

KÖBAG

A Haversack for a user with SCP (Spastic Cerebral Palsy)

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Abstract

Assistive technologies are a series of tools that are meant to tear down limitations in daily activities and dissolve restrictions in participation for people with disabilities. Therefore, this collection of gadgets could make the difference in people's lives by helping them communicate, go to school, eat, dress themselves and have leisure activities while giving them confidence and independence. KÖBAG is a wearable device based on the universal design and intuitive paradigm, that keeps your personal belongings and school supplies safe while being trendy and practical.

Problem Statement and Background

Cerebral Palsy is an umbrella term that manifests itself in a collection of motor disorders caused by abnormal brain development or damage around the time of birth or early stages in life. Consequently, the person's ability to move, maintain balance and posture becomes severely compromised. Spastic Cerebral Palsy (SCP) is the type of cerebral palsy where spasticity is the exclusive impairment present due to affection of the cerebral cortex. People with SCP can present mild to severe muscle stiffness (hypertonic) causing certain orthopaedic deformities of the limbs. [1]

However, schools worldwide are developing inclusive and accessible learning environments for people with a whole variety of cognitive, sensitive and physical disabilities. Universidad Iberoamericana has been developing over the years a program of this nature called: "*Somos uno más*". This curriculum offers academic training, participation in artistic activities and sports. Within this program, Fernando stands out in behalf of his determination and passion for "*Las Águilas del América*" soccer team. Nonetheless he used to have a lot of trouble finding a practical haversack that could keep his personal belongings safe and reachable at any moment while being able to open and close the bag by himself. The major problem encountered was the lack of ergonomic design, making it complex to wear and use.

In order to address the problem previously stated, the following table was made.

Table 1: User description and proposed Solution.

User Description	Proposed Solution
<ul style="list-style-type: none">✓ Fernando is a fulltime manual and electric wheelchair user with severe movement restrictions due to spasticity on the left side of his trunk; including his arm. In general terms the right side of his body has a wide range of proper controlled intentional motion inside his bag.✓ Fernando likes to keep his iPad and wallet available at any time, because this tools allow him to learn, communicate and access any place inside campus.	<ul style="list-style-type: none">✓ Personal design according to his range of movement and anthropometry.✓ Measurements and weight were key factors.✓ Tool appropriate for his routine and intuitive for usage.✓ Light durable, washable materials were considered for its fabrication.✓ User expectations of the product and personal preferences (colours, hobbies) were taken into account.

Approach and Design Methodology

Firstly, the SCP condition was studied in order to understand and empathize with the user. Soon after previous attempts of this contraption were tested and analyzed in terms of the aspects that could be useful and improved.

Secondly, we had an interview with the user and his parents; while this situation was going on we sustained special attention to his movements, his personal preferences and all the information that his parents provided. The same day after the interview was over, anthropometric measurements were taken in order to satisfy the “personal design” criteria.

As a result of that day the following brainstorming mind map was made (Figure 1):

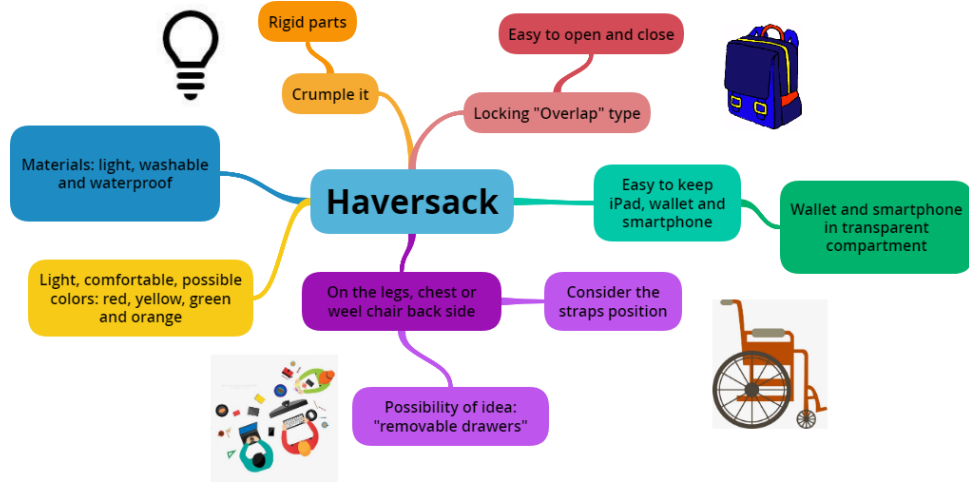


Figure 1: Product Mind Map of the Brain Storming Session.

Function Analysis Matrix (Figure 2) was chosen as the design methodology to follow, hence its simplicity and order to track down user needs one by one.

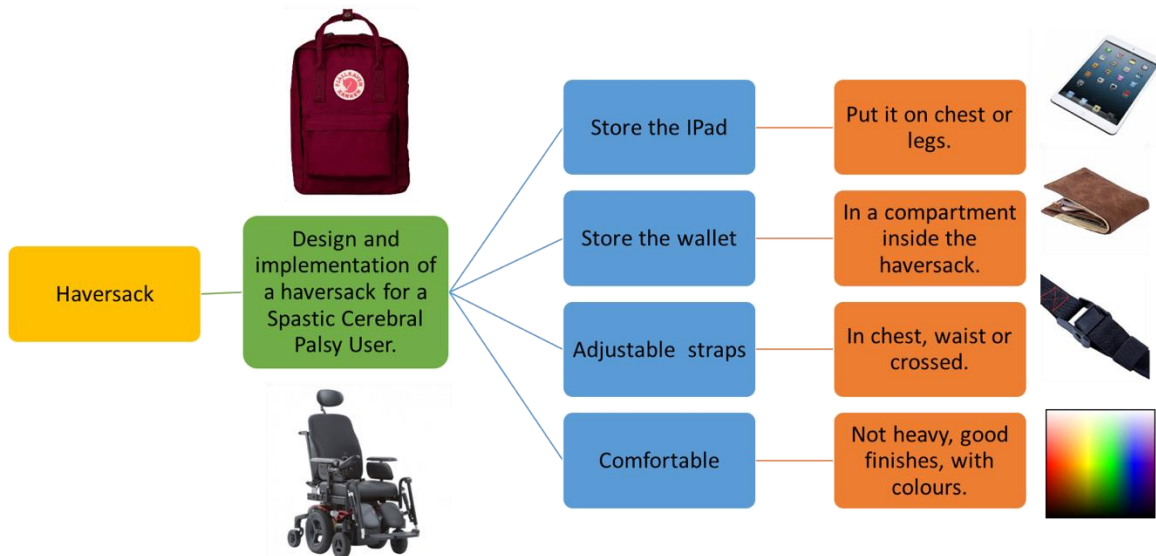


Figure 2: Function Analysis Matrix for the Product.

After establishing the materials, user needs and expectations the first prototype was sketched and successively built out of paperboard, tape and plastic remains (Figure 3). This raw model was used to evaluate functionality and comfort in terms of its measurements and potential weight. During this early stage of trials, the engineering division of the team empathized with the user. In other words, each member used the model during a whole day while being on a wheelchair. At the end of the individual trials each member gave an opinion and a contribution to improve the product.



Figure 3: Product Sketch and First Model.

Thereafter, the team recruited a meeting with the user and his parents. Its main goal was to discuss the advancements and invite Fernando to try out for a whole week of school the first version of the product. In general terms the product served its main purpose; it kept Fernando's things safe and available at his reach at any moment of the day. The only complaint was regarding the bag restraints, since this part of the bag kept falling off his shoulder while he moved. It is important to mention that this whole process was carefully documented the results of any outcomes testing and/or user feedback in order for our process to be reliable, traceable and repeatable.

Final Approach and Design

The backpack has the following traits: A wide aperture reinforced with plastic which prevent the bag from closing or dropping off while being used. It is covered with impermeable fabric; therefore it can be washed with soap and water without being damaged. It has crossed straps for the back allowing proper and adjustable fit.

The lid opens to the opposite side of the user, so it doesn't hamper the user while being open. Likewise the lid and uses a magnet to keep it closed while allowing an easy opening. Finally, the design was custom made, keeping in mind the user's favorite colour (red) and sport (football soccer).

Lastly, the final version of the product was re-designed and furtherly crafted with a sewing machine. The name of the product: "KÖBAK" is a word game which mixes 3 components: The word "kangaroo" due to the similarity with its pouch, the work "koala" by virtue of its position while hanging on a tree and noticeably the word "bag".

In the following images (Figure 4 & Figure 5) the Autodesk Inventor 2018 model used to craft the haversack is shown in addition to its measurements contrasting with the real product.

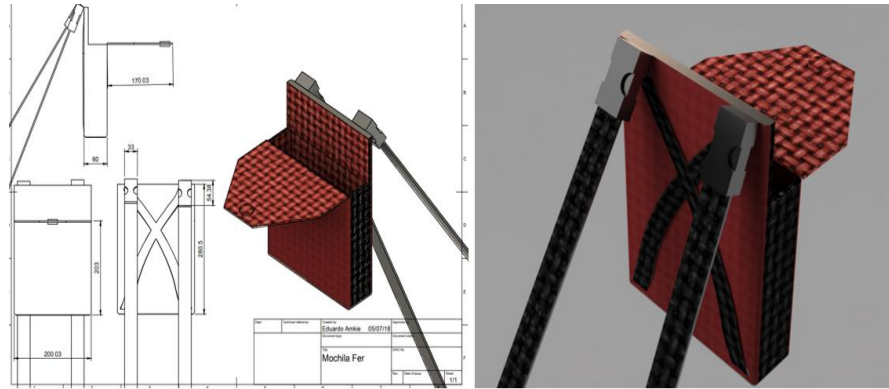


Figure 4: Autodesk KÖBAK 3D Render.



Figure 5: KÖBAK.

Cost of production and Expected Piercing

Table 1 displays the bill of materials (BOF) and the cost of each one respectively.

Part Number	Description	Material	Provider	Price [USD]
MF001	Rigid fibber, red colour 485C on Pantene scale, 1 meter	Mallorca canvas	Parisina	\$5.00
MF002	Expandable fibber, black colour, 1 meter	Spandex	Amazon	\$12.88
MF003	Fibber patches for (CITeR, F, balloon logos)	Nylon	Parisina	\$1.00 Per unit.
MF004	Black straps 2 cm width, 3 meters	Nylon	"Peletería León"	\$1. 00 Per unit
MF005	Black paperboard: 25 x 38 cm	Paperboard	Hiperlumen	\$0.6
MF006	Strap brooches	Plastic	"Peletería León"	\$0.2
MF007	Magnets 2 cm width	Magnet	Parisina	\$0.57

Raw costs of the prime materials: **\$21.25 USD** per unit.

Product price per unit (Raw Materials + Product Design + Engineering Labor): **\$35.25 USD.**

Significance

Before the project Fernando couldn't use his iPad in his classes because taking it out of the bag was complicated. Due to the zipper, dimension and materials of the bag the iPad was stuck often, also it was difficult that he ended the day with the bag well collocated, it was regularly rolling to his legs which is a distance he cannot reach.

Changing the design and materials gave the support to use just one hand to grab the iPad, with no fabric in between or zippers, the use of a magnet to close the backpack and keep the iPad inside was enough and did not bothered him. Now he takes classes in a comfortable and independent way.

Acknowledgements

We are really thankful to our teachers Abel Arredondo and Maria Padilla that gave us their full support to complete this project. Moreover, to Fernando and his family for their patience and marvelous cooperation.

This is to all who love to make the impossible, possible.

References

[1] "Somos Uno Más", <http://www.iberomx>, 2019. [Online]. Available: <http://www.iberomx/programa-somos-uno-mas>. [Accessed: 11- Mar- 2019].

[2] Parálisis cerebral infantil - Síntomas y causas - Mayo Clinic, *Mayoclinic.org*, 2019. [Online]. Available: <https://www.mayoclinic.org/es-es/diseases-conditions/cerebral-palsy/symptoms-causes/syc-20353999>. [Accessed: 01- Mar- 2019].