



Civic engagement of HEI students in the co-creation of a Pan-European mapping app for socially inclusive HEI institutions and accessible European cities

PROJECT RESULT 3

MAP4ACCESSIBILITY MAPPING WEBSITE AND PROGRESSIVE WEB APP (PWA)

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DATE: 31/10/2024

Co-funded by the
Erasmus+ Programme
of the European Union



*Map4Accessibility funded by the European Commission within its Erasmus+ Programme, under KA-2 Cooperation for innovation and the exchange of good practices, Cooperation Partnership for Higher Education
Project Number: 2021-1-IT02-KA220-HED-000030320*

Document Information

Document title	
Document file name	PR3
Revision number	V7
Issued by	Associacao Salvador, UNITUS
Issue date	31/10/2024
Status	Final

Links with Project Results

Project Results	Describe links with Project Results
PR3 app	https://app.map4accessibility.eu/

Dissemination Level

PU	Public
PP	Restricted to the programme participants including the EC
CO	Confidential
CI	Classified

ACKNOWLEDGEMENT

This report forms part of the Project Results and additional work plan deliverables (as defined in appendix to the Consortium Agreement) from the “Map4Accessibility” project which has received funding from the European Union’s ERASMUS + programme under grant agreement n° 2021-1-IT02-KA220-HED-000030320. The Community is not responsible for any use that might be made of the content of this publication.

Map4Accessibility aims at the civic engagement of HEI students in the co-creation of a Pan-European mapping app for socially inclusive HEI institutions and accessible European cities (hereinafter referred to as “Project”).

Map4Accessibility develops a pan-European accessibility mapping app to provide information on the accessibility of public spaces across 4 European cities. The project employs service-learning to engage higher education students and other stakeholders in its community mapping practices. By combining community engagement and academic coursework, preparation and reflection both students and other stakeholders will learn through active engagement and work on a community-identified concern.

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INTRODUCTION

The Map4Accessibility project aims to foster civic engagement among HEI students in the co-creation of a Pan-European mapping app designed for socially inclusive HEI institutions and accessible European cities (hereinafter referred to as the *Map4Accessibility App*).

Currently, there is a significant gap at the European level in providing multilingual, open-source mapping tools tailored to the needs of people with disabilities. While some applications exist (see State of the Art in Digital Accessibility Mapping, Project Result 1), they have limitations such as restricted geographic coverage and language options, limited scope in reviewed elements, lack of adherence to universal design principles, and insufficient adaptation to support independent mobility. The Map4Accessibility App addresses these gaps by integrating:

- accessible information about locations and routes for individuals with disabilities;
- universal design principles;
- multilingual and open-source features, with scalability potential for other European cities.

The Map4Accessibility App provides accessibility information for public spaces in four European case study cities (Berlin, Catania, Blagoevgrad, and Lisbon). Its development benefited from a Service-Learning pedagogical approach, which engaged higher education students and other stakeholders in community mapping practices. Feedback—including suggestions and bug reports—collected during explorative and urban walks in the four case studies directly informed the app's development.

Additionally, the combination of community engagement, academic coursework, and reflection enabled both students and stakeholders to actively address urban accessibility concerns while learning through hands-on experience.

The Map4Accessibility App incorporates several innovative elements:

- **Grounding in the Portuguese app +Acesso para Todos:** Built on an existing app developed by Associação Salvador.
- **Universal Design Principles:** Prioritizes both digital and physical accessibility to provide an inclusive user experience.
- **Open Source:** Designed for modification and expansion across diverse geographic and cultural contexts.
- **Participatory Co-Creation:** Engages students, specialists, and citizens in a collaborative process to ensure the app addresses real-world needs.
- **Crowdsourcing:** Mobilizes community participation to achieve goals. By gathering information from users, the app enhances problem-solving and accessibility service improvements.

To summarize, the Map4Accessibility App is multilingual, supporting English, German, Italian, French, Portuguese, and Bulgarian. It features an innovative routing application that integrates crowdsourcing to improve navigation for individuals with disabilities and to evaluate accessibility. Users can rate locations based on their experiences, generating an ad-hoc accessibility score for each location, ensuring up-to-date and reliable information. Additionally, the app offers an intuitive interface designed for ease of use, enhancing the overall user experience and simplifying navigation. It also employs a customized algorithm to predict and validate accessibility data, enabling real-time, automated updates for continuous improvement. The app's flexible, open-source design allows for the integration of additional features as budgets permit and new needs emerge.

This Project Result 3 report provides a detailed overview of the Map4Accessibility App, including its general design, features, and installation guide.

GENERAL APP DESIGN

Map4Accessibility App is designed to address the need for accessible navigation solutions for individuals with different disabilities. By leveraging modern smartphone technology, this application provides optimized routes tailored to the specific needs of users with motor, visual, hearing, and cognitive impairments. The application operates a client-server model. Users can connect from various devices (PCs, smartphones, tablets) to a server hosting the frontend and backend components, accessed via HTTPS. The front end uses Progressive Web App technology for seamless operation across multiple platforms. The back-end, built with PHP and the Laravel framework, handles data processing through RESTful APIs and uses a MySQL database. Users must register, with options for OAuth2 or personal email registration, to access the services. Location services must be enabled for accurate routing, and an internet connection is required as the application is entirely online. The system supports concurrent processing for authentication, profile management, and Google Maps API integration, ensuring a smooth user experience. During the development of each component of Map4Accessibility App, significant attention was paid to feedback from various user categories. This information guided an iterative design process, ensuring the application is user-friendly and highly customizable. Users can choose how information is presented with respect to the needs of different categories of user disabilities.

Other Map4Accessibility App characteristics

- Cutting-edge technologies to deliver a robust, user-friendly, and scalable solution:
- Frontend: React in the PWA
- Ensures high performance, fast rendering, and seamless usability across devices.
- Reusable components streamline development and updates.
- Offline capabilities enhance user experience, even in low-connectivity areas.
- Backend: Laravel for the Backoffice
- A secure and efficient framework supporting data management and administrative functionalities.
- Facilitates rapid feature development with its robust MVC structure.
- APIs ensure smooth communication between the frontend and backend.

The following sections detail the App features, namely: the Crowdsourcing-based Accessibility Rating System, the Navigation System and the Interface of the Map4Accessibility App.

The app is open-source, and the code is available in the GitHub repository:

<https://github.com/PipeCodes/map4accessibility-pwa>

<https://github.com/PipeCodes/map4accessibility-backend>

CROWDSOURCING-BASED RATING SYSTEM

A fundamental feature of the Map4Accessibility App is its system for rating the accessibility of places. The Map4Accessibility App leverages a crowdsourced rating system to provide up-to-date and reliable accessibility information. This system enables users to report barriers and obstacles at their destinations or along their routes. These reports are communicated to the routing algorithm, which alerts the user and suggests alternative paths. The rating system is based on crowdsourcing, allowing users to evaluate the accessibility of any location. The advantages of this approach are twofold. First, it increases the amount and speed of information updates about the accessibility of various city locations, thanks to the participation of numerous users who can report issues in real-time. Second, it fully engages the community in the accessibility mapping process, fostering a sense of responsibility and empathy toward people with different impairments. Users can rate both existing points of interest on the map and newly added places at any time. This enables the reporting of new accessibility issues in real time. The accessibility rating includes three options: accessible, partially accessible, and not accessible. Each rating is assigned a label corresponding to a specific impairment, such as visual or motor impairments, to reflect the varied accessibility needs accurately. An ad-hoc algorithm has been implemented and fine-tuned based on user feedback to determine the final accessibility rating of a location. This algorithm assigns importance to recent ratings, reflecting the current situation of the place while also considering past ratings to avoid subjectivity and errors. The accessibility scores are converted into a numerical scale, where “accessible” is assigned 2 points, “partially accessible” is assigned 1 point, and “not accessible” is assigned 0 points. The initial score initializes the algorithm, and subsequent scores update the final rating by incorporating a weighted average emphasizing recent ratings. This approach ensures that the latest information significantly impacts the overall rating while maintaining a balance with historical data. It uses an algorithm that prioritizes recent data, and the system offers a robust solution for identifying and navigating accessible routes for individuals with different impairments.

NAVIGATION SYSTEM

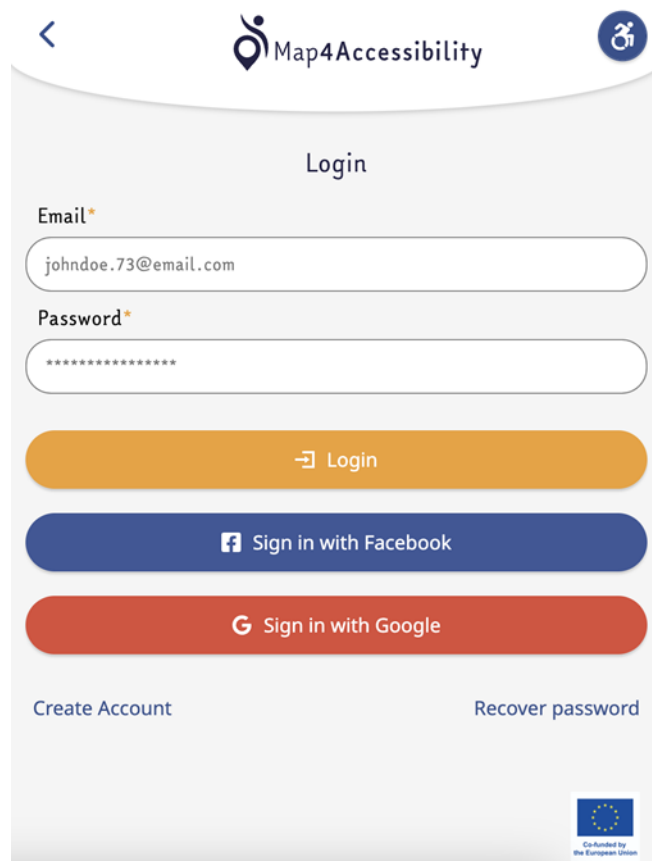
The Map4Accessibility App uses the navigation system of Google Maps that is essentially based on two Graph algorithms — Dijkstra’s algorithm and A* algorithm, to calculate the shortest distance from point A (Source) to point B (destination). This heuristic-based approach makes the algorithm particularly effective for real-time navigation and accessibility mapping, ensuring minimal-cost routes. In Map4Accessibility App, the A* algorithm incorporates a heuristic that considers different disability categories. This customization ensures that the generated routes display all obstacles and accessibility evaluations on the defined path related to the individual needs of users. Thus, the user can choose the best route for his special needs and be supported during the navigation by the traditional Google Map interface.

INCLUSIVE AND USER-FRIENDLY INTERFACE

Upon opening Map4Accessibility, users are welcomed by a landing page featuring five intuitive components designed to enhance accessibility: 1) Profile Component, 2) Search Area Map, 3) Routing Map, 4) Home Component, and 5) Accessibility Component.

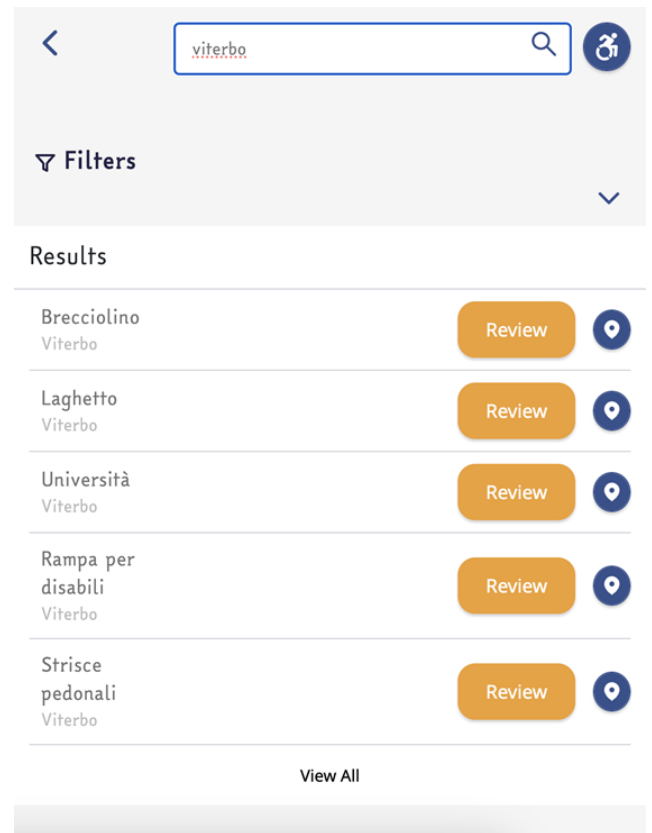
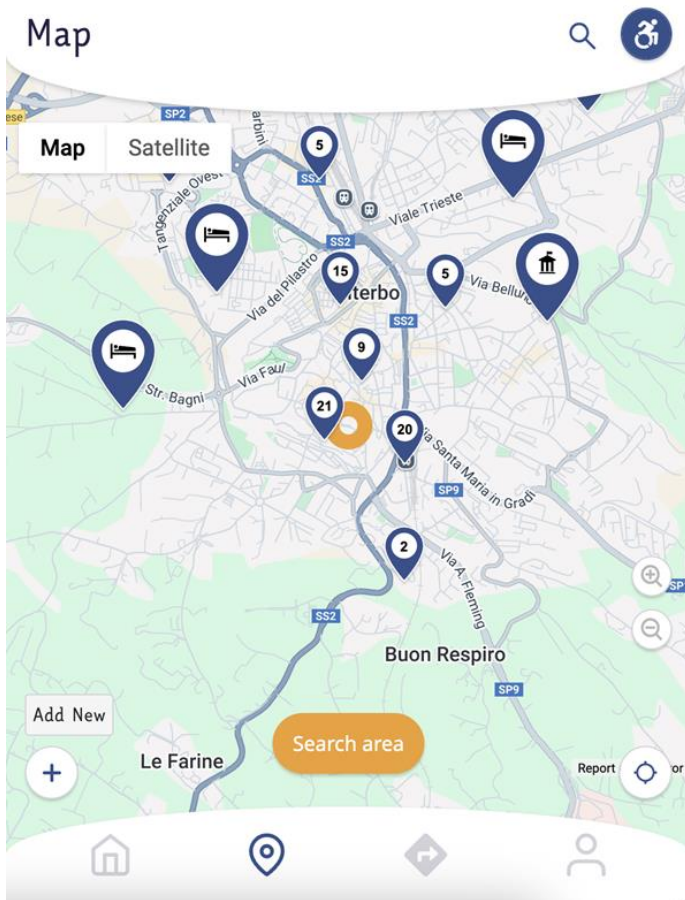
1. Profile Component

Upon launching the application, users are prompted to either create a new account or log in to an existing one. They can quickly create an account by entering their personal information or signing in using their email or Facebook credentials. Users can also specify details such as their disability type and preferences. This streamlined process ensures quick and easy access to the application's features, allowing users to start using it immediately.



2. Search Area Map

After signing in or logging in, users can input their destination, prompting the application to use GPS and sensor data to pinpoint their current location. They can view their current location, search for points of interest, and add or rate obstacles. The map interface is user-friendly, offering both a simplified default view and a satellite view, with seamless switching between modes. Users can zoom in and out effortlessly, ensuring straightforward navigation tailored to various disabilities. A simplified search bar in the upper right corner enables quick searches for points of interest. Additionally, users can filter locations by type and disability rating, with recommended places highlighted accordingly. A visible plus button on the lower left allows users to add obstacles or facilities, including details like name, obstacle type, and accessibility rating. New elements can be added by: a) using the search bar, b) visually identifying the location on the map, c) leveraging the current GPS position, or d) entering specific latitude and longitude coordinates. Users can also rate points of interest (via Google API), such as museums, schools, or parks, contributing to a comprehensive understanding of their accessibility, both inside and outside, from diverse disability perspectives.



The evaluation of accessibility

In the Map4Accessibility App, users can search for specific areas and select a place they want to rate. The rating options include “accessible,” “partially accessible,” and “not accessible.” Users can also specify the type of disability for which they are rating accessibility, such as mobility, visual, hearing, or cognitive impairments. The app features an intuitive rating interface (e.g., a green thumbs-up for accessible and a red thumbs-down for not accessible). Users first select the location they wish to rate from the map or a list of nearby places. Once a location is selected, they choose the appropriate accessibility category based on different types of disabilities. After selecting the category, users can provide additional comments or report specific obstacles encountered. Once the rating is submitted, the app updates the accessibility status of the location in real time. This information becomes available to other users, who can view ratings and comments while searching for accessible places. The app aggregates individual ratings to generate an overall accessibility score for each location, helping users identify places that meet their specific accessibility needs. Additionally, for each Google-listed place, users are prompted with mandatory and optional questions to provide detailed accessibility information for others.

Mandatory Questions

The core questions that users answer while rating a location are:

1. Entry without obstacles?
2. Internal circulation without impediments?
3. Adapted bathroom availability?
4. Supporting customer service?
5. Possibility of independent experience?
6. Accessible furniture?
7. Reserved parking?
8. Accessible outdoor space?
9. Transport adapted to the place?

Optional Questions:

How accessible is the entry? Is the entrance wide enough to accommodate a wheelchair or mobility device? Is there a ramp, elevator or other accessibility available for accessing the building or outdoor space? Are there any

The screenshot shows the 'Comment' screen in the Map4Accessibility App. At the top, there is a back arrow and the word 'Comment' in a blue header. Below the header is a photo of a McDonald's restaurant with a yellow archway. The location name 'McDonald's Viterbo San Paolo' and the address 'Viterbo' are displayed. The main question is 'How would you rate this place?'. There are three rating options: 'Accessible' (green thumbs-up icon), 'Partially Accessible' (yellow thumbs-down icon), and 'Not Accessible' (red thumbs-down icon). Below the rating options is a section titled 'Is this place accessible to people with: (mandatory)'. There are five radio button options: 'No disability', 'Physical disability', 'Visual impairment', 'Hearing impairment', and 'Learning disability'. The 'No disability' option is selected. Below this is a 'Comment' field with a text input area. At the bottom, there is a section for 'Mandatory Questions'. The first question is '1. Internal circulation without impediments?'. There are three radio button options: 'Yes', 'No', and 'n/a'. The 'Yes' option is selected.

steps or other obstacles at the entrance? Is the entrance fully prepared for my disability? Is the door accessible?

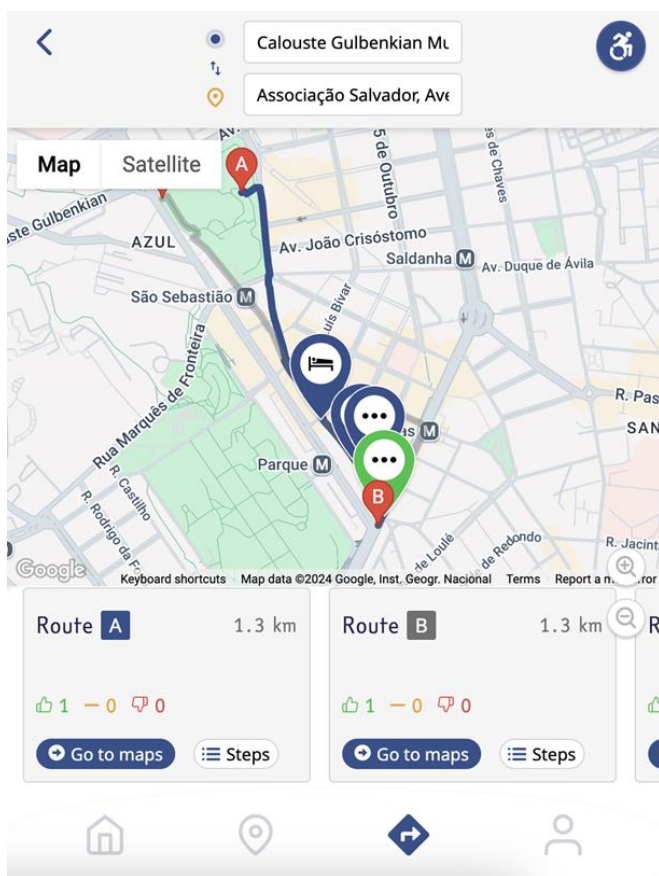
How accessible is the Internal circulation? Are the aisles and pathways wide enough for a wheelchair or mobility device? Are there any obstacles (such as furniture or fixtures) that would impede circulation? Are there any changes in floor level that could pose a challenge for someone with mobility issues? Is the inside fully prepared for my disability? Are there accessible doors?

How accessible is the Service? Are the staff trained in assisting people with disabilities? Did you like the service? Was adequate? Is it possible to carry out a purchase/experience independently? Are there any services (such as information or assistance) available specifically for people with disabilities?

Is reserved parking present? Are there any obstacles (such as curbs or other vehicles) that could impede access to the accessible parking spaces? May I go out of the car with autonomy? Is the space around the parking accessible? How accessible is the outdoor space? Are the sidewalks and other outdoor spaces accessible?

3. Routing Map

This feature enables users to find accessible routes by entering their start and end locations. The interface displays multiple route options tailored to the user's pre-specified disability and preferences from the Profile component. This customization ensures that the suggested routes meet their specific needs by highlighting obstacles, facilities, and accessibility evaluations along the way. After evaluating the proposed routes, users can view step-by-step directions or switch to the Google Navigation System for real-time guidance, including audio suggestions, to support them during their journey.



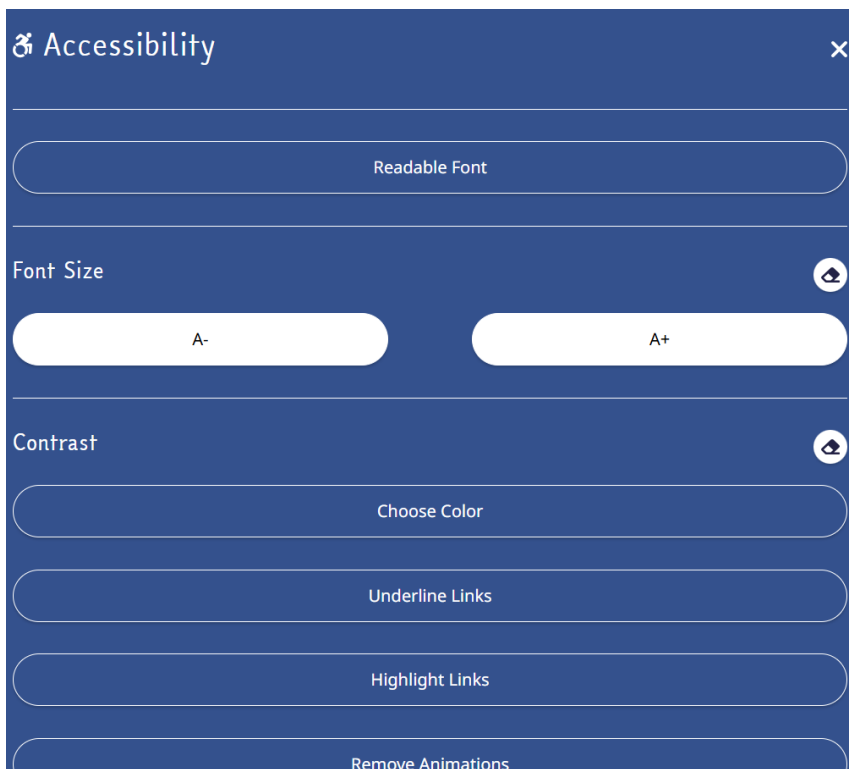
4. Home Component

This component summarizes the user's history, including last visited places, rated places, and added obstacles.



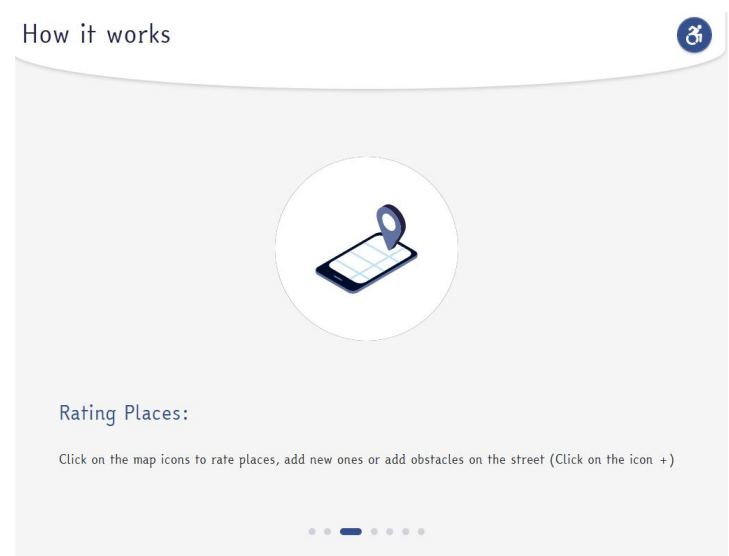
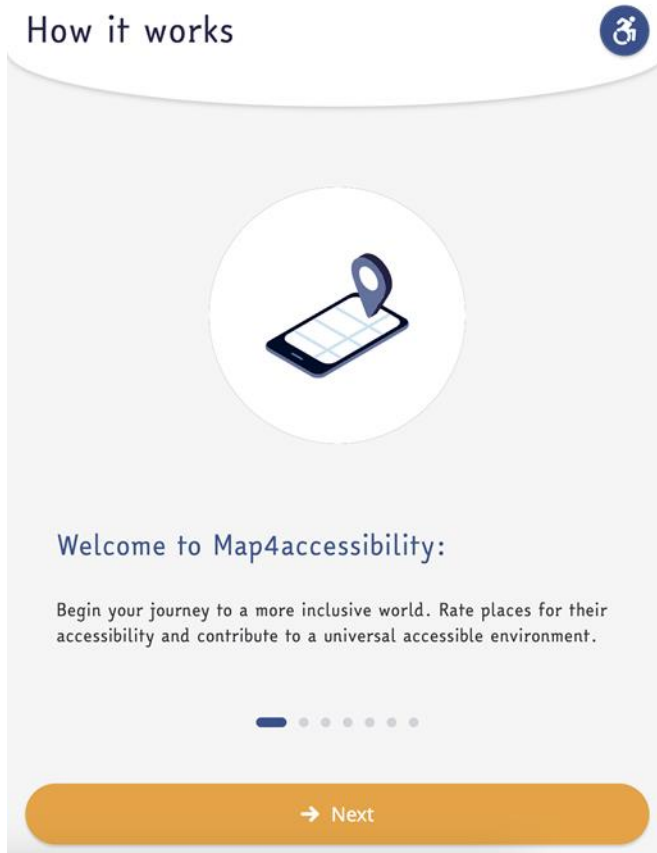
5. Accessibility Component

Accessible via the top right of the page, this component allows users to customize the application to their liking by adjusting text font (i.e., EasyReading font dyslexia friendly), font size, contrast, and colour. These options enhance accessibility and user-friendliness.



USER SUPPORT AND APP EVALUATION FORM

The first time a user opens the app, a brief introduction is displayed in sequential steps. This short sequence of images and descriptions is designed to explain the app's main functionalities and features.



Additionally, an app assessment form will appear after each accessibility evaluation to gather user suggestions and feedback. Users can complete the Google form only once. This feature is designed to provide developers with insights based on real-world app usage across various contexts, devices, and users with different disabilities. This user-centered approach supports the continued development and improvement of the app.

Why Choose this App?

- Device and Screen Compatibility: Fully responsive, designed for both desktop and mobile devices.
- No App Store Approvals Required: Accessible without the need for app store distribution.
- Open Source: Fully customizable and adaptable to user needs.
- Progressive Web App (PWA): Combines the best of web and mobile app experiences.

Key Features

Simple Login and Registration

- Easy access via email, Facebook, or Google accounts.
- Intuitive tutorial screens to onboard new users.

Explore

- What's Around You
- Integration with Google Maps to find locations such as restaurants, museums, and other points of interest.
- User-reported pins highlighting accessible features like crosswalks, ramps, or stairs.

Search and Navigation

- Search for places with detailed evaluations and accessibility challenges.
- Plan routes and quickly evaluate accessibility features.

Location Evaluation

- Contribute by evaluating locations and sharing accessibility information.
- Mandatory and optional questions tailored to disability types.
- Data contributes to improving the algorithm and user experience.

Route Planning

- Use detailed search options and integration with Google Maps.
- Select the best route and navigate confidently.



Android and iOS systems

Go to <https://map4accessibility.eu/> in your web browser's mobile device and click on download app

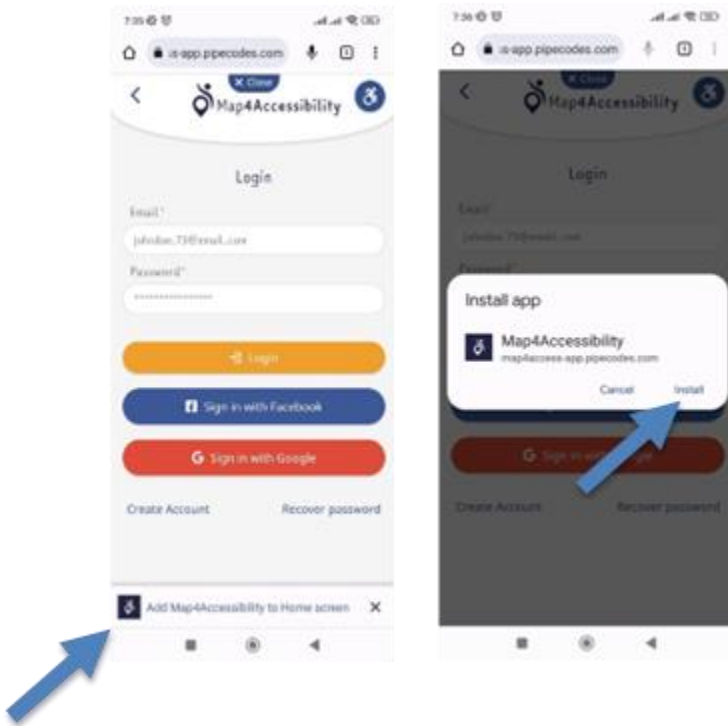
Or scan the QR code below



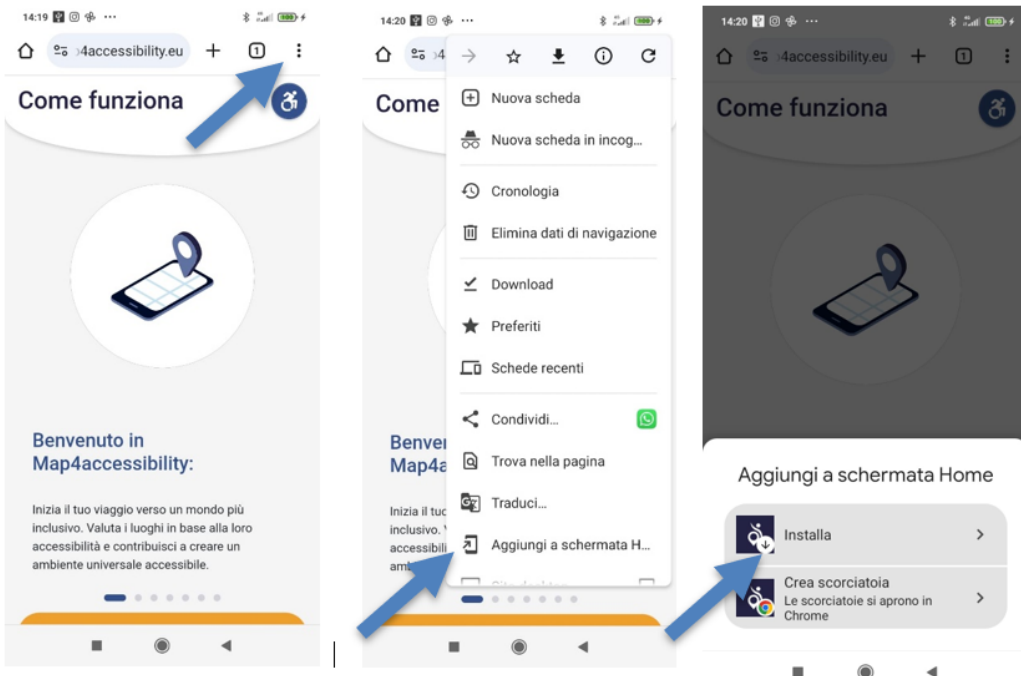
ANDROID

Depending on the android version, we have two options for installing the Map4Accessibility App.

Option A- Wait a moment, and if the prompt “Add Map4Accessibility to Home screen” appears at the bottom of the screen, tap on it to install

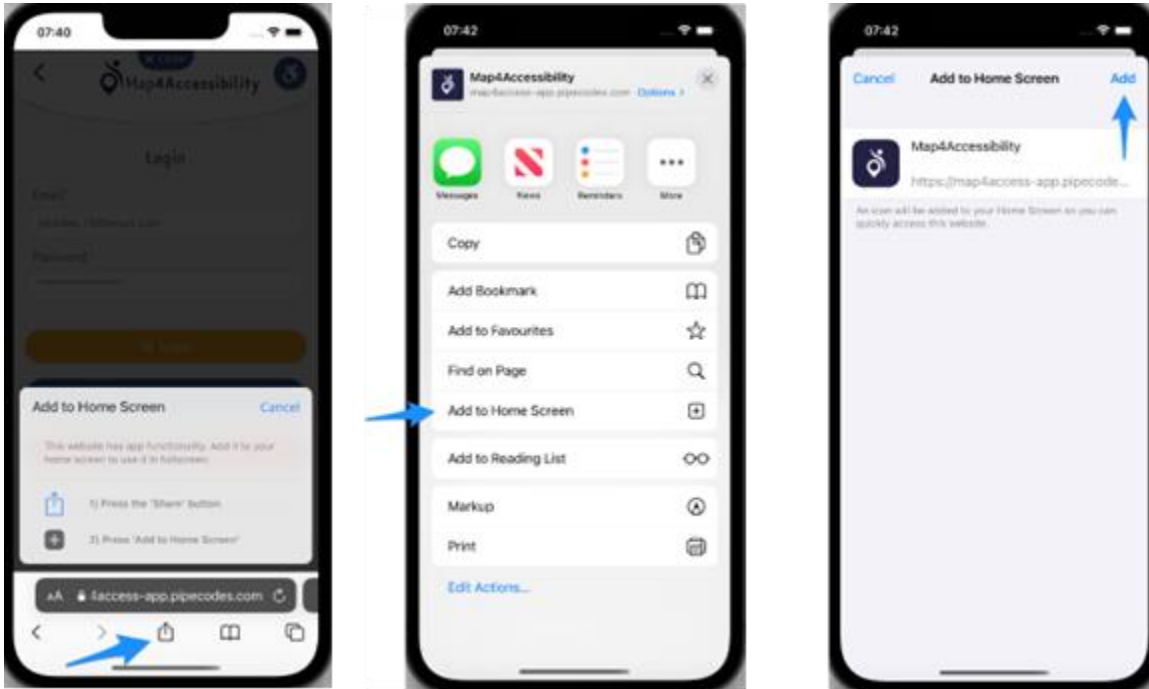


Option B - Alternatively, if the prompt “Add Map4Accessibility to Home screen” doesn’t appear, try the following installation procedure: tap the upper right corner of the screen and install the app.



IOS

You will see a prompt. Tap the Share button, then select **Add to Home Screen**.



The app is installed and added to your home screen. Tap the icon and enjoy the app! 😊



CONCLUSION

The Map4Accessibility App exemplifies how technological innovation can be harnessed to create inclusive solutions that address the unique challenges faced by individuals with disabilities. By combining sensor technologies and inclusive design, this application offers a reliable and efficient tool for accessible navigation. The user ratings provide valuable validation of the system's efficacy and potential to enhance inclusivity, contributing to a more accessible and equitable society.

With its focus on real-world feedback and adaptability, the Map4Accessibility App is poised to play a crucial role in improving the daily experiences of individuals with disabilities, empowering them to navigate their environments with confidence. As technology continues to evolve, we remain committed to enhancing the app's features and expanding its reach to support even more users.

The app is available for free download from the website: <https://map4accessibility.eu/>.