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DESIGNING A METHOD TO ACESSIBILIZE VISUAL ARTS FOR THE VISUALLY IMPAIRED

DELINEANDO UMA METODOLOGIA PARA A ACESSIBILIZAÇÃO DE OBRAS DE ARTES VISUAIS PARA PESSOAS COM DEFICIÊNCIA VISUAL

ABSTRACT

This article aims to describe the methodology used to accessibilize visual arts exhibitions aimed mainly at visually impaired people. The methodology involves audio description, tactile photographs, and a tracking system. By means of two 40-hour workshops, audio description scripts that harmonized with the tactile pieces, planned simultaneously with the preparation of the scripts, were discussed. Participated in the research project researchers in the areas of audio description, museology, and computational design. The methodology is being tested, with the mounting of an exhibition at the Museum of Photography by researchers from UECE and UFC. The project's blind consultant assessed the interaction between the three accessibility resources as positive. The audio description allowed the identification of the elements, the tactile piece, its distribution, and the tracking allowed her autonomy to create her mental images.

Keywords: Tactile Photography; Tracking; Audio description.

RESUMO

Este artigo tem o objetivo de descrever a metodologia usada para acessibilizar exposições de artes visuais voltadas, principalmente, para pessoas com deficiência visual. A metodologia envolve audiodescrição, fotografias táteis e rastreamento de toque. Por meio de dois minicursos de 40 horas cada, foram discutidos os roteiros de audiodescrição que harmonizassem com as peças táteis, planejadas simultaneamente à elaboração dos roteiros. O projeto de pesquisa conta com a participação de pesquisadores nas áreas de audiodescrição, museologia e *design* computacional. A metodologia está sendo testada, com a montagem de uma exposição no Museu da Fotografia e pesquisadores da UECE e UFC. A consultora cega do projeto avaliou como positiva a interação entre os três recursos de acessibilidade. A audiodescrição permitiu a identificação dos elementos, a peça tátil, sua distribuição, e o rastreamento possibilitou a ela a autonomia para criar suas imagens mentais.

Palavras-chave: Fotografia Tátil; Rastreamento de Toque; Audiodescrição.

1 INTRODUCTION

The Federal University of Ceará (UFC[1]) Assistive Technology Research Group aims at joining researchers from different areas to approach accessibility for the disabled. The group is also composed of people from other universities and institutions, such as the State University of Ceará (UECE[2]). Tactile Photography is one of these projects, whose objective is to enable the blind to make their own photographs, and later have access to these photos as tactile photographs. It has been carried out by the Architecture, and Urbanism and Design Department of UFC (DAUD[3]) and the Fortaleza Photography Museum (MFF[4]). An exhibition of these photographs is being produced by MFF. In order to accessibilize the photographs, audio describers were added to the group already formed by designers, museologists, museum docents, and visually impaired consultants.

This article addresses a proposal of a method to approach the subject, involving audio description, the creation of tactile pieces and finger tracking. Audio description (AD) is the translation into words of the visual elements of an artistic production (DE COSTER; MÜHLEIS, 2007, p. 189). The steps to audio describe visual art involve the production, consulting by a visually impaired person, and oral narration of a script. The AD consultant not only validates, but also participates in the AD construction.

There are many publications on AD for cinema, television, and theater, but very little on AD for the visual arts. Among the first authors who decided to problematize this type of AD are De Coster and Mühleis (2007) and Holland (2009). Both defend the highlight of sensory elements, especially those related to touch. However, both say that if the pieces are not to be handled, the AD should bring sensorial language, especially those related to touch.

De Coster and Mühleis (2007) listed what would be the characteristics of AD for visual arts in Belgium. For the authors, AD should dialogue with sensory elements, which they call visual intensity. The tactile sensations should be privileged, so that the visually impaired visitor could feel the work. AD, then, would function not only as the translation of a visual image into verbal language, but as a form of interaction between visual image and tactile sensation to be put into words. The audio description text would bring two types of signals: 1) the clear ones, which can be clearly identified by sight, and 2) the ambivalent ones, which are dependent on the other senses (touch and hearing), and which would have to be translated verbally. The authors did not reveal

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[1]Acronym in Portuguese.
[2]Acronym in Portuguese.
[3]Acronym in Portuguese.
[4]Acronym in Portuguese.

how these signs would be recognized and used a surrealist painting by René Magritte and an impressionist painting by Rik Vouters to discuss their proposal. In neither of the paintings, the signs are clear. Furthermore, when they propose AD, what they think are clear signs are nothing more than physical descriptions without showing the peculiarities of the two painters' art. Even though they do not propose any systematic standard for the AD of visual art works, the question of intersensoriality must be relevant for the AD of visual art works, since Holland (2009) also mentions its importance.

Holland (2009) was trained in audio description to evaluate the accessibility offered for the visually impaired in English museums. He was surprised by the "neutrality" rule prescribed by AD professionals, in which the subjectivity of the audio descriptor would be left out in the name of objectivity, following the maxim advocated by the American Audiodescription Coalition (2009): "Describe only what you see". For him, this impartiality does not exist: "The more audio descriptions I make, however, the more impossible this seems to me" (HOLLAND, 2009, p. 173). For him, audio describing only the physical characteristics of visual art does not translate art. In the description of the physical characteristics, the parts are there, but the whole (art) is left out.

Mayer's research (2018) also suggests the relevance of touch for the enjoyment of visual art by the visually impaired. When visiting the exhibition "Red Deviation: Impregnation, Surroundings, Deviation", a group of congenital blind people had a good experience because of their tactile experience. Before hearing the AD, they touched all the objects in the three exhibition rooms. Apart from the white walls, everything was red. By combining verbal and tactile information, they could create their own interpretation. They did so by associating the color with anti-military revolts and violence during the Brazilian Dictatorship (1964-1985), in addition to uncomfortable feelings with the one-color rooms.

Although De Coster and Mühleis (2007) and Holland (2009) consider the intersensory issue in AD to be important, the authors do not present systematic patterns to build this experience. In our proposal, Multimodal Social Semiotics is the theory in which these patterns are based. The theory was not meant for the visually impaired, but the semiotics resources they propose enabled us to use these resources to lead the audio describer's view.

The materialization of photographs into tactile pieces consists in translating visual elements of an image into objects that can be identified by touch. Photographic images can be quite complex, which requires an identification of the most important elements and their planes (depth positions based on the observer's field of view). In this work, to produce tactile pieces, the layer stacking method was applied, in which each layer of the piece defines the contours of a given

element of the image. When necessary, auxiliary pieces are produced to make the identification of a specific element easier.

Aiming to give more autonomy to the person who is feeling the piece, the touch tracking system was developed, which, through a webcam and a reflective element attached to the person's nail, identifies the place of touch. With a previous mapping of some regions of the piece, it is possible to play audios as the user explores each part of the tactile photography. This allows the person to more easily confirm the elements of the tactile piece that were previously described through audio description.

As we were experimenting different types of accessible materials, we decided to discuss their harmonization in a workshop. The idea emerged because we did not find in the literature any experience which unites audio description, tactile pieces, and tracking system.

This article is divided into six more sections. The first describes the workshop that discussed all the actions carried out in the project. The second brings the relation between multimodal social semiotics and audio description. The third deals with how the photographs were materialized by means of the creation of tactile pieces. The fourth is about the tracking system for the visually impaired to touch the most important parts of the piece. The fifth shows a preliminary reception research to test the method so far. Finally, there are the final remarks to describe the future outcomes.

2 BUILDING THE METHOD: A WORKSHOP ON ACESSIBILIZATION OF VISUAL ARTS

The participants were all the people involved in the exhibition named At One's Fingertips (*Na Ponta dos Dedos*). Two workshops of approximately 40 hours each were given. Different groups were formed to build the ADs for the 20 photographs of the exhibition. Each group contained at least one of the professionals among the participants: designers, audio describers, museologists, museum docents, blind participants – photographers and consultants. At the same time, the tactile pieces were planned for them to combine with the AD. Finally, the AD was discussed with all the people involved. The idea was to follow the ordinary process for building an AD: writing the script, submitting it to a visually impaired consultant and revising the script. Although the oral narration was discussed and performed for the blind audience to take part in the plenary discussions, it was only finished during the final preparations for the exhibition.

As a result, some preliminary parameters were produced, based on Negraes (2018, p. 61). The first one is related to contextualization by providing information necessary for introducing the

artwork, such as title and date. The second refers to descriptions ranging from the whole to the parts, forming a sequential narrative. The third reinforces the importance of describing the colors, by relating them to forms, sensations and textures. The fourth shows the description of the characters, their gestures, posture, costumes, facial and body expressions. The fifth deals with perspectives, giving details about angles and photographic plans. Finally, the choice of evaluative language that denotes affection, judgement, appreciation, engagement, and modalization. The next section will exemplify the process of the production of one AD. We chose this one, because it demanded an auxiliary piece, a 3D model, to complete the process of accessibilization. In addition to this one, the same strategy was used in another tactile photograph.

3 AUDIO DESCRIBING VISUAL ARTS

The research group affiliated to the State University of Ceará, Subtitling and Audio description – LEAD[5] (*Legendagem e Audiodescrição*), realized that Multimodal Social Semiotics could be helpful to audio describe visual arts within the scope of an Academic Cooperation Program between the State University of Ceará and the Federal University of Minas Gerais (PROCAD CAPES – 2008-2012). The theoretical background was composed by the Grammar the Visual Design by Kress and Van Leeuwen (2006) and the Visual Language Map by O'Toole (2011), who worked with image description and analysis of visual artwork. Although these multimodal models are not aimed at people with visual impairments, they helped guide the audio describer's view, helping them prioritize visual information in the AD script. The basic principles of multimodal social semiotics are the description of specific semiotic resources to achieve the three basic communicative functions: ideational (content), interpersonal (interaction between participants) and textual (text building), described by Halliday's Systemic Functional Linguistics (1978) for verbal language.

Kress and Van Leeuwen (2006) and O'Toole (2011) suggest a script for reading static images and works of art based on the use of language related to the semiotic resources involved in the production. For the ideational function, they use the term **representational**, which encompasses the representations contained in the images through narratives, scenes or portraits. The interpersonal function, which is called **interactive** by Kress and Van Leeuwen, and **modal** by O'Toole, takes into account the impact of the work on the viewer. Finally, the textual function, called **compositional** by the authors, is focused on the resources used by the artists to create their work.

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[5] Acronym in Portuguese.

Figure 1 brings the focused photograph made by one of the visually impaired photographers.

Figure 1 – The girl in a photo session

Source: MFF's Archives.

According to O'Toole (2011), an image can be approached by means of four categories: work, episode, figure, and member. Each category is viewed through one of the metafunctions of language (**representational**, **modal,** and **compositional**). The photo describes a scene (an episode), representing a photo session in the Society for the Assistance of the Blind (SAC[6]). It was made in long shot and vertically. It is structured with an element, a girl, in the middle, dividing it into two parts (**compositional** aspects): on the left, a camera, on the right, SAC's backyard. Kress and Van Leeuwen (2006) would add that, as the photo was made at eye level angle, the girl is looking directly at the photographer, demanding attention.

All these characteristics were considered, as well as the parameters described above. The AD began by contextualizing the photo, giving an overview of what is going to be described.

> Vertical photography made by Mary X shows a young girl posing in the open courtyard of the Society for the Assistance of the Blind (SAC). In the foreground, in the center of the photo, we have Jane X. She is standing, leaning her right shoulder against the outer wall of a building and resting her left hand on her hip.[7]

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[6] Acronym in Portuguese.

[7] Script in Portuguese: Fotografia vertical feita por Mary X. Mostra uma moça jovem posando no pátio aberto da Sociedade de Assistência aos Cegos (SAC). Em primeiro plano, no centro da foto, temos Jane X. Ela está em pé, encostada com o ombro direito na parede externa de um prédio e apoiando sua mão esquerda na cintura.

Then the next step was the description of the girl, as she was the most outstanding element in the photo.

> She has brown skin, shoulder-length curly brown hair, and a small fringe covering her forehead. Her eyes are small and half closed. In her left ear, she wears a diamond shaped wooden earring. Her right ear is covered by hair. She smiles and poses for the photographer. She wears a black V-neck t-shirt with the Fortaleza Photography Museum logo in white. It's the MFF[8] employees' uniform. The logo is related to the facade as well as the museum's internal structure. Below the logo is the museum's name in white. Jane also wears a watch on her right wrist, black pants and black Converse All-Star sneakers.[9]

The following part describes elements which are on the left side. This part is filled with colors, different shades of green, yellow, and gray. Most of them were suggested by the visually impaired consultants.

> Jane leans on the outside corner of a building, where the side wall is pale yellow, and the front wall is jade green. At the bottom of this front wall, there is a structure that resembles a masonry bench, about 40 centimeters high. On the seat is a black camera with a black handle that hangs out of the seat. The seat is dark gray, but the rest of the bench is the same jade green color as the wall. The floor seems to be made of greenish ceramic, forming a kind of geometric design, similar to a beehive. Jane is right at the intersection between the two walls.[10]

Although we had discussed the materialization during the workshop, we had to change the description of the right side when the piece was finished. The first text had a top-down direction, beginning with the description of the ceiling, then the trees, and finally the fencing of a playground. The problem was that our consultant confused the roof structure with the fencing. They were similar in the tactile photograph. Also, we were describing the left wall, then the bench and the camera and then the floor. Therefore, it made sense the consultant hands were groping the bottom of the tactile piece (photograph) and hence confused the two structures. This can be seen in Figure 2.

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[8] Acronym in Portuguese for *Museu da Fotografia Fortaleza*.

[9] Script in Portuguese: Ela tem pele parda, cabelos castanhos, encaracolados, na altura dos ombros e com uma pequena franja que cobre sua testa. Seus olhos são pequenos e estão semicerrados. Na orelha esquerda, ela usa um brinco amadeirado no formato de um losango. Sua orelha direita está coberta pelo cabelo. Ela sorri e posa para a fotógrafa. Veste uma camiseta preta com gola V com a logo do Museu da Fotografia Fortaleza na cor branca. Trata-se da farda dos funcionários. A logo lembra a fachada bem como a estrutura interna do museu. Abaixo da logo está o nome do museu na cor branca. Júlia também veste calça preta e usa um relógio no pulso direito e tênis no estilo all star preto.

[10] Script in Portuguese: Júlia se apoia na quina externa de um prédio, no qual a parede lateral é amarela claro e a frontal é verde jade. Na parte de baixo dessa parede frontal, há uma estrutura que lembra um banco de alvenaria, com altura de mais ou menos 40 centímetros. Sobre o banco está uma máquina fotográfica preta com a alça também preta que pende para fora do assento. O assento tem cor cinza escuro, mas o restante do banco tem a mesma cor verde jade da parede. O piso parece ser de cerâmica esverdeada formando uma espécie de desenho geométrico, que lembra uma colmeia. Júlia está bem na interseção entre as duas paredes.

Figure 2 – Tactile photograph
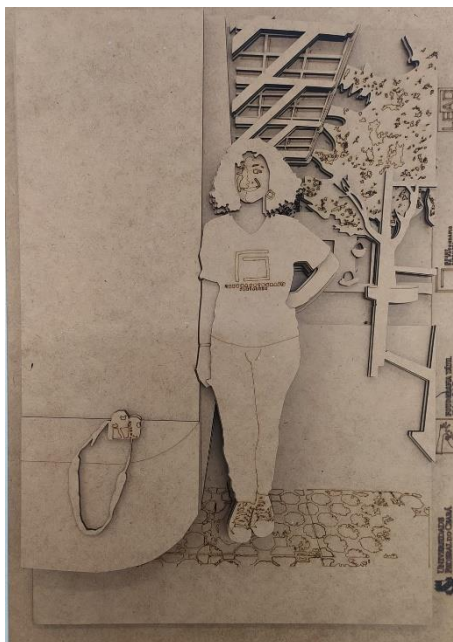
Source: MFF's Archives.

The solution was the adoption of a bottom-up description, beginning with the playground fencing, then the trees and concluding the script with the ceiling.

> To Jane's right there is the fencing of a playground, the lower half of which is yellow and the upper half, white. Behind Jane, we have the SAC patio, with a greenish cement floor and two large trees, whose leaves reflect the strong sunlight. At the base of the trees, around their trunks, there are circular structures in light green color that serve for sitting. From the branches of one of the trees hang two jars. Behind the trees is a building with a tea pink wall and two gray doors. In the upper part, in the center of the photo, following the yellow wall, there is a ceiling of brown tiles supported by wooden beams.[11]

The harmonization between the AD and the tactile photograph was fundamental for the visually impaired to see the photo by using their fingers. At least that is what our preliminary results show. This issue is going to be discussed below.

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[11] Script in Portuguese: À sua direita, está o alambrado de um parquinho, cuja metade de baixo é amarela e a de cima é branca. Atrás de Jane, temos o pátio da SAC, com chão acimentado esverdeado e duas grandes árvores, cujas folhas refletem o forte brilho do sol. Na base das árvores, contornando seus troncos, há estruturas circulares na cor verde claro que servem para se sentar. Dos galhos de uma das árvores pendem dois jarros. Atrás das árvores, há uma construção com parede rosa chá e duas portas cinza. Na parte superior, ao centro da foto, acompanhando a parede amarela, temos um teto de telhas marrons sustentado por linhas e caibros de madeira.

4 MATERIALIZING THE PHOTOGRAPHS

In order to obtain a more accurate materialization process for the photographs, we used digital fabrication methods (ARAÚJO; SANTOS, 2015; CARFAGNI *et al.*, 2012). The tactile piece was assembled using a 3mm Medium Density Fiberboard (MDF) layer stacking methodology. The first step in planning is to identify the most important elements in an image and their planes (depth placements from the viewer's field of view). In this step, a discussion was held in which the participants gave their opinion on the identification of the elements and the best way to perform the tactile piece. The result of this planning for materialization was confronted with the proposal of audio description for each photo, with the objective of obtaining coherence between the two resources, so that people with visual impairments can access the pieces by touch and by hearing. Then, the pieces were divided into layers and drawn in software with vectorization techniques as shown in Figure 3. After this process, the pieces were cut in a laser cutting machine and glued in layers. The details of the images were executed in embossed glue or engravings and underwent tests in the consultancy.

Figure 3 – Vectorization of the layers
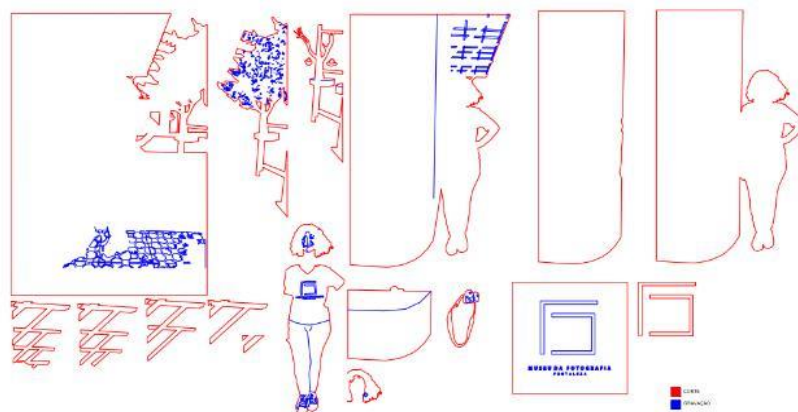
Source: Tactile Photography's Archives.

In the piece of the photograph we are explaining in this article, there were eight layers: in the first layer, which is essentially the base of the tactile piece, there is, in an engraving form, the floor with geometric drawings; in the second layer there is the back wall; in the third layer there are the jars on the tree and its leaves; in the fourth layer there is the tree trunk and the circular structure around it, the playground and the roof tiles; on the fifth layer there is a part of the roof; in the sixth layer there is the wall and the wooden roof structure; in the seventh layer, there is the masonry

bench and most of the girl's body; in the eighth layer there are the girl's hair, her t-shirt, the camera on the bench and its strap.

In addition to the geometric designs of the floor, other elements are also engraved: the tree leaves; Jane's facial features and her earring; the MFF logo and the name of the museum on the girl's t-shirt; her watch; the camera's details, such as buttons and viewfinder; the shoes and the girl's silhouette. After pasting the MDF layers, a MFF's staff used 3D embossed glue to give more tactile prominence to some elements of the tactile piece. The elements shown (Figure 1) were: tree leaves, earring, MFF's logo, watch, sleeve hem, line between legs, shoelace, camera and its strap, and the drawings on the floor.

For this piece, we believed that the Museum of Photography logo on the shirt would be barely recognizable due to its size. An auxiliary piece (Figure 4) with only the museum's logo was then created to allow the visitor to better identify what is printed on the shirt.

Figure 4 – Auxiliary piece with the museum's logo

Source: MFF's Archives.

5 DESCRIBING THE TRACKING SYSTEM

The last stage of preparation before the exhibition was the choice of the elements to be included in the tracking system. Our consultant, based on the complete AD script and the tactile piece, selected nine points of interest. The elements chosen were: the girl's face (1), the camera on the left (2), the floor (3) and the tree in the background (4); very small elements, like the jars hanging from the tree (5), the circular structure around the tree trunk (6) and the museum logo on the girl's t-shirt (7); or elements that could still cause some kind of doubt or difficulty for the target audience, such as the ceiling (8) and the playground (9). As we can see on Figure 5.

Figure 5 – Tracking system points of interest

Source: Tactile Photography's Archives.

Once we decided which elements of the photograph would be tracked, we made brief descriptions of these elements, using part of the full AD script. At this time, as the purpose of the tracking system was more to confirm the location of the elements than to describe them in detail, the descriptions were sometimes limited to just one word. After recording these audio description excerpts, these files were assigned in the tracking software to certain locations of the tactile piece to which they referred.

In addition to this software, the tracking system is composed of a base, where each tactile piece is fixed, one at a time; a rod, approximately 40 centimeters high, on the side of this base; and a webcam on the upper end of this rod (Figure 6).

Figure 6 – Tracking system structure with the webcam
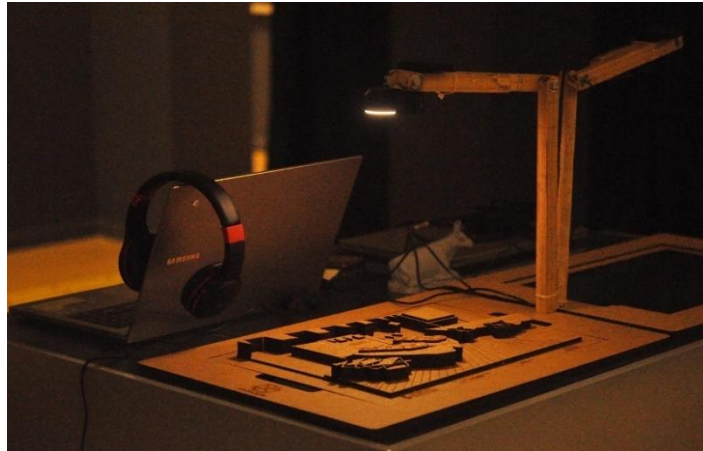
Source: Tactile Photography's Archives.

The webcam is positioned to capture the entire tactile piece that is on the base. The software developed for the tracking system is programmed to obtain constant readings from this webcam. The moment the system user passes their hand over the tactile piece, the system identifies a point of greater reflection (Figure 7). Currently, this point of greater reflection is achieved by sticking a glossy adhesive on the nail or on any area of the user's finger. If this reflection point coincides with the location of one of the elements of interest previously selected, the system will provide the audio referring to that element. For example, in the photo (Figure 1), if the user swipes the finger with the sticker over Jane's face, which has been identified as a point of interest, the audio "Jane" will be heard by the user.

Figure 7 – Tracking system and identification of the point of greater reflection
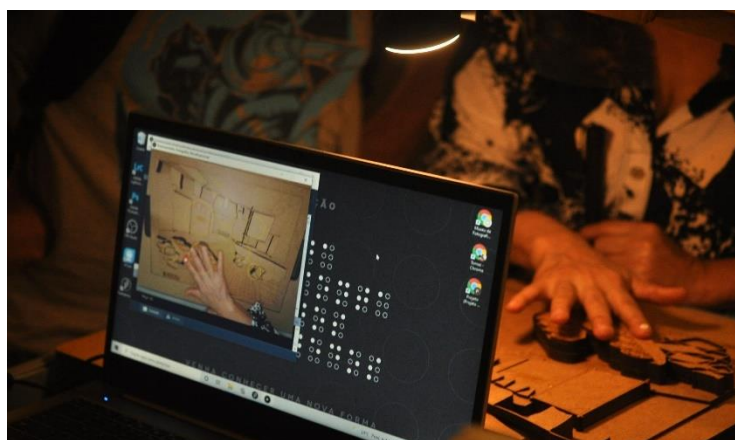
Source: Tactile Photography's Archives.

With this system, it is possible to increase the user's perception and identification of what is being touched in the piece. The system allows, in real time, to associate the touch with the description. Without this technology, the tactile piece and the audio description work independently, leaving to the user the task of identification of the elements of the piece, which in some cases may not be so easy. As the association is made in real time, in this case, descriptions are made briefly, so that the user can appreciate the piece more quickly, without the need of a complete audio description. In this sense, the system works as a complement to the other resources (tactile part and audio description).

6 TESTING THE METHOD

To find out if the current AD script, the tactile piece and the tracking system are in harmony with each other, we will soon carry out reception research with some visually impaired participants. The method has already been tested (VIEIRA ET AL., 2021) by two deaf consultants. The tests results showed to be promising for evaluating the enjoyment of each photograph by the visually impaired audience.

The reception research will be divided into four phases. Firstly, the participant will listen to one of the two versions of the AD script: the final version that has gone through all the previously explained processes and a longer version of this script, with more details and technical terms of photography composition. This phase aims to allow the participant to create a mental image of the photograph that will be confronted with its tactile piece.

In the second phase, after listening to one of the versions of the script, the participant will have access to the tactile piece and will be able to interact with it. At this stage, the fingers move faster, because, in addition to becoming familiar with the dimensions of the piece, the participant can confront the image created mentally by means of the AD with the elements materialized in the piece. This will help them to confirm or not some hypotheses, like, for example, the spatial location of each element or its forms. In the third phase, the participant will listen to the full AD again, now checking these elements in real time.

The fourth phase consists of the tracking system, which offers descriptions only of specific elements. This phase helps to resolve doubts that may still exist regarding the location or identification of some specific elements. In the case of the photograph presented (Figure 1), the jars hanging from the tree in the background and a circular structure around these tree trunks can be confused with other elements, because they are very small. It is also important to distinguish

between the fence and the roof. As it was previously stated, these elements, based on the AD consultants, were responsible for changing the sequence of presentation in the AD script.

As shown in Vieira *et al*. (2021), after each phase the participant can report their impressions about the AD, the tactile piece, and the process, expressing doubts and difficulties that might still exist and possible solutions.

7 FINAL REMARKS

This paper proposed a method to make an artistic exhibition accessible, involving audio description, tactile photographs (Figure 8) and a touch tracking system. Twenty tactile pieces and audio descriptions were made using the method for the exhibition At One's Fingertips (*Na Ponta dos Dedos*), held at the Fortaleza Photography Museum.

Figure 8 – Part of the twenty Tactile Photographs produced for the exposition

Source: MFF's Archives.

Headphones with the audio descriptions, the materialized photographs and two touch tracking systems were made available to the visitors as shown in Figures 9 and 10. One important aspect was that the printed photographs were smaller than the tactile pieces. This was intentional. The aim was to emphasize who the protagonists in the exhibition were: the visually impaired audience, who would see the photographs by means of their fingers and ears.

Figure 9 – Tactile Photographs and headphones with audio descriptions

Source: MFF's Archives.

Figure 10 – Tracking system

Source: MFF's Archives.

When evaluating the proposal, our blind consultant mentioned the role of each resource for her to enjoy the photographs. Audio description allowed her to identify the elements in the photo, giving the directions to run her fingers through the piece. Touch helped her to recognize the distribution of elements which compose the photo, as well as their shape and depth. Also, she felt more secure to enjoy the photo, as the touch provided a faster experience with the image. Finally, she said that the tracking system boosts the creation of mental images, giving the visually impaired more autonomy in the process. Besides, it helps the perception of all details more precisely.

Figure 11 – 3D-printed auxiliary piece of a cow

Source: Tactile Photography's Archives.

Another element that called her attention was the inclusion of a 3D model in the acessibilization of one of the photos (Figure 11). The photo has in the foreground the sculpture of a cow lying down with her paws folded back. According to her, it was hard to understand the cow's position, but after touching the model, she could have the experience of touching the whole, instead of only the part pictured in the photo. Neither the AD nor the tactile photograph provided this experience. However, she added that the model completed the experience and that it doesn't replace the other two resources.

This article showed a possibility for making an exhibition of photographs accessible to people with visual impairments. We believe that the proposal is relatively simple and efficient to be used in museums. The promising results showed here are very preliminary results based on the tests with one photograph as was mentioned in section 6 and the touching carried out by the consultants before the exhibition At One's Fingertips. The pandemic hampered the beginning of the reception research with other participants. We hope it can be done shortly.

REFERENCES

AUDIO DESCRIPTION COALITION. **Standards for audio description and code of professional conduct for describers**. 3. ed. Los Angeles: Audio Description Coalition, 2009. Disponível em: https://www.perkinselearning.org/sites/elearning.perkinsdev1.org/files/adc_standards.pdf. Acesso em: 25 set. 2021.

ARAÚJO, Manoel Deisson Xenofonte; SANTOS, Deborah Macêdo dos. Fotografia Tátil: desenvolvimento de modelos táteis a partir de fotografias com a utilização de impressora 3D. **Revista Brasileira de Design da Informação – Infodesign**, São Paulo, v. 12, n. 1, p. 62-76, 2015. Disponível em: https://www.researchgate.net/profile/Deborah-Santos-10/publication/308378601_Fotografia_Tatil_Desenvolvimento_de_modelos_tateis_a_partir_de_fot ografias_com_a_utilizacao_de_impressora_3D/links/57e268e208ae1f0b4d95c024/Fotografia-Tatil-Desenvolvimento-de-modelos-tateis-a-partir-de-fotografias-com-a-utilizacao-de-impressora-3D.pdf. Acesso em: 27 set. 2021.

CARFAGNI, Monica; FURFERI, Rocco; GOVERNI, Lapo; VOLPE, Yary; TENNIRELLI, Giovanna. Tactile representation of paintings: an early assessment of possible computer based strategies. *In*: IOANNIDES, Marinos; FRITSCH, Dieter; LEISSNER, Johanna; DAVIES, Rob; REMONDINO, Fabio; CAFFO, Rossella (Ed.). **Progress in Cultural Heritage Preservation**: EuroMed 2012. Berlin/Heidelberg: Springer, 2012. p. XX-XX. (Lecture Notes in Computer Science, v. 7616). https://doi.org/10.1007/978-3-642-34234-9_26.

DE COSTER, Karen; MÜHLEIS, Volkmar. Intersensorial translation: visual art made up by words. *In*: CINTAS, Jorge Díaz; ORERO, Pilar; REMAEL, Aline. **Media for all**: subtitling for the deaf, audio description, and sign language. Amsterdam/New York: Rodopi, 2007. p. 189-201.

HALLIDAY, Michael Alexander Kirkwood. **Language as social semiotic**: the social interpretation of language and meaning. London/ Baltimore: Edward Arnold & University Park Press, 1978.

HOLLAND, Andrew. Audio description in the theatre and the visual arts: images into words. *In*:

DÍAZ CINTAS, Jorge; ANDERMAN, Gunilla (ed.). **Audiovisual translation**: language transfer on screen. Basingstoke/New York: Palgrave Macmillan, 2009. p. 170-185.

KRESS, Gunther; VAN LEEUWEN, Theo. **Reading images**: the Grammar of Visual Design. 2. ed. London/New York: Routledge, 2006.

MAYER, Flávia Affonso. **A importância das coisas que não existem**: construção e referenciação de cor por pessoas com cegueira congênita. Belo Horizonte: Editora PUC Minas, 2018.

NEGRAES, Manoel José Passos. **Delineamento para audiodescritores consultores**: um estudo de caso em capa de disco. Fortaleza: UECE, 2018. TCC não publicado. 73 p.

O'TOOLE, Michael. **The language of displayed art**. London: Routledge, 2011.

VIEIRA, Roberto Cesar Cavalcante; ARAÚJO, Vera Lúcia Santiago; SEOANE, Alexandra Frazão; SALES, Larissa da Conceição; RODRIGUES, M. Liliane; LIMA, Neyara Rebeca Barroso; CORDEIRO, Luciana. Exposição Na Ponta dos Dedos: proposta de acessibilização por meio de fotografia tátil, rastreamento de toque e audiodescrição. *In*: CONGRESSO BRASILEIRO DE PESQUISA E DESENVOLVIMENTO EM TECNOLOGIA ASSISTIVA, 2021, Caxias do Sul. **Tecnologia assistiva**: projetos e aplicações. Bauru: Canal 6, 2021. v. 1. p. 196-204.

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