's body, deviating us from the main goal that is the protection of important areas.

– The anchoring system to the bottom of the chair was not clear, being removable it should be easy to quit, but the structure had to have the proper ridigity to keep the shape stable.

The idea was to create a very intuitive structure that closed as two superimposed circles and that will unfold with the help of the waterproof fabric forming a large tense structure that could be anchored to Rudy's wheelchair (it was also easily removable). Bringing as a reference the tent 2 seconds of the Quechua brand.

SUGGESTIONS

At the time we understood that by making the structure only from the right side Rudy was susceptible to getting wet, we decided to change the concept.

Although the form was interesting, innovative and left the current stereotypes in terms of state of the art. We decided to have priorities, as one of our key requirements was to protect at least two of the critical zones completely, and this prototype surely did not achieve the objective.

The ideation process was interesting and we risk proposing something completely different through the form.

3 TOP PROTECTION

DESIGN

After taking the measurements of the curve that covered Rudy perfectly from his back to a little above his head, we designed three identical arches that in parallel formed a dome from above Rudy's head, up to his shoulders, completely protecting all his head.

We created two different patterns, one for the transparent plastic that would cover the part where the user has greater visibility and another one in the back where we used waterproof fabric.

On this occasion we use at the ends another type of thicker fabric leaving the space to insert the fiberglass tube.
But the sewing method was always the overlap of double stitched fabrics.

PROS

– Having had the guide curve was essential to build the prototype and helped us to have a reference for the final prototype.

– The use of two different materials to build the molds allowed us to understand that it was not necessary to use only plastic and that we could balance with fabric and even use a different material for the seam where the fiberglass tube is inserted.

CONS

– The user expressed discomfort with the plastic material, highlighting that it was very opaque and did not allow him to see clearly.

– It is necessary to lower the angle of the frontal arc in order to protect below the shoulders of the user.

– The fiber material of the tubes were very rigid and the curve was not maintained when the structure was dismantled.

This was the last prototype that we made before the final one, we did it taking into account many of the suggestions that were left after the production of the previous models and taking in consideration also the model that we had made in the workshop.

SUGGESTIONS

The idea of integrating plastic and waterproof fabric in the prototype was essential to understand that we could combine two different materials achieving the fair visibility that Rudy needs (with a more thin transparent plastic) as well as covering the back with a special waterproof fabric that distributes the sound load when it rains and also provide protection.

Using the fiberglass tubes to form the curves allowed us to understand that the material is too rigid, and that if we made the decision to use it we would have to have a completely fixed structure to the union with the wheelchair.

Additionally, as a suggestion by the user, the fabric should be lengthened until it covers a little below the shoulders and was also necessary to close the hole that remains in the back of the prototype to guarantee total protection to the back.

ROTATION SYSTEM

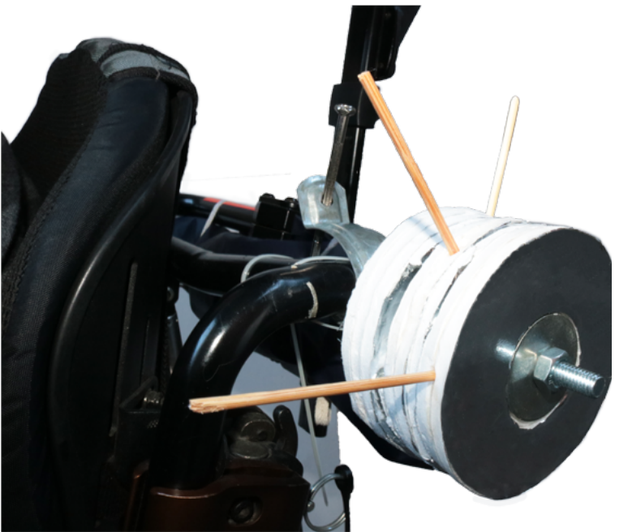
DESIGN

The rotation system was ideal to give curves the right angles and allow Rudy to be protected when required.

This system was conceived with the idea of allowing the user to autonomously move the material of the cover in three different levels without making the greatest effort with his left hand.

This mechanism consist of three concentric plates of 9 centimeters that rotate in a central axis, each of the layers has different extractions of material in the internal part that allows to fit with the next piece to serve as a stop to do the movement and thus obtain the desired angle.

We did the model in a rigid cardboard due to its easy manufacture and check of the turns.



PROS

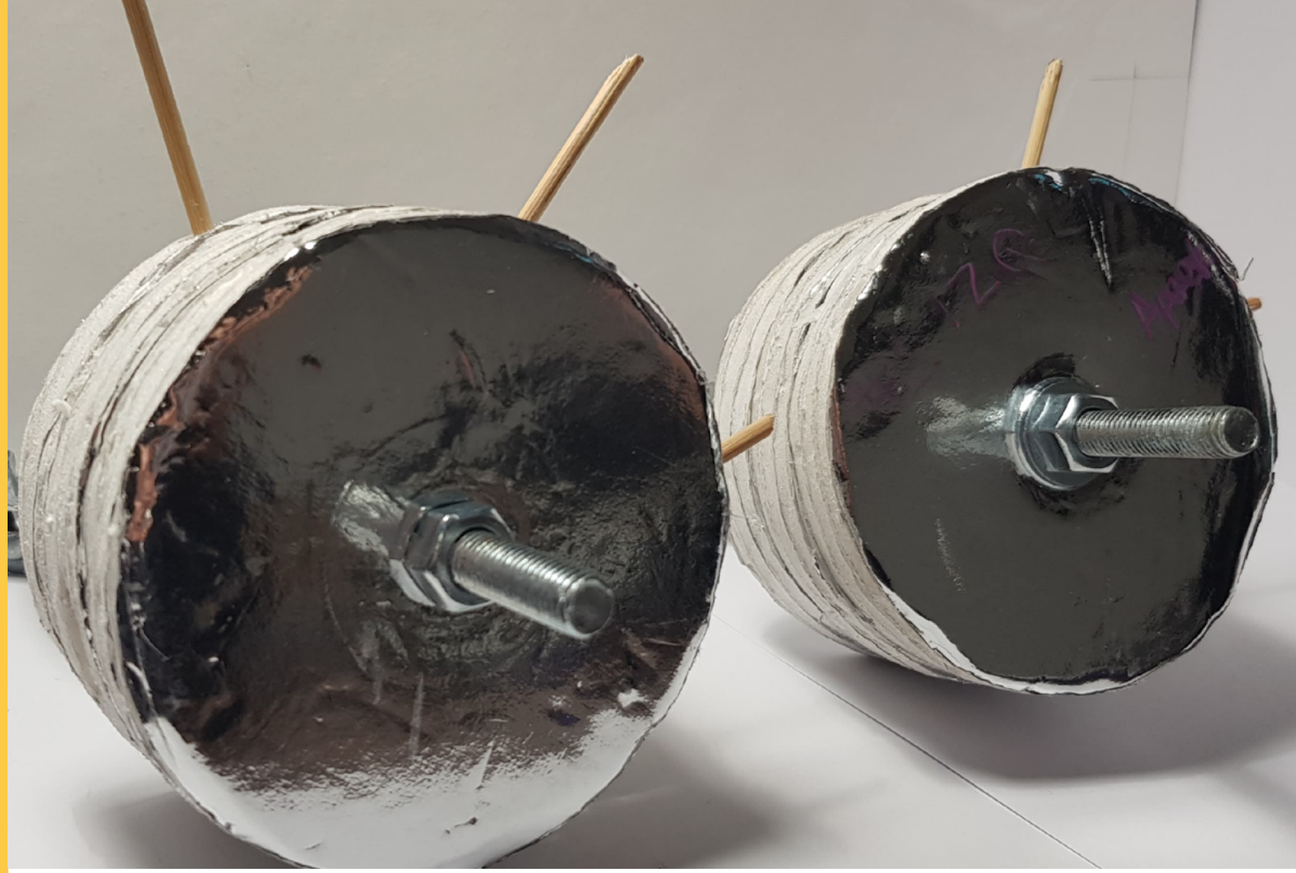
– The system was compact and worked quite well as a concept.

– The turns were made correctly and it was possible to obtain the three desired levels.

– It was not necessary to rotate the discs by hand to achieve the movement, just by taking the edge of the cover and pulling it down was possible to make a quite intuitive motion and obtain the right angles.

CONS

– The material with which we decided to prototype was not particularly rigid and could not withstand the curves of the fiberglass tube of the previous prototype.



SUGGESTIONS

We thought at the beginning in producing the prototype in wood, but after going to consult with several experts in this field and taking into account that this system was going to be in constant contact with water, it was suggested to us to think of other materials such as aluminum or plastic.

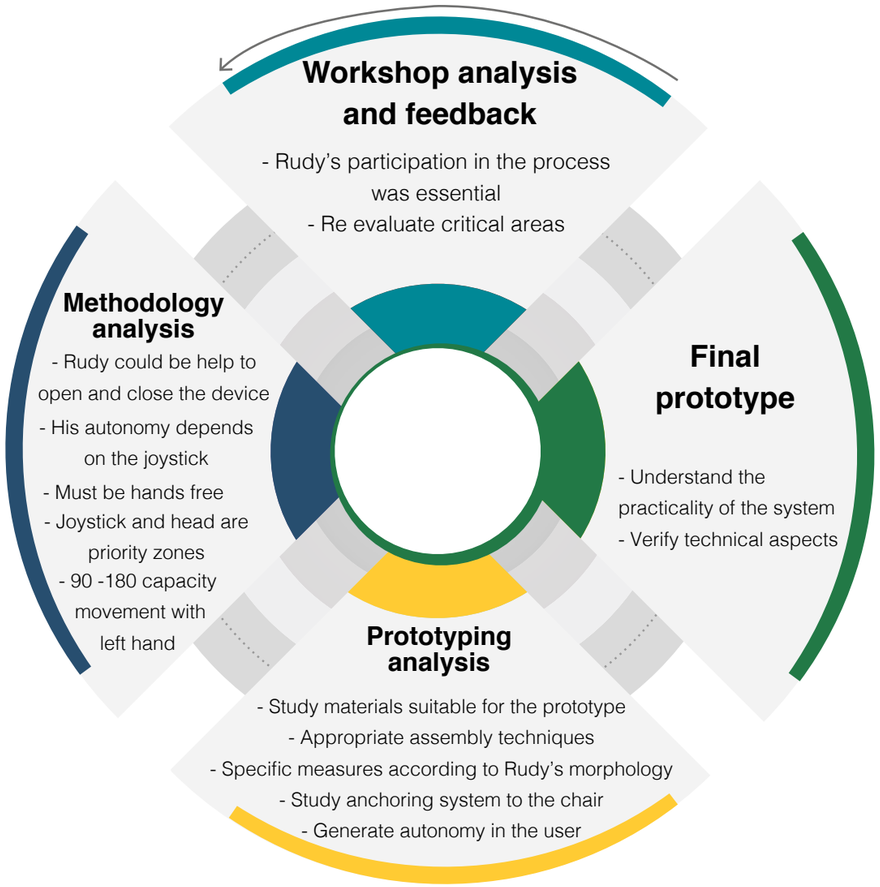
Aluminum was the first option since it is quite resistant, will surely have a longer life cycle than wood or plastic and the user will not have to think about changing this piece.

The production system of aluminum discs is complex, it requires a metal lathe to generate the circumferences but it turns out to be a very successful technique to achieve good results and material finishes.

It is important for us to contemplate the idea of the prototype in plastic since the production system is more friendly and through a laser printer the discs could be achieved, taking up the concept of design by components and allowing the discs to be within reach. by many users.

FINAL PROJECT

Main insights and relevant considerations



The process of co-planning and co-design with the user was essential for the development of the project, and allowed Rodolfo to develop different activities that changed his daily life, submerging him in a fun creative journey, reaching results that met his expectations.
On the other hand, the workshop allows us to understand that evaluate the critical areas of Rudy's body and the wheelchair was necessary

The analysis of the different factors carried out during the matodology, was an important point of inpiration and allowed us to obtain important design requirements.

Rudy's travel allowed us to understand that the user could be helped to open and install the device during two important points of his journey, and understand that the autonomy of Rudy depends completely on his joystick to the extent that this allows him to mobilize.

The study cases and state of the art, inpired us to make a hands-free device, and combine two different materials such as waterproof fabric and plastic.

Design concept let us to check the user's motor ability, and consider it to design. In addition, establish the two most important critical areas, the electric command giving a 100% relevance and the top and arms of Rudy with a percentage of 80%.

The prototyping phase was a creative journey that allowed us to establish essential aspects of design, without this phase it would not have been possible to reach an approximate solution. Being able to check each prototype with the user helped us to understand relevant points in terms of form, measurements, material, use, among others, of which we want to highlight the following:

- Materials suitable for the prototype: The thickness of the plastic, must be different for the part of the protection of the joystick and for the part of the upper body protection.
- Understand water-resistant assembly and sewing techniques.
- Understand the specific measures according to the morphology of the user
- Study the rotation system, check the correct angles and study the anchorage system to the wheelchair.
- Try to make the user relatively autonomous when using the system.
- Keep in mind that Rudy always wears his jacket in winter (important factor for measurements).
- The device must be removable but not disarmable, according to the scenarios proposed with the user.

The final project was the definition and completion of technical aspects of design, rectification of measures, material and user satisfaction verification, for which we consider an important stage, without discarding that improvements in design can always be made, the approaches made are part of our analysis and the process we carry out through the Co-design model.

The final project is the result of the culmination of several stages of the design process and the analysis that we did during this creative journey.

In the same way, it's an approximation to a result that tries to cover and fulfill the main objectives of the project.

Furthermore it takes in consideration the feedback and suggestions of the prototyping phase, and especially the important estimates that the user expressed during the path, consequently we managed to consolidate an idea, and make it real.

This last stage brings together in this idea all the modifications, it is the last prototype in which we have been able to verify and complete the operation.

The changes generated have had a positive impact on the user, intuiting an approach to the form with completely real measures, carefully taken as a result of the morphology analysis of the person involved and his requirements, as well as the analysis of the critical areas to carry out the design.

We always wanted to show in this book the process that we were developing throughout our Co-Design project, in fact this is not the final product.

For us it is important to highlight that an idea always has the possibility of being improved, it is a cycle that does not end, even after manufacturing, it is possible to identify important modification that can satisfy even better the user's needs

The final prototype was completely made by hand with the collaboration of local artisans, and we wanted to give this great added value to the design. Given that as one of the phrases in the Makers book says, "consumers tend to appreciate more the products of which they feel part of the creative process in some way"; This is how, through our co-projecting model, we integrated Rodolfo into many of the phases, so much so that although he was not able to help us due to his motor difficulties, he was involved and created his Handy Cap .

This project in our opinion has a great potential to the extent that it can be further developed and improved through the help of designers and professionals from different disciplines that are able to contribute with their knowledge to always arrive at a more accurate solution.

"Variability is a characteristic of all things made by hand, and today variability can be part of an automated chain of design and production."

SYSTEM COMPONENTS

The final prototype is presented as a set of different components:

The main component is the part of the joystick protection. That was manufactured in PVC transparent film thickness of 0.50 mm. And allows to protect from the beginig of the joystick to the middle of Rudy's left arm, after the wrist.

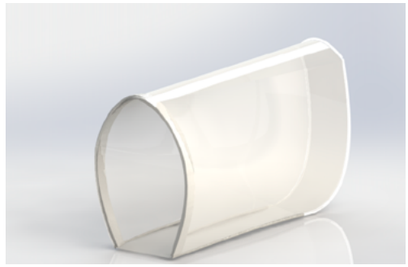
In the initial part, we reproduce the identical shape of the joystick, enabling it to fit perfectly to the measurements. The plastic is extended along the command supported by a nylon wire that is inserted into a silver rod giving stability to the structure. And then the final curve is supported by a PVC strap providing the right diameter and curve and allowing the entry of the user's hand.

The plastics were joined using the paper paterns, which consist of two plastic molds that are tied by means of a fabric hem that allows the subsequent entry of the wire forming an appropriate curve and providing a rigid structure.

The fabric and the plastic were sewn with the technique of point back from the internal part of the prototype, making sure to leave seams completely closed avoiding the entrance of water.

As a complement, we add to the final curve a sleeve in waterproof fabric of 13 cm, which conforms to the curve and allows to close the spaces between the jacket of the user and the component in plastic, preventing completely the entry of water.

Considering that the user does not have the ability to install the component autonomously, the structure will be fixed to the wheelchair. And Rodolfo will be helped by a person to install it and remove it when he needs. Considering also that it is not an uncomfortable element and can be easily moved.

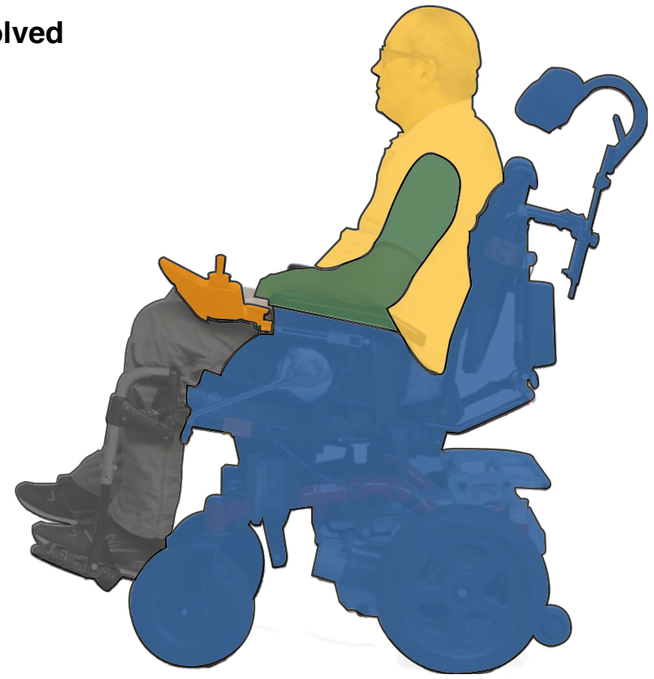


Joystick protection
main form of the
component

Joystick protection
structure of the
component

Critical zone involved

Electrical part
100%



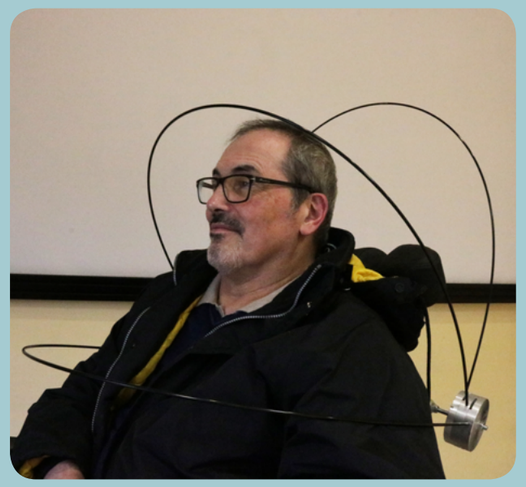
The second component is subdivided into several parts that come together to form a single protection system in the following way:

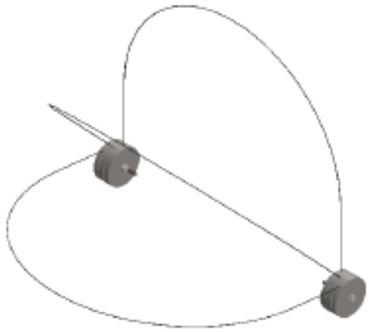
The curves are formed using three tubes of 0.25 mm diameter made of fiberglass that, when folded, reproduce the shape of three arcs of different perimeter and that allow to form the main structure of the component.

The paper paterns are two, the first one is the transparent that is manufacture in Polyvinylchloride PVC 0.55 mm of thickness and the other is the fabric in Polyester (PES) which is a waterproof material that protects from the rain.

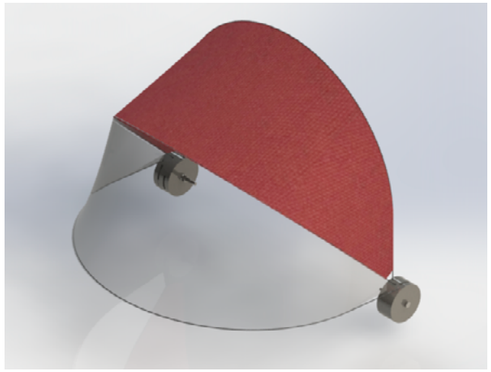
These two paterns were joined using a JUKI's industrial sewing machine, that allow to sew "stitches" for products in every field. The manufacture method was always sewing on the back side of the fabric and joining it to the plastic overlapping them and tracing two parallel seams that left in the middle a space of 1 cm to insert the wire later.

Finally and being an important part of this component, we find the rotation system, which is the part where the tubes in fiberglass are anchored. It was designed based on the user's requirements, taking into account that his movement capacity is slight, the design of the discs allows that as the surface of the fabric mold is pulled, it moves from the right to form an angle of 50 degrees and then an angle of 10 degrees, which will allow adequate coverage of the user in the area of the head and upper extremities.





Structure of component system



Structure of component system with the the patterns composed of waterproof fabric and PVC

Critical zones involved

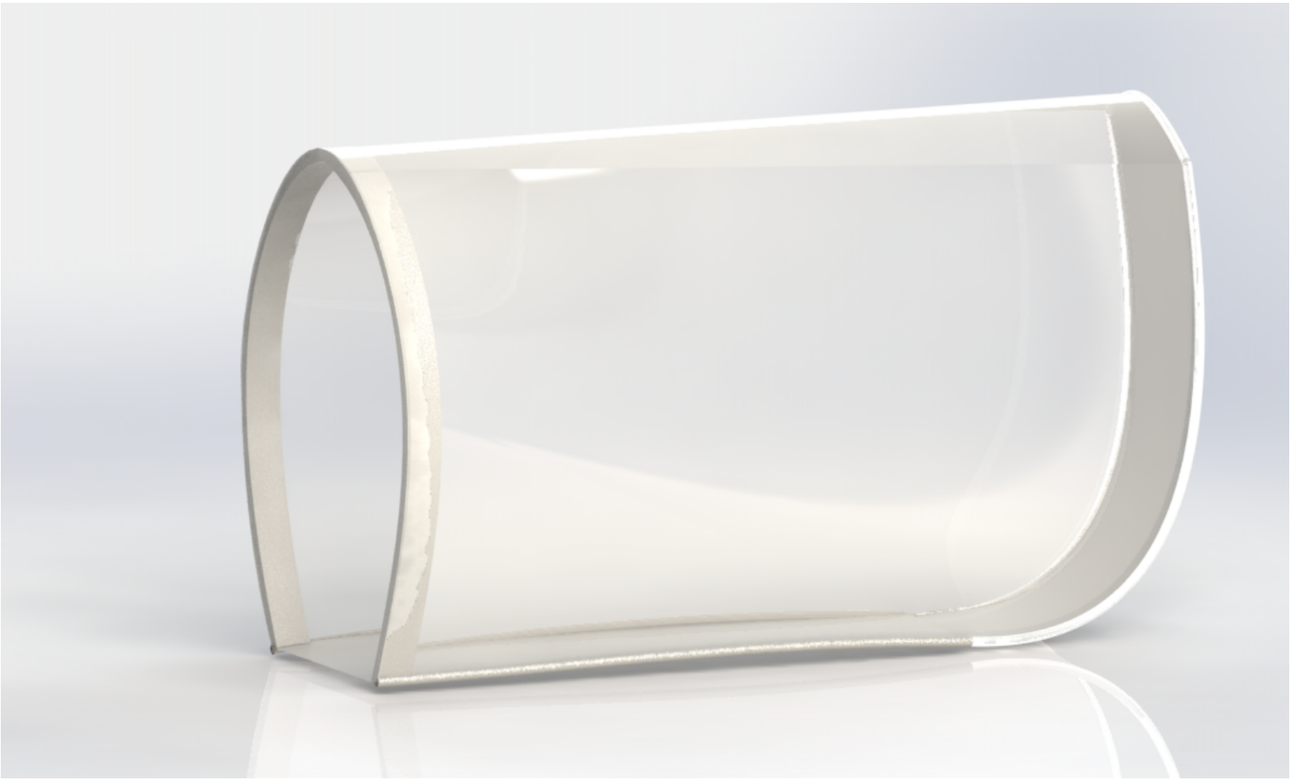
Head
60%

Arms
30%

JOYSTICK PROTECTION

Structure

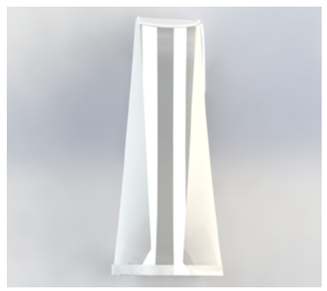
Isonometric axonometry



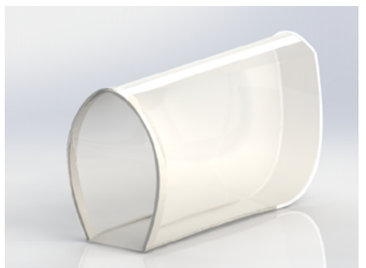
COMPONENT #1

Joystick protection

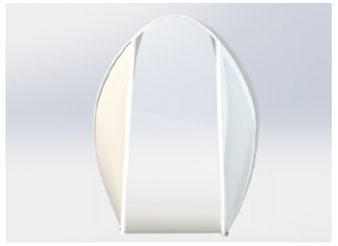
Top view



Isonometric axonometry



Front view



Side view

Main Structure

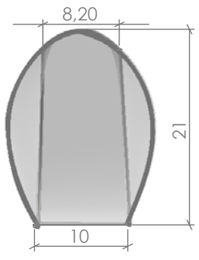
Joystick protection

Scale 1:5

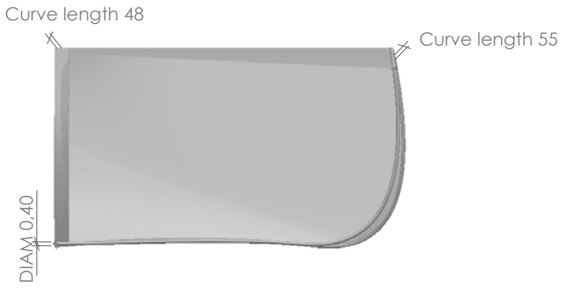
quote in cm

Top view

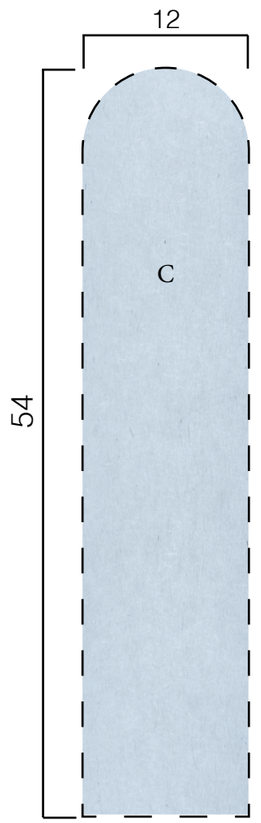
Front view



Side view

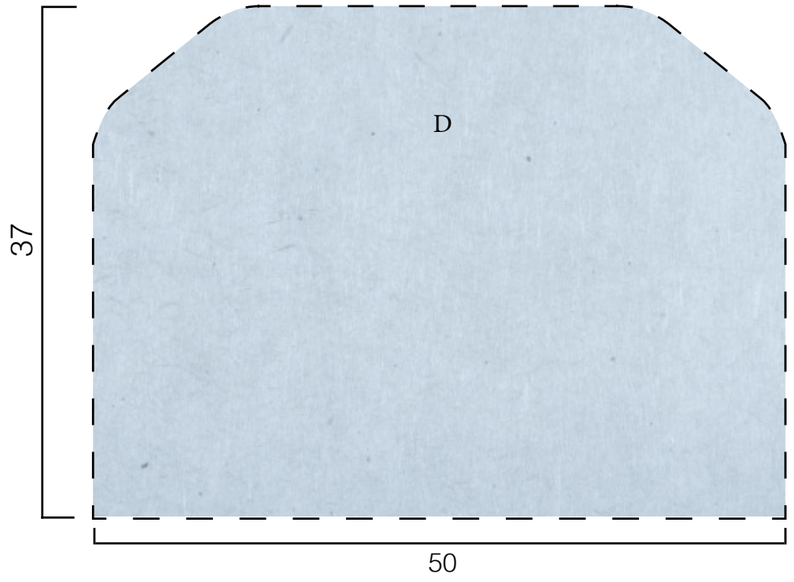


JOYSTICK PATTERN (PLASTIC)

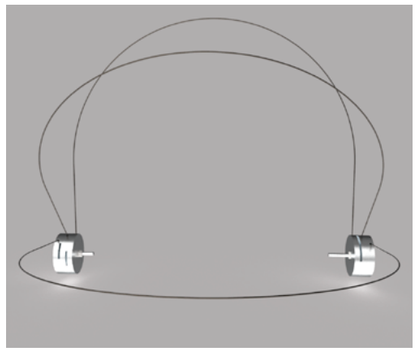


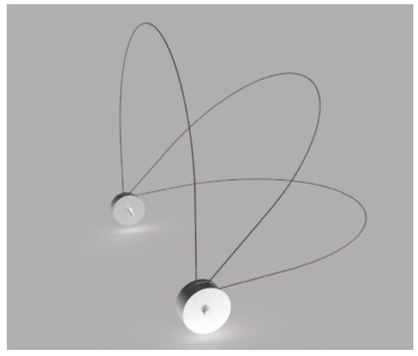
Ref. C
Name. Joystick cover/ bottom
Fabric. PCV sheet
Color. Transparent

Ref. D
Name. Joystick cover/ upper
Fabric.PVC sheet
Color. Transparent



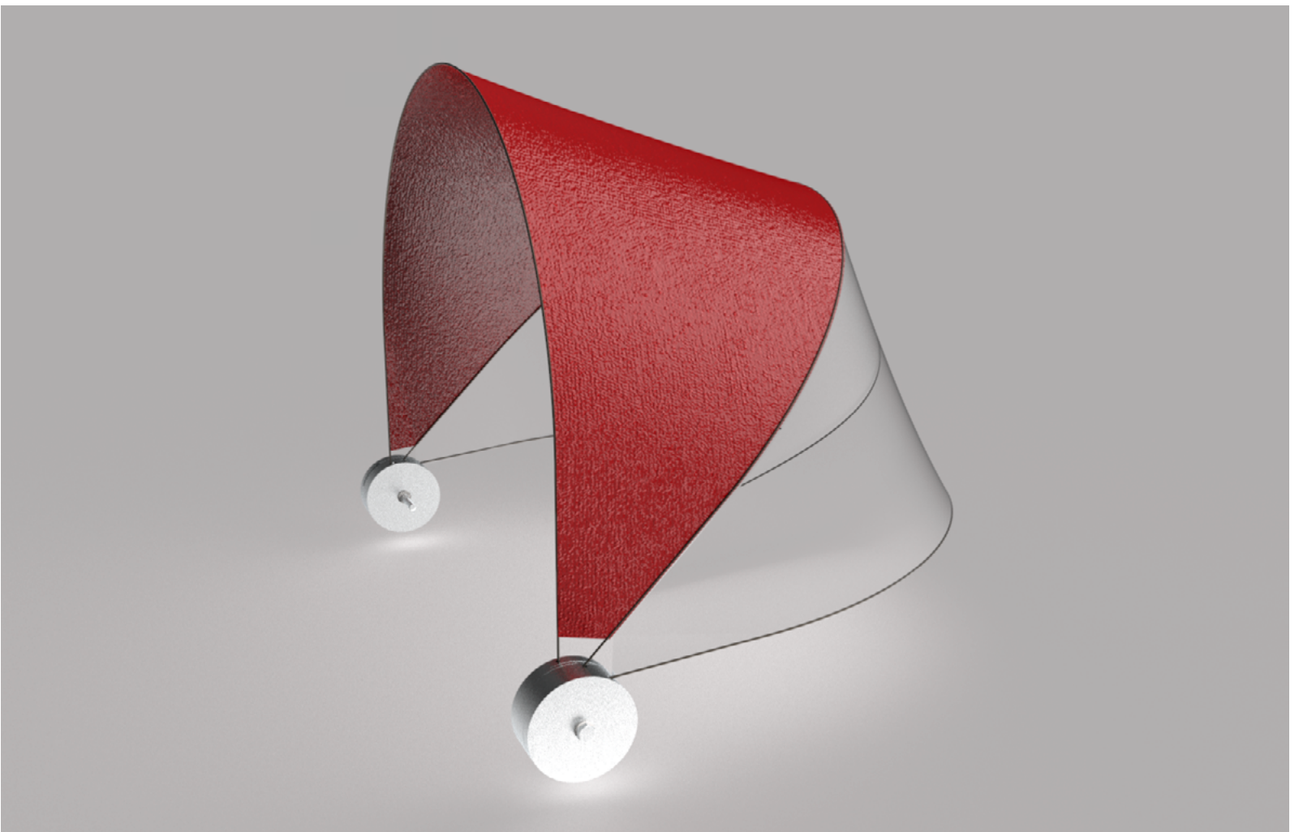
TOP PROTECTION





Structure

Isonometric axonometry



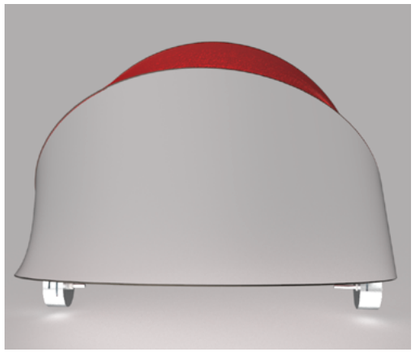
COMPONENT #2

Top protection

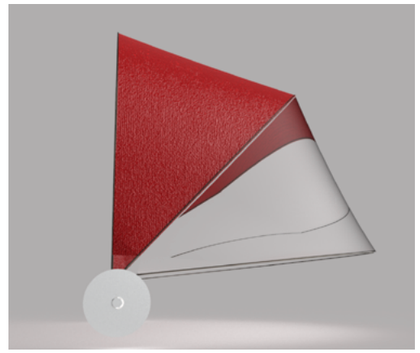
Scale 1:10

Top view

Front view



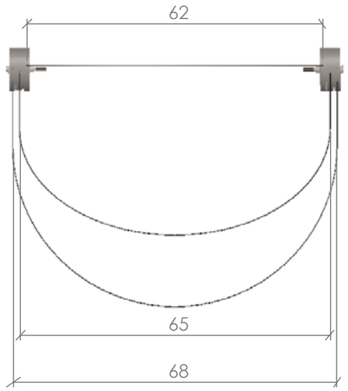
Side view



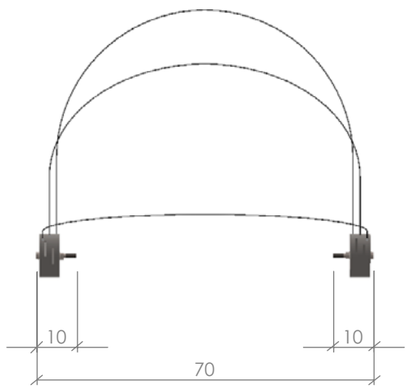
Main Structure

Top protection

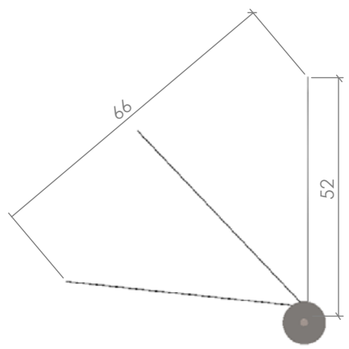
Top view



Front view



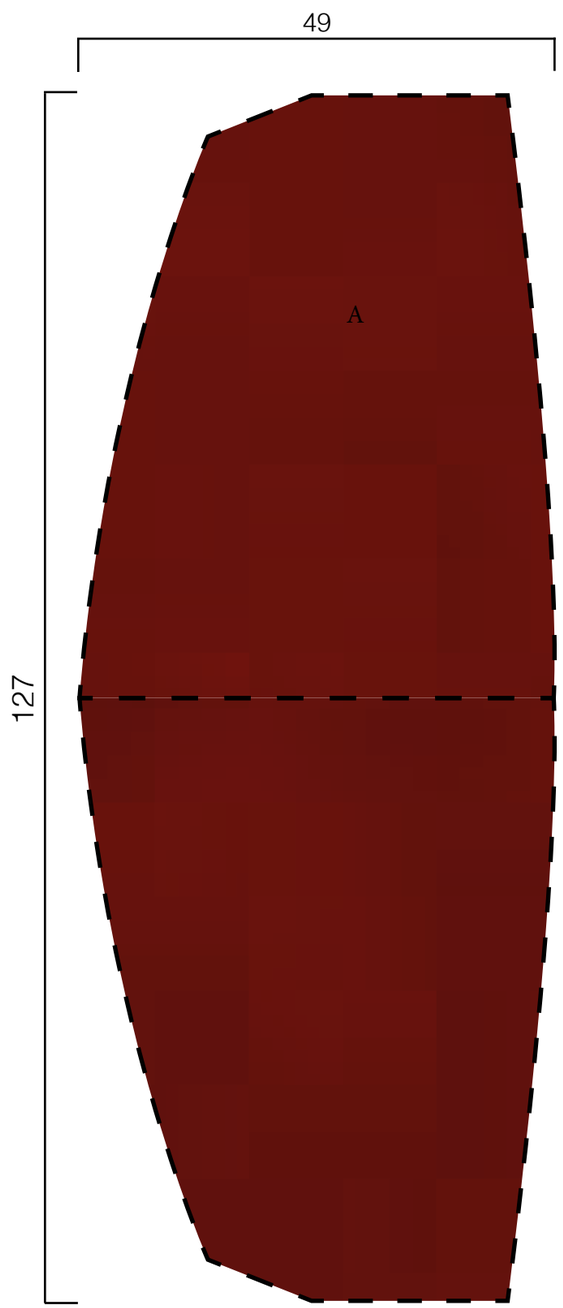
Side view



Scale 1:10

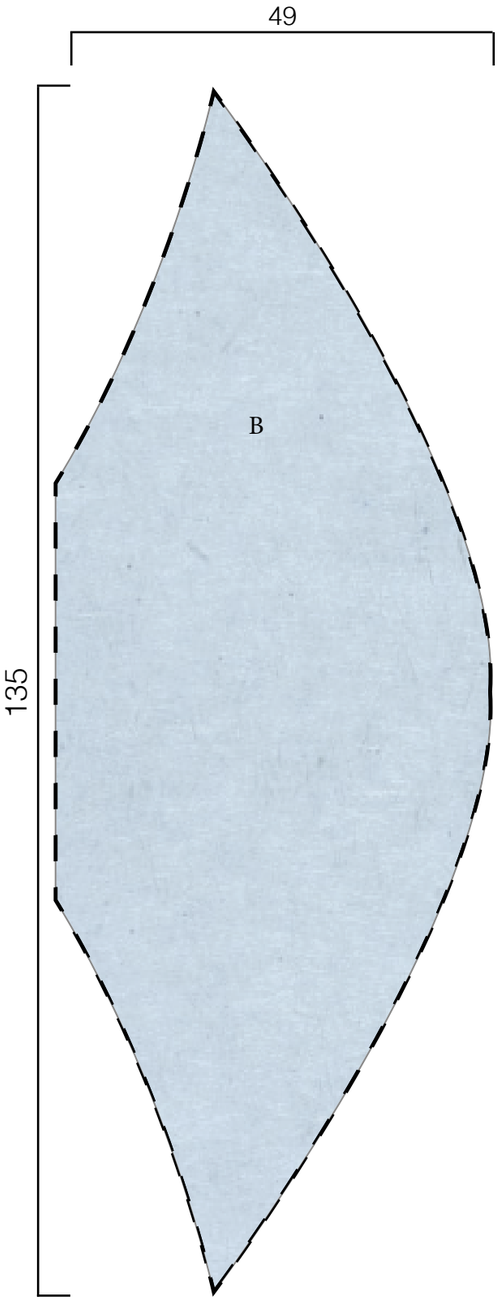
quote in cm

COVER PATTERN (FABRIC)



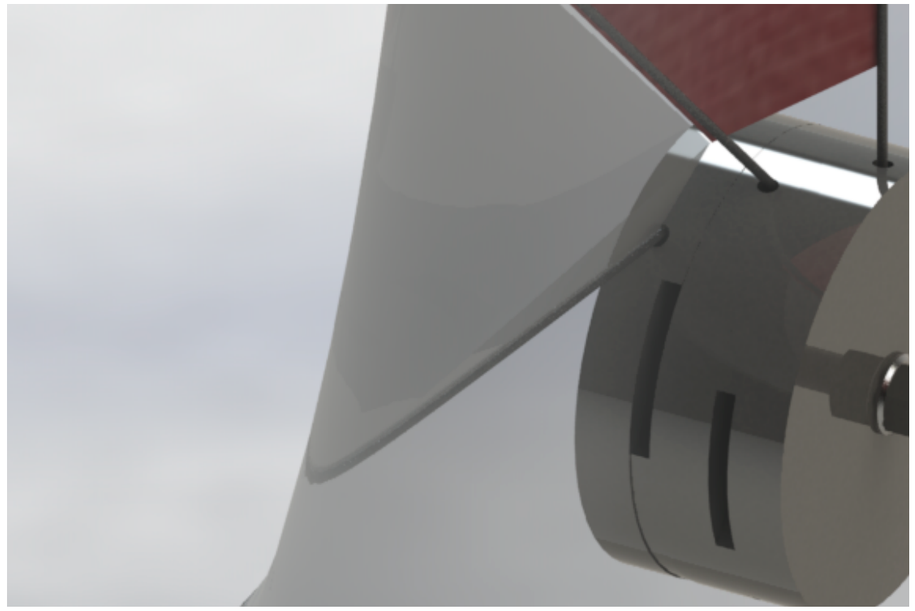
Ref. A
Name. Head cover
Fabric. Polyester 100%
Color. Red wine

COVER PATTERN (PLASTIC)



Ref. B
Name. Head cover
Fabric. PVC sheet
Color. Transparent

ROTATION SYSTEM



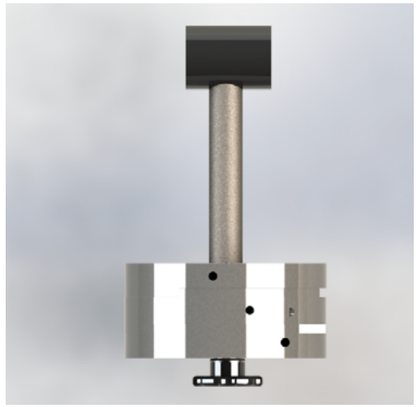
Fit detail of the discs mechanisnm
Rotation system

COMPLETE ROTATION SYSTEM

Top protection

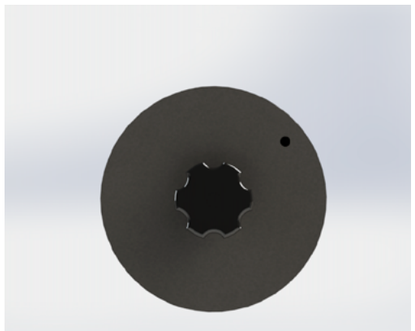
Scale 1:2

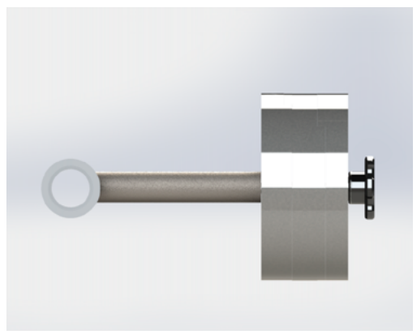
Top view



Front view

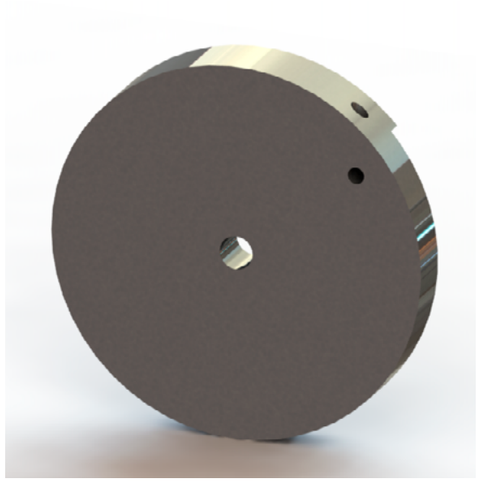
Side view





Rotation System - Piece # 1

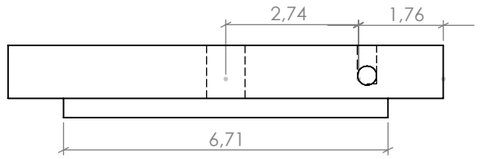
Isonometric axonometry



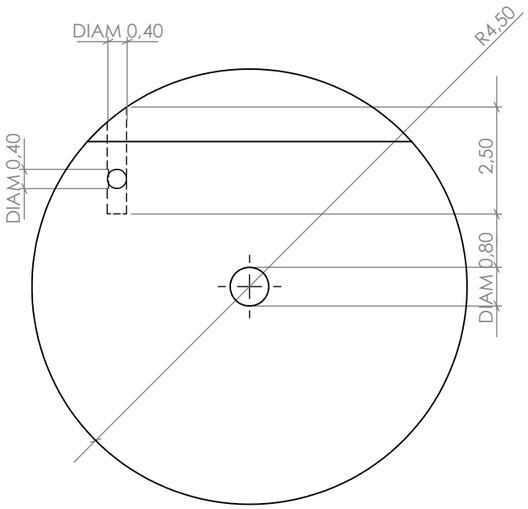
Scale 1:2

quote in cm

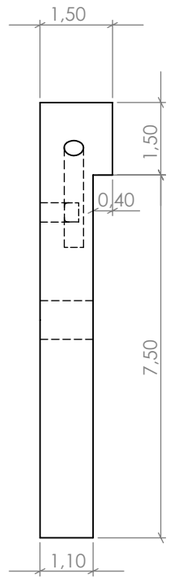
Top view



Front view

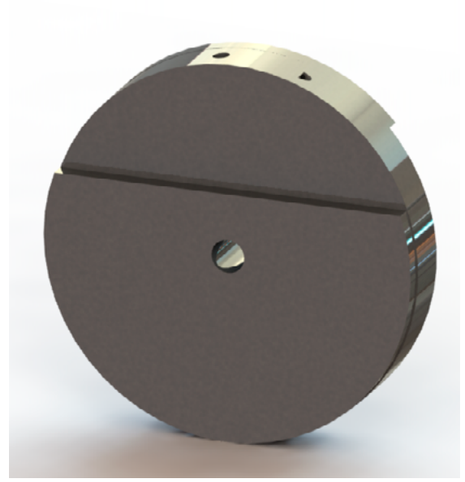


Side view



Rotation System - Piece # 2

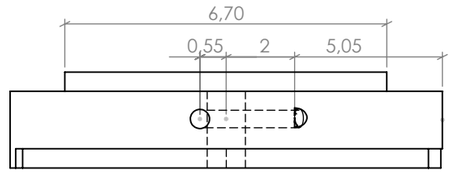
Isonometric axonometry



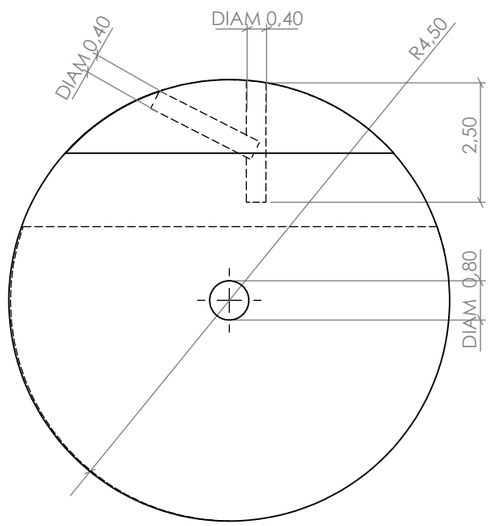
Scale 1:2

quote in cm

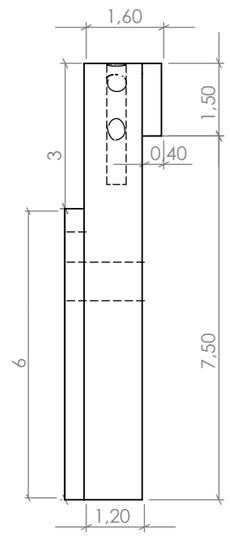
Top view



Front view

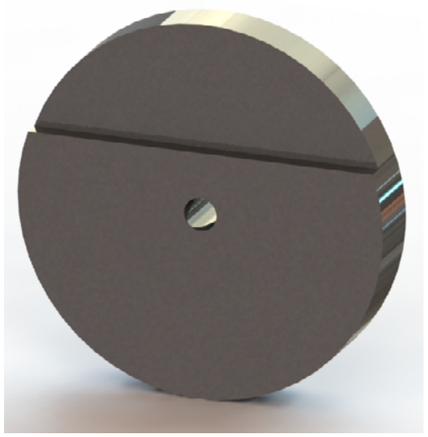


Side view



Rotation System - Piece # 3

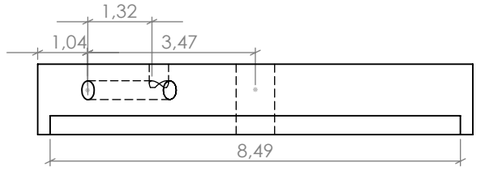
Isonometric axonometry



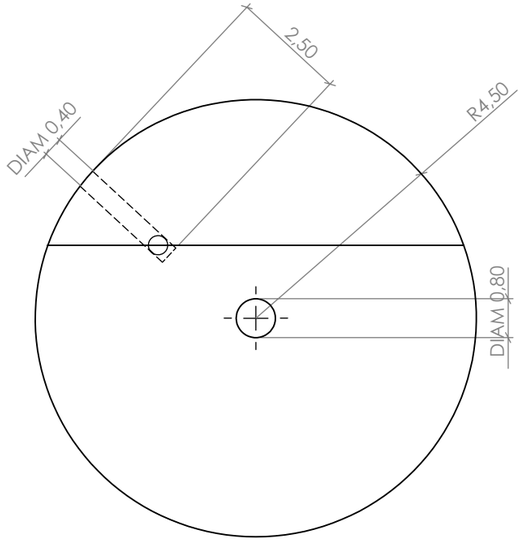
Scale 1:2

quote in cm

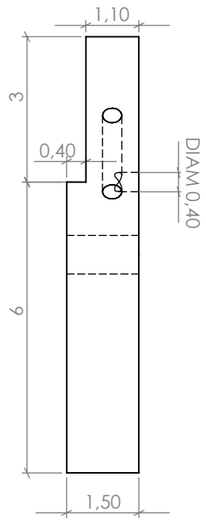
Top view

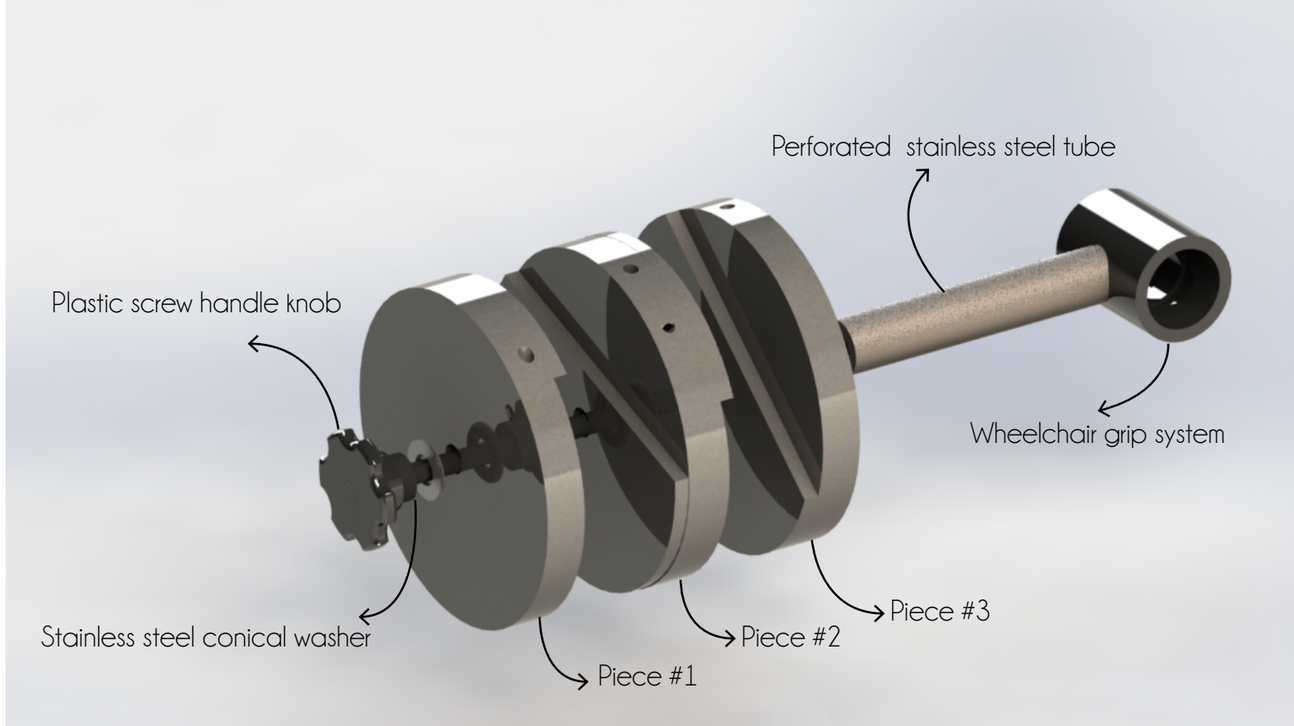


Front view

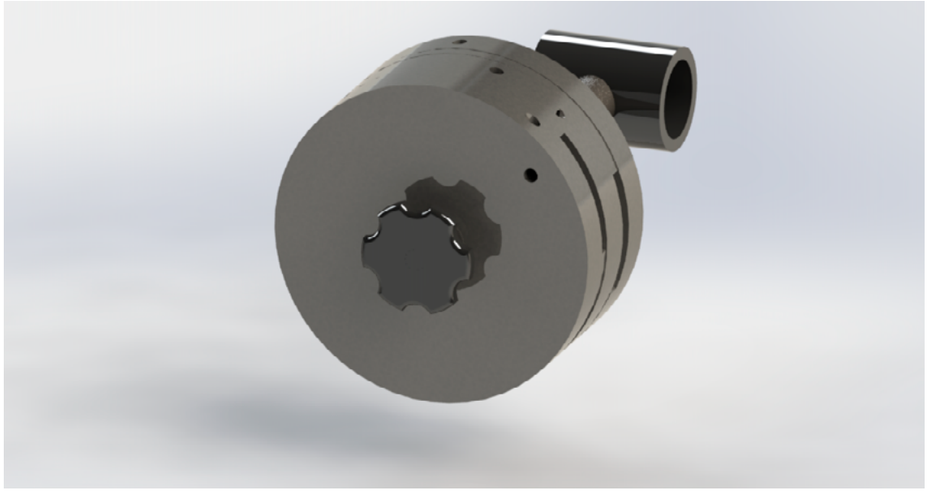


Side view





Exploded view drawing
Rotation system



Rotation system with all its components - Render

7.1 MATERIALS

During the development of the prototypes for our project we have used different materials, the choice for the development of the final prototype is consequence of this previous experience with the previous prototypes, which allowed us to concretely identify each of the properties of the materials used for the construction of the different elements of our project. In this way, we can choose the most appropriate materials according to the user's demands and requirements.

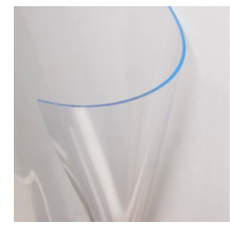
The choice of materials for the development of our prototypes are:

Head and upper body protection

Waterproof fabric
PVC transparent sheet
Fiberglass sticks
Thread
Aluminium
PVC hold

Joystick protection

Waterproof fabric
PVC transparent sheet
Thread
Nylon wire
Silver rod
PVC strap

MATERIAL	NAME	COMPOSITION	PROPERTIES	USE	SAMPLE
1	Waterproof Fabric	Polyester 100%	Waterproof Resistant	Used in the upper part that covers Rodolfo's head and to cover the structure wire of the joystick protector.	
2	Plastic sheet 0.20 mm 0.50 mm	Polyvinylchlori-de100 %	Waterproof Resistant Transparent	Used in both prototypes to allow visibility to Rudy.	
3	Fiber glass stick	Glass - Fiber (FG) 100 %	Resistant Flexible	Material used to create the three curves of the prototype that covers Rudy's upper body.	

MATERIAL	NAME	COMPOSITION	PROPERTIES	USE	SAMPLE
4	Thread	Polyester 100%	Resistant Strong fibers	The thread was used to join the fabric and the transparent plastic sheet of both prototypes	
5	Aluminum discs	Aluminium 100%	Waterproof Resistant Corrosion resistance	Used to create the parts that allow opening and closing the upper part mechanism.	
6	PVC Clip	Polyvinylchloride100 %	Resistant Easy to use Waterproof	Used to assemble the aluminum mechanism to the wheelchair	

MATERIAL	NAME	COMPOSITION	PROPERTIES	USE	SAMPLE
7	Nylon wire	Nylon 100%	Waterproof Resistant Flexible	Used to give the curve to the joystick protector, allowing the flexibility of the object	
8	Silver rod	Silver 100%	Resistant Rigid Malleablet	Used in both prototypes to allow visibility to Rudy	
9	PVC Strap	Polyvinylchloride100 %	Resistant Flexible Easy to handle	Used to give the final curve to the prototype of the joystick and let the arm of Rudy easily enter	

FINAL PROTOYPE

JOYSTICK PROTECTION

TOP PROTECTION

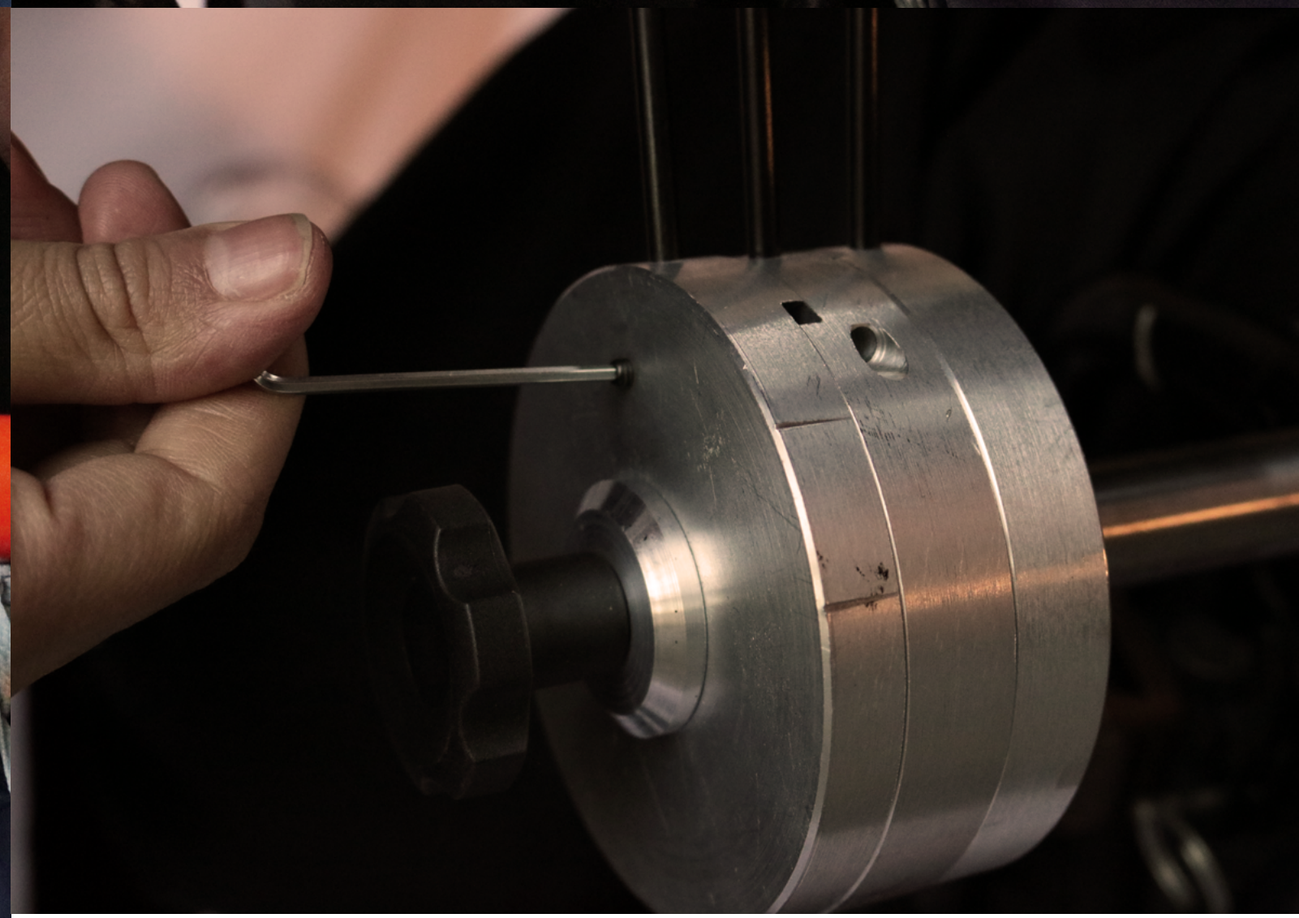
OPENING OF THE CAP

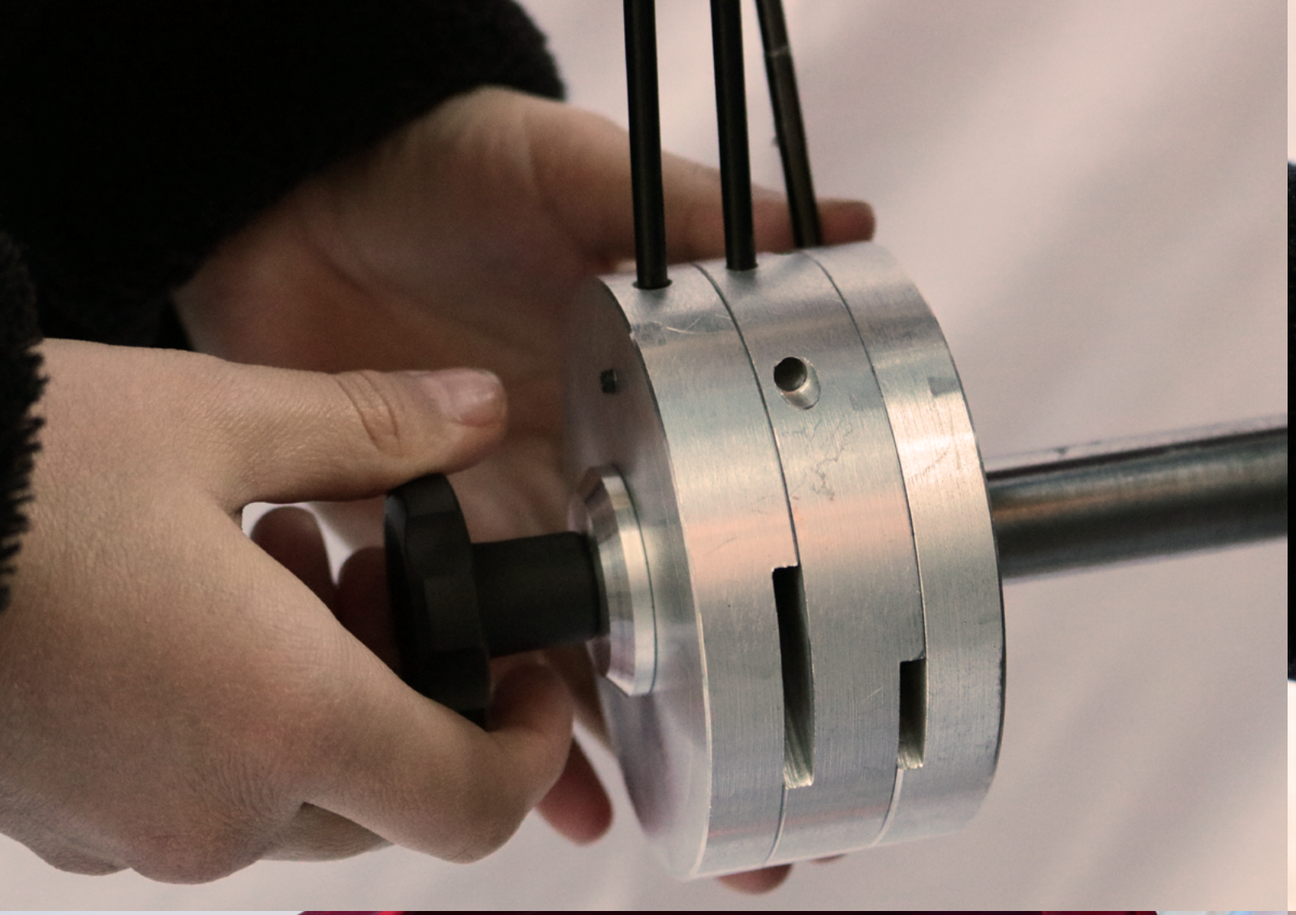
1.

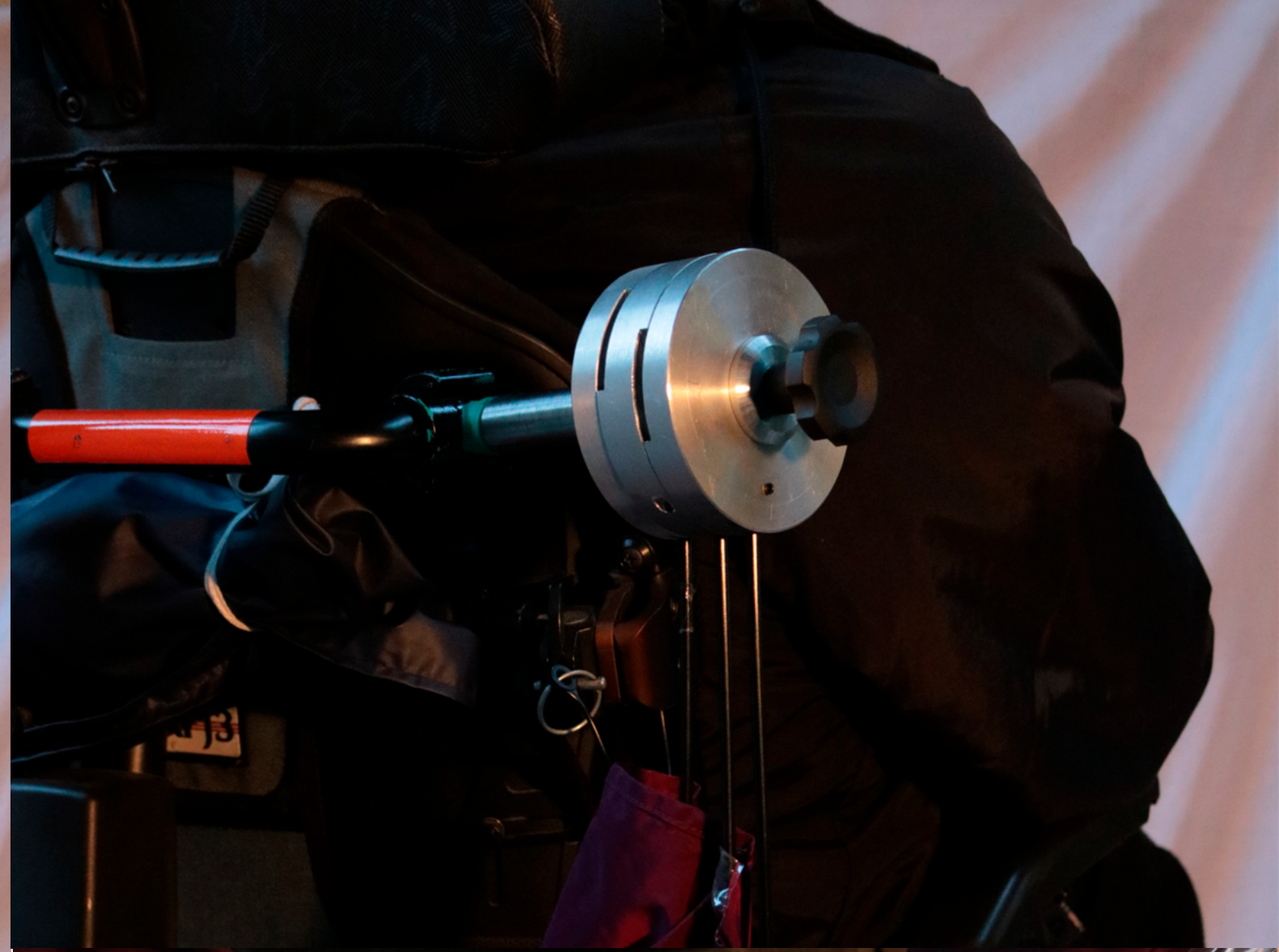
2.

3.

4.







RODOLFO GREPPI

Using Handy Cap

FINAL CONSIDERATIONS

The final project is the result of the development and conclusion of several stages of the Design model that was born from the Design for each one workshop and it surely has been an enriching experience from many points of view both for Rodolfo and for us as well.

The development of this thesis left us a very important learning at a personal and professional level, since working hand in hand with a specific person, with particular needs allowed us to see and demonstrate a more human type of design, where the user is truly at the center of the project, as thinking about the needs of a single person, one of the most important thing is to establish a relationship of trust and empathy, bearing in mind that the person will be the main ally in this creative journey. As the user connects with the designer to show and share important information.

This process undoubtedly allowed us to have a different approach to industrial design, a more focused approach to detail and with the participation and help of other people from other fields that made this project a reality.

Consequently, this project model and the constant ethnographic work that accompanies it, allows us to know the user at a more detailed level, discovering aspects that another type of approach and another method of projection wouldn't have given us. This because being in constant and direct contact in Rudy's everyday life, to know and understand his illness, to live in his environment, will always create an empathy and develop an enormous sensibility.

At project level specifically, to realize a project with a need that must be solved is difficult but at the same time motivational, since in the desire to leave the person a functional object, you face and surpass any obstacle.

We have gone through some of them, but the whole process is a constant learning. We finish this thesis satisfied of the work done and at the same time aware that there are always things to improve.

To be more specific as to the final prototype:

- One of the main objectives was to provide Rudy autonomy, this we have achieved to a certain extent, because somehow the physical limitations he has did not allow us to achieve it 100%.

- The elaboration of the mechanism that allows to open the curves could be made in an equally resistant material and with the same properties of resistance to environmental factors, but a little lighter, improving the whole manufacturing process from the prices of the raw material and the elaboration.

- The use of different materials for the same object is even more difficult with the lack of knowledge of the different methods of design with fabrics or plastic materials, in which an exact measurement is needed and that is not always easily obtained.

- One of our intentions in choosing and carrying out this project was the possibility of protecting from the rain not only Rudy, but so many people who have the same need, however, in the process we realized that wheelchairs change from one person to another depending on their particular demands. This does not mean that different types of grip can not be developed to fit our opening system, which could be a solution and a project to work on later.

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