



Fashion and Inclusive Design: Assistive Technologies Applied to Clothing

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Abstract. The present work reports the results of a research project carried out by the Textile Engineering Department at the Federal University of Santa Catarina (Blumenau, Brazil). The project's main objective was to develop inclusive apparel textiles, meeting the different bodies and biotypes of people with or without disabilities. Contributing to the development of assistive technologies applied to clothing. Thus, in 2018, an inclusive fashion collection was developed for people with physical disabilities, co-produced with the members of ABLUDEF - Blumenau Association of Physically Disabled. The methodology used was based in a bibliographic research, deepening the approached themes in the project, as design and inclusive fashion, assistive technologies, and accessibility, as well as field research, conducted with ABLUDEF members. Among the final results, the garments made for the project were highlighted and modeled at the 6th South Brazil Awards for Inclusive Fashion, in Florianopolis (Brazil).

Keywords: Inclusive design · Fashion for all · Assistive technologies

1 Introduction

Today's fashion is becoming increasingly democratic in response to different styles, tastes and economic powers. Although fashion companies are concerned with serving different segments and consumer profiles, there is still a lack of studies and product development for people with disabilities.

Attempting to meet these market demands, the research project "Fashion is for everyone: a study of the principles of Universal Design applied to clothing" was created and developed by the Textile Engineering Course at Federal University of Santa Catarina (UFSC), Blumenau, Brazil, in partnership with the Department of Textile Engineering of University of Minho (UM), Guimaraes, Portugal.

The project, carried out in 2018, aimed to develop a collection of inclusive clothing for people with physical disabilities, in co-production with members of the Blumenau Association of Physically Disabled (ABLUDEF), based on a reflection of the different dimensions of sustainability. Among the different pillars of sustainability, the social

and the cultural were highlighted. Social sustainability was contemplated here through the development of products for people with physical disabilities and the involvement of other co-participating institutions. Cultural sustainability excelled in considering art as one of the aesthetic expressions inherent in human creation.

The methodology used in the project, applied bibliographic and field research, striving to strengthen pertinent concepts, such as inclusion, accessibility, inclusive fashion, universal design, sustainability, as well as Brazilian art featuring a Brazilian artist chosen as an inspirational theme of the collection.

2 Applied Methodology and Obtained Results

As mentioned before, the work presented here is the result of the research project developed in 2018, in which two volunteer students participated on a development team. One from the Textile Engineering course, involved in the field research, design of the collection, study of pattern design and study of the assembly process; and the other, a Control and Automation Engineering, involved in the successive tests to verify the feasibility and reliability of the technology, assembling all electronic devices, performing the programming and designing the application layout.

The objective of the project was to work in an integrated way with the ABLUDEF members, trying to meet all the demands observed for the creation of the collection. Thus, the partnership with the professionals and associates of the institution involved in the project was fundamental to create a relational, co-production and co-creation work system. Based on this principle, a set of actions were developed, allowing the relationship between the activities and the knowledge built throughout the year. Initially, it was considered the development of a collection targeting the needs of wheelchair users, incorporating in the garments technology to detect falls, although during the implementation of the project, it was realized that these features of clothing could also help others with different types of special needs, allowing to increase the target market, proposing products that could benefit more people.

According to the data from the 2010 Population Census, released by the Brazilian Institute of Geography and Statistics (IBGE), it is estimated that approximately 1/4 of the Brazilian population has some type of disability: “More than 45.6 million Brazilians reported having a disability. [...] The number represents 23.9% of the country’s population” [1].

The methodology used in the project favored bibliographic and field research, with the use of participant observation sociological research, that consists of the actual participation of knowledge in the life of the community or group. The observer/researcher assumes, at least to some extent, the role of a group member. Therefore, it is a technique by which one comes to know the life of a group from within itself. Interviews were conducted with the director, teacher and some members of the ABLUDEF Association. To be able to detect the real needs of the subjects involved, a questionnaire with mixed questions (close and open), was applied.

By means of contact with ABLUDEF members, it was identified that the people who suffered the most from falls were those with physical disabilities with malfunction or paralysis of the lower and/or upper limbs, making it difficult to move. According to

reports, falls were often frequent both in the street and at home. Most of the respondents used some kind of equipment that helped them to get around, such as walking canes, crutches and walkers, and most of them lived alone. When asked what could be improved in clothing, some answers guided the development of the collection, such as: pieces that would help them during the task of dressing, turning it easier, making them more autonomous; pieces without zippers, since some had difficulties in their hands; pieces slightly larger and more comfortable; and pieces that would not limit their locomotion.

For the development of the collection, it was used the planning methodology described by Treptow [2] as theoretical support, as well as the premises of Universal Design. As a result of the research, a set of garments were created, which endeavored to somehow meet the real demands of the users.

Employing the theories of Universal Design, products should be usable for everyone regardless of their disability. To do so, the necklines of the blouses were more open and had the same height in the front and in the back, making it easier to wear. For example, a person with visual impairment would not experience the situation of failing dressing it, avoiding the possibility of ending using it backwards. All seams of the garments had a clean finish, reducing discomfort with skin contact.

Trousers had an elastic waistband, allowing greater comfort to the wearer as it will grow as needed and stitched sideways for easy wearing. Most members sit for a long time, thus, a rigid, buttoned waistband ends up irritating the belly and sides, region that accumulates fat over time. Trousers were designed wider to disguise the use of a diaper, if the wearer needs it. The pattern design of trousers was looser and straighter, aiming to avoid arrested movements and block blood circulation of lower limbs. In terms of materials used, all pants were made with functional materials, donated by Invel Medicinal Clothing, featuring a unique patented technology from Bioceramica® MIG3®, infrared irradiator. This innovation incorporated into the tissue stimulates the production of nitric oxide (NO), soluble gas that has vasodilating and bronchodilating properties, which provides better blood circulation, bringing benefits to the user. This way, the whole leg is stimulated while wearing the pants. This population sits for long periods, resulting in low mobility of the lower limbs, and most have problems with blood circulation, causing problems such as edema (swelling) and even wounds.

A long vest was also made and sublimated, printed with the word “Palhaça” (female clown), by Gonçalo Borges, teacher, speaker and inclusive visual artist. Gonçalo paints his works with his mouth and his feet. He is currently a member of the Mouth and Foot Painters Association (APBP).

The key piece is a jacket with a Wi-Fi microcontroller inside to detect falls of users with poor mobility in the upper and lower limbs. The sensors, connected to a portable cell phone battery and a Wi-Fi network, were incorporated after the recognition of its relevance from the contact with ABLUDEF members, referring the constant number of falls. “Palhaças” (two female clowns) were printed on the back of the jacket. The artwork represents the affection between mother and daughter.

The fall detection system consists of a gyroscope/accelerometer, microcontroller with Wi-Fi connection and a buzzer. Through the gyroscope/accelerometer data and calculations performed by the microcontroller, it is possible to determine if the user has suffered a fall, as it accurately detects a fall in motion. If there is a fall, the electronic

device beeps and sends an alert message via Wi-Fi to the desired contact (friend, family member, caregiver, among others). The buzzer alerts people close to the user if an unforeseen event occurs. In case of accident, the monitoring needs to be done remotely, the message alert causes a previously registered contact's mobile phone to receive a message via the application.

All components are assembled and attached together to occupy the smallest possible space and were inserted in a 3D printed box, providing greater flexibility and robustness for the garment. The electronic devices are powered by a common Power Bank battery (portable charger), aimed to charge mobile phones, offering great power to the device and autonomy to the user. The jacket, device, and application interface are presented in Fig. 1.



Fig. 1. Jacket equipped with falls detection system, representing the front view; the interior view (showing the pocket where the box with the device is inserted); the back view (with the print “Palhaças” by Gonçalo Borges); the 3D printed box; the electronic devices inside the box; and the application interface.

During the research, several tests were performed to collect information related to the movement of individuals during their daily life (walking, running and climbing stairs) and simulations of falls, in order to isolate and differentiate patterns present in each of these actions. The graphics obtained were compared by analyzing the difference between the patterns. In the end, it was concluded that the calculation of the parameters Sum Vector Magnitude (SVM), Euler angle, Gravity-weighted SVM (GSVM), Gravity-weighted Differential SVM of Acceleration (GDSVM) were essential for the correct determination of a real fall.

The project was submitted, classified and presented at the 6th South Brazil Awards for Inclusive Fashion. The exhibition took place on November 28, 2018, in the city of Florianópolis, Santa Catarina (Brazil). The three looks produced in the collection can be observed in Fig. 2, during its presentation in the event by ABLUDEF members.



Fig. 2. 6th South Brazil Awards for Inclusive Fashion. Looks modeled by ABLUDEF members.

The final results of the project include the runway show of the collection at the 6th South Brazil Awards for Inclusive Fashion; honors received from the Blumenau City Council; achievement of the finalist category of the 3rd Creative Brazil Award, in the Design category; reports in the mainstream media; nomination for the Academic Merit Commendation; support from an alderman; and work published on social media and broadcasted on Blumenau Legislative Television.

3 Conclusion

The main objectives of this project were achieved, highlighting the possibility of working in an integrated manner, providing interaction between university and community. The project offered the scholars involved greater knowledge about the different dimensions of sustainability, Brazilian and regional art, as well as provoking the perception of social responsibility in the diversity of our world.

Finally, the project has contributed to a greater conscious of the market demand and possibility of a building a more egalitarian society. This project intended to develop products that target people, especially those with disabilities, considering their references and social representations, with the objective to provide them greater autonomy and consequently better quality of life. Corroborating with this idea, is the quote from the teacher, artist and speaker Gonalo Borges [5]: “It is not the law that will protect the disabled. It is awareness.”

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