Design for Inclusion, Gamification and Learning Experience

edited by
Francesca Tosi, Antonella Serra, Alessia Brischetto, Ester Iacono

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Ergonomia&**Design**

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6. Design and Prototyping for Disability. WAVE Case Study

by Lorenzo Berti, Piergiorgio Callegher, Cecilia Garuti, Vittoria Roccatelli, Francesca Toso, Maximiliano Romero

Abstract

The present paper introduces the methodology applied for the development of Wave, an open source assistive device for blind people.

The project was developed during the "Intelligent Products" Design Studio, of the Product Design Master Course at the Iuav University of Venice.

WaVe is an open source assistive device for blind people that is designed to be attached to the standard white cane to help the users while memorizing new routes in urban context, granting them more autonomy. We cooperated with a blind user, that helped us to understand the main problems in his experience of urban orientation, as example the necessity of tutoring assistance for the study of a new route, requiring multiple walks before proper memorization. Our purpose was to give the user more autonomy, reducing the number of meeting with a tutor: WaVe allows the user to record new routes through reference points, giving him the possibility to retrace them in autonomy. To reach this aim, we decided to use RFID technology, using passive tags as reference points, and the cane as antenna. The product development process started thanks to a series of interviews that we submitted to the user, which allowed us to understand that the topic of autonomous orientation is really felt by the blind, who often have to compromise. Analyzing the results of the interviews we have chosen to work on the white cane, a support that is always present in the life of the blind and that leaves many possibilities for intervention.

The design process has always developed using tools open source, in order to guarantee an easy reproducibility of the final product. The user contribution was fundamental during the design phases, useful to understand the real needs and making changes during the work. Wave strongly improves the user's autonomy through the reduction of the need of memorizing information.

Keywords: *Design Open-Source, User Centered Design, Learning Experience, Blind Orientation, RFID.*

6.1 Introduction

A blind user can find lot of difficulties during outdoor orientation, caused by many factors as a though environment, other people distraction or necessity to find non-visible references, and all of this requires a great amount of concentration.

WaVe is an assistive technology for blind people, that helps them to reach their autonomy in daily habits. The device has been designed to allow the user an easier memorization of his usual or new routes, reducing the needs of a tutor for training walks: nowadays, the memorization of a route can happen in different way, but all of these happen with the help of a tutor for many times. With WaVe, we used technology to make this process easier, both for the user and the tutor, turning the classic white cane into an antenna, capable to store a new route in his journey.

6.2 Methodology

During the project we were assisted by a man affected by late blindness, that offered as volunteer to help us to identify the problem and test our prototypes for the product development.

The first phase was about the identification of the problem and the focus on specific connected issues, then the research addressed the spatial reeducation of blind persons as the most important phase to get back their autonomy.

The research was first centered on how people affected from late blindness learn to come back to their regular life. Most of the work is made from associations, that provide lessons and tutors for the blind people but, in a second moment, technology can have a very important part in making easy the actions that usually would require a tutor.

At this point our volunteer was directly involved in three meetings: the first was made to identify the problem itself, and came out how outdoor orientation could be a real issue; the second, to understand his orientation technique, made up of:

1. first walk with a tutor;
2. subdivision of the route in segments;
3. assign to every segment an amount of steps;
4. reconstruction of the route on paper, in order to store it;
5. repeating the route with tutor until found confidence (usually 5-6 times).

And the third, in which the user showed us how the technique was applied in an outside walk. The process works very well, but asks to the user a great amount of concentration during his route: he must count every step walking, and every little error can be very relevant at the end of the segment.

Following the identification of the problem, we conducted a desk research on the existing products available for blinds and understand which technology can provide a correct localization.

Most of the found products did not contemplate GPS localization as solution, mostly for the fact that GPS has an accuracy up to 3 meters, too much to guarantee a safety trip to a blind user, specially in a city as Venice, our case study, in which the small and close roads can cause many problems.

Our design took the right inspiration specially looking indoor orienteering projects, such as museums or airports. We understood that the user did not need to be tracked for all the route, but he simply had to identify some hotspots, such as in the turns or in danger points.

We have identified RFID technology as the best technological solution: it consists of an antenna capable to read sensors. Since sensors have an unique identification number and don't need alimentation, we have decided to give the user the possibility to place them through all the city, and to transform the standard white cane into the antenna to read them.

After developed the design, and after had the confirm by our user, we started to build the prototype.

The purpose to have an open source product brought us to use open source technology and easily available materials, such as arduino for the electronic part or 3D printing for the shell construction.

Once had the prototype the project ended with a first field research, in which we found some errors in usability of the product that were corrected and tested in a second field research.

6.3 Results

The project was developed during the "Intelligent Products" Design Studio, of the Product Design Master Course at the Iuav University of Venice. WaVe is an open source assistive device for blind people that is designed to be attached to the standard white cane to help the users while memorizing new routes in urban context, granting them more autonomy. We cooperated with a blind user, that helped us to understand the main problems in his experience of urban orientation, as example the necessity of tutoring assistance for the study of a new route, requiring multiple walks before proper memorization. Our purpose

was to give the user more autonomy, reducing the number of meeting with a tutor: WaVe allows the user to record new routes through reference points, giving him the possibility to retrace them in autonomy.

The aim of the project is to give directional instructions to the blind or visually impaired user, leading him step by step along his usual routes through the transmission of informations related to a series of reference points: in fact some of the rehabilitative techniques, aimed at teaching autonomous orientation, are based on the teaching of how to acquire various points of reference, points that the blind person can use in order to recognize a piece of road while walking along it.

The intention is to make possible a "tracking" of a series of routes by the user himself, who will use a device that can be applied on the white stick and a series of RFID tags which he will position at each crossroad of interest along his usual routes.

Every RFID tag is characterized by a code and once the RFID systems have been positioned the user will be able to store on his database all his "paths", which interpolate the tags placed around the city: these memorized routes can then be selected from an online application, to guide the blind person around the city through tactile and auditory feedback.

The user can also add personal notes that will be read by the device in the proximity of a tag, in order to provide more information about the area in which it is located: in this way the user can personalize the information that WaVe provides him, entering information of personal interest or related to any elements of danger present on the route.

Once the tags have been positioned by individual users, these can be used by any other WaVe's user, with the aim of creating a sort of community around the product itself: after identifying the tag belonging to someone else, the blind person will be able to register it on his personal database and use it in order to create his own routes.

Prototype. WaVe is a device that can be applied to any standard folding white stick: in this way the project is able to better respect the typical logic of an open source project.

The external shell is 3D printed and consists in two main parts: the tip, in which the antenna and the RFID module for reading the tags are positioned, and the handle, in which the battery and the rest of the electronics parts are positioned. The external shell also includes two buttons, which allow the user to interact with the device.

WaVe is powered by a rechargeable battery, so that it is easy for the user to control his charge level. All internal components are controlled by an Arduino

Wifi, which guarantees its working and the connection to the online database and the site.

The bill of materials includes:
- Arduino Wifi;
- a standard white folding stick;
- RFID Module;
- RFID Antenna;
- 1 DF Player for audio feedback;
- 1 vibration motor for vibration feedback;
- 2 buttons, for the registration of the tags, the audio notes and the reverse routes;
- 1 power button;
- a rechargeable lithium battery;
- 3D printed components;
- various electronic components.

During the development of the prototype we found it difficult to find the most suitable RFID technology for WaVe: in fact for the final product the technology to be used is UHF (Ultra High Frequency), which works between 860 and 960 MHz and is characterized by a range of action between 40 cm and 1 meter. However, this is a technology that is difficult to find in a short time: for this reason we made the prototype with a 125 kHz RFID antenna, easier to find but with a range of only 15 cm: in this way we were able to prototype WaVe and test its functionality and limits with the user, despite the technology used was not the most appropriate. This process allowed us to understand what changes to make to the project in order to make it easier and more comfortable for the user.

Shared materials/instructions. WaVe is an open source project, and for this reason it is important that it can be easily reproduced by anyone.

The entire project was developed with the aim of being shared on Posta: an open source platform born from the collaboration between Italy and Argentina with the aim of making assistive technologies accessible to anyone in any part of the world. The open source logic is in fact based on the sharing of online projects, allowing them to be easily downloaded for the purpose of being used.

The materials shared on Posta, so that WaVe can be easily reproduced, are:
- 3D model of the outer shell;
- electric Scheme;

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- bills of materials;
- code for Arduino;
- instructions.

6.4 Conclusions

The main aim of WaVe is to guarantee greater autonomy for the blind in the urban context.

The project is able to lighten the amount of informations that the user usually has to memorize in order to be able to orient himself, avoiding to distract him excessively thanks to the use of non-invasive feedback, preventing any dangerous situations.

WaVe is easily reproducible by the user himself considering that it is an open source project, and allows the blind person to involve the tutor fewer times for the memorization of a route.

At the moment we have prototyped the stick (the tip and the handle) and created the online database, with a simulation of the site.

With the development of the project and the direct relationship with the user we have had the opportunity to understand how it is actually important for a visually impaired to acquire greater autonomy, especially in the city context.

The main problem we have encountered is about the positioning of the tags around the city, for which a permit would be required from the city municipality itself: however, thanks to the generation of a community around the WaVe project, it would be easier to obtain consent and diffusion.

Furthermore, during the research phase we discovered that there are numerous types of RFID tags, characterized by different fixing methods: in this way it will be possible to select the most appropriate type of tag for each city context.

We can then assert that, despite these possible limits concerning the positioning of the tags, it is possible to find compromises so that the positioning is accepted by the city municipality.

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References

Alliegro M. (1991), *L'educazione dei ciechi*, Armando Editore, Roma.

App per non vedenti, Text available at www.disabili.com/prodotti/speciali-prodotti-a-ausili/app-disabili/app-per-non-vedenti. Accessed November, 2018.

Associazione Nazionale Istruttori di Orientamento Mobilità e Autonomia Personale (1996), *Passo dopo passo*, International Inner Wheel Club Milano Castello, Milano.

Cambratech, www.cambratech.it. Accessed November, 2018.

Guani M.*, Strumenti e metodologie per la riabilitazione visiva: l'esperienza del CERVI di Alessandria, Corso di perfezionamento: Tecnologie per l'autonomia e l'integrazione sociale delle persone disabili, A.A. 2005/2006,* Università Cattolica del Sacro Cuore, Milano.

Piscopo G.M. *(2016), Le difficoltà di un non vedente, intervista al professore Calogero Zarcone.* Text available at www.siciliaonpress.com/le-difficolta-di-un-non-vedente-intervista-al-professore-calogero-zarcone. Accessed November, 2018.

Rapisarda G. (2014), *L'educazione dei ciechi e le loro principali istituzioni in Europa e in Italia*, Università degli Studi di Catania, Dipartimento di Scienze della Formazione (phd thesis).

Romero M., Ferrari C., Toso F. (2018), *Designing and prototyping intelligent products for users with disabilities, a teaching experience* in *ICERI2018 Proceedings*, 11th annual International Conference of Education, Research and Innovation, Seville, Spain (pp. 5570-5577).

Smiley S. (2017), *RFID Tag Antennas*. Text available at https://blog.atlasrfidstore.com/rfid-tag-antennas. Accessed November, 2018.

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