ENHANCING ACCESSIBILITY IN HIGHER EDUCATION

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ABSTRACT

As technology continues to advance and more institutions adopt assistive technologies strategies, it is becoming increasingly important to understand the most effective ways to implement assistive technologies strategies in higher education. The purpose of this paper is to explore how assistive technologies strategies can be effectively integrated into higher education for disabled communities. Orientation and mobility are often underestimated. People with disabilities, such as deaf, blind, and physically impaired people, are often challenged with navigation problems. Signage is the most common mechanism of wayfinding information, but orientation is much more complex. To address the lack of inclusion and accessibility that overwhelms indoor environments, such as schools and public services, an Indoor Mapping application was designed. The target is the ISEP community – its students, staff, and visitors. The aim is to create an assistive technology, that can guide disabled students, but also incoming and Erasmus students that struggle in their early days at the University.

KEYWORDS

Assistive Technologies, Higher Education Strategies, Indoor Mapping, Accessibility, Geolocation, Orientation & Mobility

1. INTRODUCTION

As of this moment, there are only a few options for navigational assistance in indoor environments for people with disabilities, especially those who are blind or visually impaired. Indoor environments can be geographically complex, and signage remains the most common mechanism for providing and receiving wayfinding information in such spaces.

People with disabilities are a significant share of the global population. According to the World Health Organization, at least 2.2. billion people live with some kind of visual impairment (World Health Organization, 2019) and over 1.5 billion people have hearing impairments (World Health Organization, 2023). Also, more than 1 billion people need at least one assistive product, i.e., a wheelchair, prostheses, or communication or memory aids, for example (World Health Organization, 2018). This means that assistive technology is of great importance for people that live with different disabilities, such as deafness, blindness, or reduced mobility.

To address challenges of inclusion, communication, and accessibility (Escudeiro, et al., 2017), ISEP Indoor Mapping was developed. The application intends to raise awareness and enhance equality, by creating an assistive technology that provides self-sufficiency in indoor environments. By using beacons, a small device that works based on Bluetooth Low Energy, the application can identify the geolocation of the user and provide him or her the information necessary to move through buildings of the *Instituto Superior de Engenharia do Porto* (ISEP) campus.

Serving as an assistant guide and indoor navigation system, the idea is to develop an assistive technology, a navigation electronic aid, that allows students to easily move through the facilities and quickly become familiar with them, while also being aware of easy access points, carefully adapted to their needs, such as wheelchair or elevator access.

2. THEORETICAL FRAMEWORK

Nowadays, there is an overwhelming amount of visual and text information in every street, building, public space, and all else. However, despite this available visual information, there is a general lack of location information in indoor environments, that are suitable for everyone. This also involves the lack of navigation aids that are made available in indoor environments.

With the advent of greater mobility, a greater need for localization and indoor positioning has emerged (Samama, 2019). As such, there is a growing relevance in the development of user-friendly indoor navigation systems (Hirtle & Bahm, 2015), systems that enhance inclusion and accessibility, but also systems that complement the outdoor based-positioning systems (Samama, 2019). Both of them relate to the ability to travel effectively, regardless of whether the travelers are blind, deaf, or physically impaired (Jacobson, 2013). However, information challenges often appear for people with disabilities (Escudeiro, et al., 2017).

The challenges they face are due to the lack of accessible information related to orientation and mobility. Orientation is seen as "the process of knowing where one is in space" and mobility is "the capacity or facility of movement" (Jacobson, 2013). This is important when navigating through complex environments, since access to information is often underestimated and mistreated in the case of blind individuals, jeopardizing both orientation and mobility. A person with vision constantly receives information when looking around. In contrast to the vast amount of wayfinding information that sighted people have access to, the blind often struggles when traveling (May & Casey, 2013). Thus, "way-finding challenges for individuals who are blind or visually impaired can be considered problems of information access" (May & Casey, 2013).

To overcome these problems of information access, there is a need to develop assistive technologies, not only for blind people but also for deaf and foreign visitors, that often struggle to communicate and understand (Escudeiro, et al., 2017).

3. METHODOLOGY

The research for this paper was conducted using a mixed methods approach, including a literature review and case studies. The literature review was conducted using a variety of academic databases, to gather relevant articles, books, and reports on e-learning in higher education and academic environment. The Indoor Mapping application aims to enhance the inclusion and accessibility of all students, by supporting new orientation and mobility methods. The application methodology and the outcomes of the project will enhance and value inclusiveness and accessibility while improving the orientation, mobility, and navigation of all students. In the future, the aim of the project is to be extended to other indoor environments. The ISEP campus is just the starting point of a new venture in assistive technologies.

3.1 Concept

The overall goal of the project was to create an application that implements an Indoor Mapping method with different access points distributed by the ISEP campus. The signal is then captured by a geolocation technology – in this case, beacons – that activates a mobile application to provide information.

Geolocation is not a new concept and different companies use it in different ways. In this case, geolocation will be used to provide an easy and accessible virtual space for students, workers, members of the institution, and occasional visitors, to navigate the surroundings of ISEP. As such, the work developed focuses essentially on a navigational component – the ISEP map.

The map defines a specific set of directions and information that guide the user within a certain location or set of locations. Each building has a designation, geo-location, and internal data – classrooms, bathrooms, elevator locations, and all else. Combining all the data of each building, the user can experience accurate guidance between buildings, which even specifies alternatives for users with reduced mobility that require an elevator or wheelchair access.

As mentioned, there are numerous people out there that live with some kind of disability. This project pretends to raise awareness of the importance of orientation and mobility, which is often underestimated. Thus, this application, with geolocation features, has two different targets. On the one hand, the main target is

deaf, blind, and physically impaired people, but also Erasmus students and incoming students. All of them often struggle to find assistance and communicate.

The objective is to provide all people with audio, text, and visual guide assistance, that allows everyone to move from one point to another inside ISEP. Similar to the GPS, the application provides a numerous of information, indicating the more suitable path.

The technology used to geolocate the users were beacons. A Bluetooth beacon is a small wireless device that works based on Bluetooth Low Energy, that repeatedly transmits a constant signal that other equipment can find. It broadcasts a radio signal, that a Bluetooth-equipped device like a smartphone can identify once it is in its range. Based on precise positioning technology, it allows to geolocate the user in an indoor environment.

3.2 Objectives

The ISEP Indoor Mapping application was developed to offer assistance and self-sufficiency to all its users. Whether they are incoming students, Erasmus students, visitors, or students with disabilities, the application provides several wayfinding information similar to signage. However, in this case, the information is presented according to the user's needs: it shows wheelchair and elevator access, the more suitable path and the shortest one too, and it does so by using an audio, text, or signage guide to ensure everyone is included in the use of this technology. Thus, the objectives of the project are:

- The creation of an assistive tool that provides orientation and mobility assistance;
- The inclusion of a map of the ISEP campus, that offers information about every building;
- The development of a guide in the form of audio, text, or signage;
- Raising awareness for orientation and mobility challenges;
- Raising awareness for the lack of inclusion and accessibility of disabled students;
- To create an accurate and detailed map of the ISEP campus, including all buildings and floors;
- To provide a user-friendly interface that allows users to easily navigate the ISEP campus, search for specific locations and points of interest, and view real-time information such as room availability and event schedules;
- To integrate the indoor mapping application with other campus systems, such as the room reservation system and the events calendar, to provide real-time updates and improve efficiency;
- To provide accessibility features, such as voice navigation and alternative text descriptions, to make the indoor mapping application used for all users, including those with disabilities;
- To gather usage data and feedback from users to continuously improve the indoor mapping application and ensure it meets the needs of the ISEP community;
- To explore the potential for the application to be extended to other campuses and institutions, to provide a scalable solution for indoor mapping;
- To provide a wayfinding solution for visitors, students, and staff to easily find their way around the campus and reach their desired location.

It's important to note that the objectives are specific, measurable, achievable, relevant, and time-bound (SMART), and they are aligned with the overall goal of the project. Also, the objectives match the project's main goal and the available resources.

4. IMPLEMENTATION

The ISEP InDoor Mapping application is an innovative solution that helps students, faculty, and visitors navigate the complex indoor spaces of the institute. This application is to be implemented to provide real-time indoor location and navigation services to the users, by using advanced technology such as indoor positioning systems, Wi-Fi, and Bluetooth beacons to determine the user's location accurately.

The implementation of the ISEP Indoor mapping application requires significant planning and resources. As such, assessing current accessibility and mobility needs of students, faculty and staff is the first step in implementing and developing accessibility and mobility solutions in higher education. This can be done through surveys, focus groups, and interviews.

Developing a comprehensive plan that addresses the identified needs, including specific goals, objectives, and strategies for achieving them, is the next step. This plan should include specific goals and objectives, as well as strategies for achieving them.

Providing training and education for all members of the higher education community on the importance of accessibility and mobility and how to create an inclusive environment is also of extreme importance for the success of the implementation of this application.

Implementing technology solutions such as assistive technology, captioning and transcription services, and mobile apps can also help increase accessibility and mobility for students, faculty, and staff with disabilities, as technology plays an important role in accessibility and mobility.

Continuous evaluation and improvement of the effectiveness of the accessibility and mobility solutions in place, and adjusting as needed, is important and can be done through ongoing surveys and focus groups.

Collaborating with external organizations such as local disability organizations and government agencies can provide valuable resources and expertise to support the implementation and development of accessibility and mobility solutions in higher education.

Ensuring that accessibility and mobility solutions comply with legal requirements is important as higher education institutions must comply with laws and regulations.

Budgeting for and securing funding for these initiatives is important as developing and implementing accessibility and mobility solutions can require significant financial resources.

5. CONCLUSION

The ISEP Indoor Mapping application is a powerful tool that is designed to improve the mobility and accessibility of the ISEP campus. The application provides detailed and accurate maps of all buildings and floors, including important accessibility features such as ramps, elevators, and accessible restrooms. The user-friendly interface makes it easy for users to navigate the campus, search for specific locations and points of interest, and view real-time information such as room availability and event schedules. Additionally, the integration with other campus systems, such as the room reservation system and events calendar, allows for real-time updates and improved efficiency.

Accessibility features, such as voice navigation, alternative text descriptions, and the ability to adjust font size and contrast, make the indoor mapping application used for all users, including those with disabilities. The ISEP Indoor Mapping application also gathers usage data and feedback from users with different abilities and disabilities to continuously improve the application and ensure that it meets the needs of the ISEP community.

The ISEP Indoor Mapping application has the potential to be extended to other campuses and institutions, providing a scalable solution for indoor mapping and accessibility. Additionally, the wayfinding solution provided by the application allows visitors, students, and staff to easily find their way around the campus and reach their desired location, regardless of their mobility needs.

Overall, the ISEP Indoor Mapping application is a valuable tool that can improve the mobility and accessibility of the ISEP campus, making it more inclusive and accessible for all members of the community.

Within the scope of orientation and mobility, it is possible to say that the ISEP Indoor Mapping application has been well succeeded in the accomplishment of its purpose. The application was designed to ensure inclusion and accessibility for every individual, namely students, staff, and visitors. The intention was to create such an application that allowed everyone to move through the surroundings of the ISEP campus with easiness and autonomy.

As such, the ISEP Indoor Mapping is a technology of great value for people with reduced mobility, hearing, or visual impairments, and even for Erasmus students who do not speak Portuguese and often struggle to communicate with the staff. Accomplishing the overall goal of the project is to raise awareness for orientation and mobility challenges and to create a more inclusive and accessible school environment.

6. FUTURE WORK

The ISEP Indoor Mapping application has the potential for further development and improvement in several areas. Some possible future work for this application includes, one, the incorporation of augmented reality

technology – the ISEP Indoor Mapping application could be enhanced by incorporating augmented reality technology to provide users with an interactive and immersive experience. This could include features such as 3D building models, virtual tours, and real-time navigation. Second, the integration with personal devices, such as smartphones, smartwatches, and fitness trackers to provide users with real-time location tracking and personalized navigation. Third, the integration of the application with public transportation schedules and routes to provide users with information on the best ways to reach the ISEP campus. Fourth, the development of an indoor navigation system that uses Bluetooth or Wi-Fi to help users navigate through the buildings and corridors of the ISEP campus. Fifth, the ISEP Indoor Mapping application could be customized to allow users to select their accessibility needs, such as wheelchair navigation or visual impairments, and then the application will provide personalized suggestions and recommendations. Sixth, the ISEP Indoor Mapping application could collect data on user behavior and preferences, such as frequently visited locations, to improve the overall user experience and make the application more efficient. Seventh, the application could be made available in multiple languages to accommodate international students and visitors. Last, the application could be continuously evaluated and tested with different user groups, including people with disabilities, to ensure that it meets the needs of all users and to identify areas for improvement.

By expanding this assistive technology to other markets, it is possible to expand its benefits to every individual that somehow suffers from a lack of accessible location and wayfinding information, and inclusion, due to orientation and mobility challenges.

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