# Artificial intelligence in support of accessibility: analysis of existing technologies and the brain-friend

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## 1. Introduction

Today, we live in a context where accessibility and inclusivity are key issues in the socio-technological landscape, ensuring equal access to information and resources is essential to allow each individual to fully participate in society and enjoy their rights. This concept not only concerns the removal of physical barriers, but also of digital and cognitive barriers, where people with visual impairments may have difficulty accessing unstructured online content for reading via screen readers, while those with hearing impairments may encounter obstacles with multimedia content without subtitles or transcripts, just as inclusiveness is not limited to physical disabilities, but also includes cultural, linguistic and cognitive differences. In this context, generative artificial intelligence offers tools and techniques to improve accessibility and promote inclusivity, thanks to its capacity for machine learning and adaptation to individual needs, providing highly personalised solutions, understanding and interpreting a wide range of data, including text, images and sound, and adapting the way information is presented according to users' preferences and needs [1].

Scope of this paper is to present an application case study characterised by an accessibility system and related 'brain-friend' device, an expert system that is able to determine the accessibility profile of a user considering a series of parameters with the aim of generating the content requested by the user in the context of the accessibility profile of the user detected, and also a device for the interaction with the user and the use of content according to the accessibility profile determined by the system. Brain-friend represents an important tool for accessibility for digital cultural heritage applications. This paper shows also new possible approaches of the use of "brain-friend" to implement "custobot" experiences and also "human firewall" applications.

## 2. Brain friend

In a socio-technological landscape where accessibility and inclusiveness are increasingly important, ensuring that information and resources are accessible to all is crucial. Fair and non-discriminatory access to information is essential for enabling every individual, regardless of their abilities or limitations, to fully participate in society and exercise their rights. Numerous solutions are currently available to enhance accessibility, ranging from traditional assistive technologies to cutting-edge applications of artificial intelligence (AI). AI, in particular, holds the potential to revolutionize accessibility by offering personalized and dynamic solutions tailored to the specific needs of each individual [2].

Accessibility is not only about removing physical barriers; it also involves eliminating digital

and cognitive obstacles. For instance, individuals with visual impairments may struggle to access online content that is not properly structured for screen readers, while those with hearing impairments may find it difficult to engage with multimedia content that lacks subtitles or transcripts. Inclusivity, on the other hand, extends beyond physical disabilities to encompass cultural, linguistic, and cognitive differences. Everyone deserves the right to access information and actively participate in society, regardless of their diversity.

Artificial intelligence offers a wide array of tools and techniques that can be leveraged to improve accessibility and promote inclusiveness. With the ability to learn and adapt to individual needs, AI-based systems can deliver highly customized solutions that enhance access to information and services. These systems can process and interpret various types of data, including text, images, and sound, and adjust the presentation of information according to the user's preferences and requirements. This is the context for the system under study, which utilizes artificial intelligence in the form of an expert system to determine a user's accessibility profile. The system considers various parameters collected in a semantic knowledge base, such as age, cultural background, visual, hearing, and cognitive disabilities, as well as other specific individual needs. It also includes a crowd computing module designed to create a collaborative AI model that adapts to the linguistic and terminological profile of the identified user.

Additionally, the system features an AI module that analyzes and interprets textual and multimedia content, along with another AI module that regenerates the analyzed content in a manner that is accessible to the determined user profile. The system can be integrated via API calls into browsers and applications, enabling users to access and comprehend online content according to their specific accessibility needs. Additionally, the system includes an electronic "Brainfriend" device, designed to interact with users and deliver content in alignment with the accessibility profile determined by the system.

This device is equipped with an AI module for interpreting information acquired through a microphone, creating an information model based on what has been learned, and another AI module that provides answers to user queries (e.g., information about a person, a story, or an ongoing encounter). Currently, there are no existing accessibility systems that offer the innovative and personalized solutions required to fully enable every individual to access and participate in the digital world and everyday life.

Within this context, the Brainfriend represents a groundbreaking system for accessibility through content interpretation. It features a software module with a user interface that allows for the definition of an accessibility profile (such as age, cultural background, visual impairments, hearing impairments, learning disabilities, or phobias) and a crowd computing module for the creation of a collaborative AI model tailored to the user's terminology and language style. This system regenerates and interprets acquired content, making it accessible according to the user's profile. Integrated into browsers or applications, it allows for the interpretation of web pages, sites, blogs, and news articles, ensuring that content is understandable according to the user's accessibility profile. Moreover, the system can be implemented through an electronic interface (device) that aids in the accessibility of information and decision-making in daily life [3].

This device assists users in gathering and interpreting information, providing clear answers to their questions (e.g., about a person, a story, or an ongoing encounter). The Brainfriend device guides users in creating their own personalized model, delivering comprehensible responses based on their accessibility profile. In the realm of cultural heritage, Brainfriend is an innovative AI-based system that conveys content to users in a language suited to their accessibility needs [4]. By leveraging generative AI, it becomes possible to enhance content enjoyment based on age (child/adult) and cultural background. Brainfriend is particularly effective in facilitating the understanding of journalistic, scientific, and digital heritage content. For example, each artwork is narrated in an accessible and personalized manner [5].

With Brainfriend, users can also discover information about the artist, historical context, discovery details, and other curiosities through a personalized and accessible interface. This module is also integrated into virtual reality content consumption scenarios and the "Realverso", the metaverse of sustainability [6].

## 3. User analysis on the potential of the Brainfriend

To assess the potential market impact and the response to user needs for Brainfriend, a questionnaire was administered to a convenience sample of 51 users. These participants were distributed across different age groups and were employees of private companies in Italy. All were familiar with generative artificial intelligence and had used it at least once. The survey revealed that 88.2% of respondents perceive a significant level of social marginalization related to cultural levels in their area.

Furthermore, 88.2% of respondents indicated that journalistic information is often incomprehensible to users, regardless of their cultural background, and 94.1% found institutional information similarly difficult to understand. According to the respondents, a "Brainfriend" module capable of interpreting web content according to the user's profile (82.4%), or an electronic device that can listen to people's daily experiences to help them remember events, information, and improve their lives, would be highly useful.

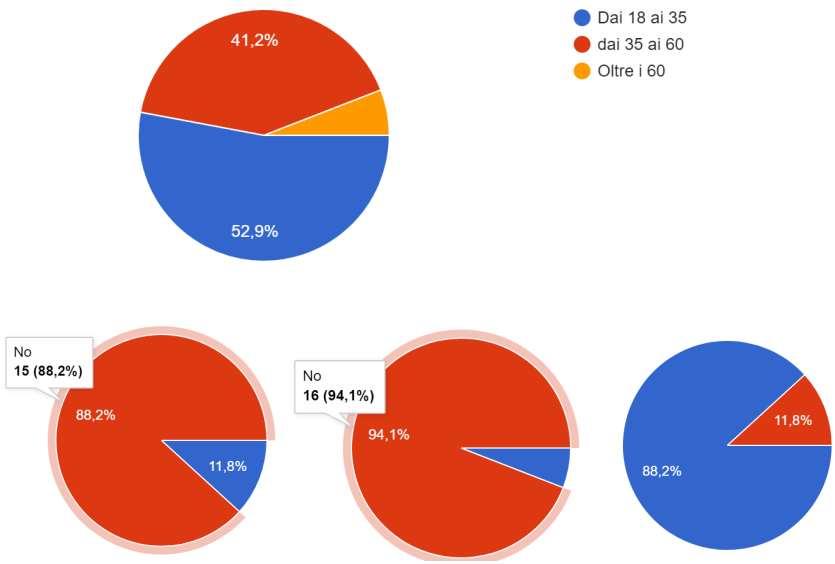


Figure 1 – Results of surveys

"Brainfriend" operates on a key principle: the customization of content according to the user's needs and level of preparation. We simulated, through different user scenarios, how AI-generated content could be tailored to various target audiences.

Three users are highlighted to illustrate how this personalization process might unfold:

Patrick, born in 2012, is a teenager and represents a novice user. The system is designed to provide Patrick with content that is accessible and easy to understand, considering his young age and initial level of competence.

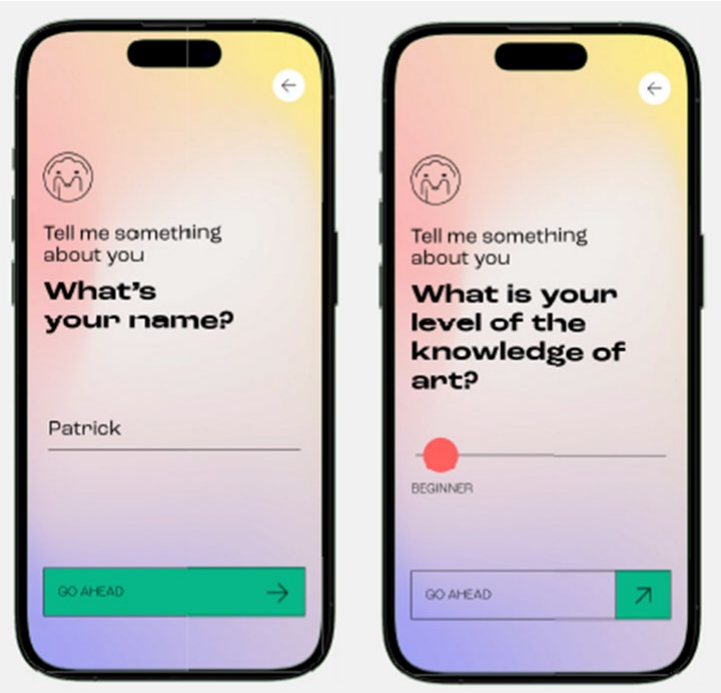

Figure 2 – Patrick

Nicole, born in 1988, is identified as an intermediate user. This suggests that Nicole has some familiarity with the content or system in question but is not yet an expert. For her, the "Brainfriend" system could present content that is slightly more complex than what is provided to Patrick, offering challenges that stimulate her growth and learning without being too difficult to manage.

Figure 3 – Nicole

Olivia, born in 1969, describes herself as an expert. This implies that she has extensive experience and in-depth knowledge in the area of interest covered by the system. For Olivia, "Brainfriend" should generate advanced content that allows her to explore complex topics, catering to her need

for a sophisticated and stimulating learning experience.


Figure 4 – Olivia

As highlighted above, "Brainfriend" is an ambitious project aimed at creating a deeply personalized user experience through the use of artificial intelligence, tailoring content not only to the user's level of expertise but also to their specific needs.

## 4. Application developments and market analysis

Today, Brainfriend represents a crucial tool for improving accessibility, particularly in the context of the new shopping experience. The web of the future must cater not only to users in terms of accessibility but also to AI bots, enabling them to perform actions automatically (e.g., making a purchase).

For example, a user could request to buy a T-shirt with specific style preferences, size, and budget constraints. An electronic payment tool could then authorize a “custobot” to carry out the search and potentially complete the purchase on the user’s behalf.

To introduce these capabilities, it is essential to rethink web page development, especially in e-commerce, with a focus on AI integration. This approach allows users to delegate tasks, such as searching for and purchasing items, to their "Brainfriend" simply through voice commands.

The challenge now lies in establishing new standards for web development that are sustainable and inclusive for users while also being accessible and interpretable to AI bots [7]. Interfacing with tools like Brainfriend would significantly enhance the accessibility of various services for any user group. Additionally, in a world increasingly plagued by online threats, Brainfriend can serve as a key component of the “human firewall,” helping users prevent social engineering attacks that exploit the powerful tools of generative AI.

For instance, it can assess the safety, reliability, and validity of an online offer or sale (e.g., fair pricing, potential health or environmental issues detected through web sources). Thus, AI can be humanity’s first ally in preventing social engineering attacks carried out using advanced digital techniques.

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