

Assistive Technologies for the Deaf: A Study of the Search for Indexed Patents at the Brazilian National Institute of Industrial Property

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This article presents a patent search study of 'Assistive Technologies for Deaf People.' The aim is to investigate patented technologies in Brazil, deposited with the National Institute of Industrial Property, to identify the tools developed for deaf people and to identify market opportunities for the advancement and development of new technologies that benefit the information and communication of deaf people. The methodological approach is a systematic review followed by a prospective study. Nineteen documents with extensive coverage deposited in the INPI's patent database were selected. Finally, the prospection showed a significant indication of assistive technologies, the vast majority of which favor the communication of deaf people, prioritizing Sign Language, thus ensuring linguistic accessibility, autonomy, and social inclusion.

Keywords. Patents. Assistive Technology. Communication. Deaf. Social Inclusion.

Introduction

In contemporary society, technology and its advances have enabled humanity's quality of life, influencing the ways of living in society in various social spaces, whether at home, at school, at work, or church, among other areas. In this sense, technological innovations have a premise to develop and/or expand ideas to meet demands, whether of products or processes, so the importance of producing new technologies that meet new demands is essential.

The Brazilian Inclusion Law - LBI (2015) [1] corroborates what is defined in the Convention on the Rights of Persons with Disabilities of the United Nations - UN (2007) [2]. Article 2 of Law 13.146, of July 6, 2015, presents the concept of a person with a disability with long-term impairment of a physical, mental, intellectual, or sensory nature. The law above refers to several instruments that aim to guarantee the rights of people with disabilities so that they are enforced and respected.

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Also, in article 3 in III, the section of the BII, assistive technology is defined as: "products, equipment, devices, resources, methodologies, strategies, practices and services which aim at promoting the functionality and participation of the person with a disability, aiming at his/her autonomy, independence, quality of life and social inclusion". According to the Technical Help Committee – CAT, from the Republic's Human Rights Secretariat, assistive technology consists of an area of knowledge of interdisciplinary characteristics, which encompasses products, resources, methodologies, strategies, practices, and services that aim at promoting the functionality, related to the activity and participation, of people with disabilities, aiming at their autonomy, independence, quality of life and social inclusion. Thus, the legal devices, through public policies, aim to ensure rights. Because of the above, it is essential to emphasize the need to develop technologies that help the autonomous lives of people with disabilities. In this study, hearing impairment/deafness was prioritized to weave a dialog about the assistive technologies explicitly developed for Deaf people, using a search for patents indexed at the National Institute of Industrial Property – INPI.

According to Marchesi (1996) [3], deafness is, therefore, characterized by a greater or lesser loss of normal perception of sounds, and there

are several categories of hearing impairment, generally classified according to the degree of hearing loss. In contemporary times, the term hearing impaired is used in the clinical/medical environment. Thus, a person with a hearing deficit cannot acquire the oral/auditory language. However, the word Deaf is used by the deaf community, whose goal is to base the construction of a linguistic and cultural identity anchored in the Brazilian Sign Language - Libras, recognized and regulated by laws and federal decree. According to Skliar (1999) [4], sign language cancels the disability and allows deaf people to constitute a different minority language community, not a deviation from "normality". Thus, to think of deafness as a linguistic difference, not as a pathology and not as a disability that attributes to the Deaf person a condition of inferiority for being users of a language of gestural mode.

Thus, the main objective of this study is to prospect patents filed with the INPI and thus identify assistive technologies developed for deaf people as accessible tools for communication and identify market opportunities for the advancement and development of new technologies that benefit information and communication for deaf people.

Assistive Technology for the Deaf

According to research by the Brazilian Institute of Geography and Statistics - IBGE (2019) [5], it is estimated that 5% of the Brazilian population comprises deaf people. Around 10 million citizens, of which 2.7 million have profound deafness. Thus, it is necessary to understand that assistive technology is a powerful tool that enables accessibility for the Deaf, including them autonomously. Therefore, it is significant to highlight those assistive technologies for the Deaf as a principle to ensure equity, thus promoting communicative, educational, and social accessibility, which ensures their participation in a society mainly composed of hearing people. In this sense, the technologies aimed at Deaf people are essential tools that can create several

spaces for interaction, teaching, and learning, providing autonomy and making information and communication accessible to everyone in the democratic process of contemporary society. Nowadays, with the inventiveness of the Internet, as well as technological advances and innovation, information arrives more and more quickly to people through the use of several tools that provide information, communication, and learning. These technical resources are intended to promote the accessibility of people with disabilities, which aims to provide conditions for using social spaces, various services, media, and education.

Materials and Methods

A systematic exploratory literature review was carried out to broaden knowledge on the subject. A qualitative approach was used, followed by a descriptive prospective study of technological solutions that offer accessibility to deaf people. A survey was carried out of patent application processes on the National Institute of Industrial Property (INPI) platform, indexed nationwide from 2000 to 2023 [6]. The period chosen is justified by the "Accessibility Law" enacted by Law 10.098 on December 19, 2000 [7]. The National Institute of Industrial Property is a government body that works with patent and trademark registration. It is a federal autarchy linked to the Ministry of Economy, according to Decree No. 9660 of January 1, 2019. The INPI was chosen because its main objective is to enforce the rules regulating industrial property nationally. The INPI is a free platform for online access to the patent search and analysis system with information on patent applications filed in Brazil (INPI, 2023) [6].

The search strategy used was advanced search - Keyword, Title, and Abstract for the following descriptors in Portuguese - Assistive Technology, Deaf, Hearing Impairment, Deafness, and Technology. Data was collected in May 2023 (Table 1). The exclusion criteria were patents

Table 1. Search descriptors.

Palavra Língua Portuguesa	Tradução Inglês
Tecnologia Assistiva	Assistive Technology
Surdos	Deaf
Deficiência Auditiva	Hearing Impairment
Surdez	Deafness
Tecnologia	Technology

that did not focus on the research topic and those filed before the accessibility law.

Results and Discussion

Forty-one patent documents were found. After reading and analyzing the documents, nineteen were selected, focusing on the study of Assistive Technologies developed for deaf people found in the INPI database (2023) [6]. With the results obtained, a table was drawn up describing the names of the patents, a graph showing the annual evolution of patent filings over the years surveyed, and a table describing the institutions that safeguarded assistive technologies designed for deaf people, with the number of patents listed according to the name of those institutions. It is important to note that the research aimed to identify possible technologies that help deaf people communicate, be autonomous, and be socially included. Table 2 lists the names and titles of the patents applied for at the INPI between 2000 and 2023, in descending order. After reading the applications requested by developers of specific technologies for deaf people, it was possible to see the diversity of innovative projects aimed at helping these people in various social spaces in their daily lives.

The graph shows the annual evolution of patents filed between 2000 and 2023. Figure 1 shows the annual evolution of patent applications filed, correlated to the various technological areas, between 2000 and 2023. The number of patents registered remained the same from 2000 to 2007, with a pattern of growth in 2010, when

there was a more significant occurrence in the number of patent registrations with (04) filings. It was noted that from 2020 to November 2021, no number of patents were filed in the area researched in the INPI database. Thus, it is essential to note that there are also no records between December 2021 and May 2023. However, the reason why we did not see any new patents can be attributed to secrecy, which, according to the rules, usually lasts 18 months.

Table 3 shows the list of applicants separated by column with the classification by the name of the university, company, and individual who protected these assistive technologies designed for the Deaf. It is worth noting that nineteen patents were selected, and the table shows eighteen applicants, as the Federal Center for Technological Education of Minas Gerais has two applications.

Conclusion

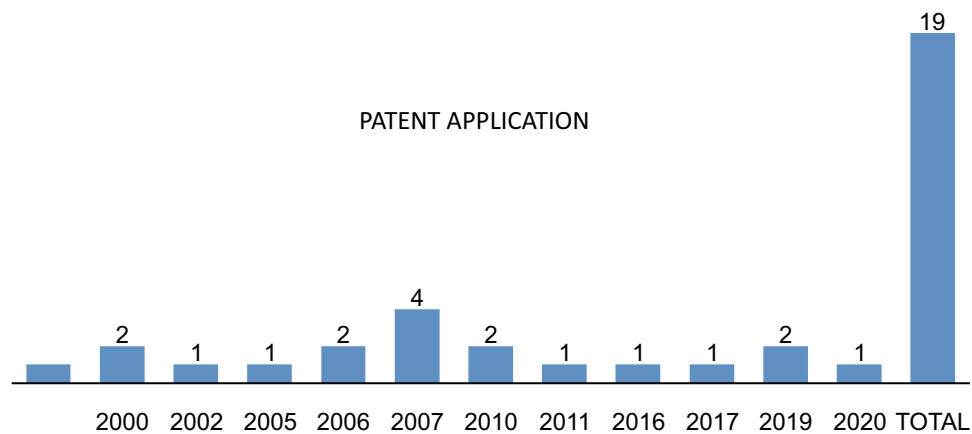
This research allowed us to map the existence of patented technological innovations considered "Assistive Technologies for the Deaf," defined as resources or services to benefit the lives of deaf people in society. The search revealed that there are (19) technologies registered with the INPI, which are considered assistive technologies, as they help deaf people mainly by favoring information and communication, thus guaranteeing linguistic accessibility, as provided for in Brazilian legislation through laws and federal decrees, which consider Libras to be the first language. Thus, it was found that patent registration is an essential indicator of the development of technologies that

Table 2. Patent titles.

Real-Time Sign Language Conversion for Communication in a Contact Center
Method for the Concatenative Synthesis of Sign Languages for the Generation of Realistic Three-Dimensional Signaling Avatars
Electronic System for Monitoring Babies and Children by Hearing Impaired Caregivers
System and Methods for Generating, Preserving and Signing Terminological Neologisms in Sign Languages
Electromechanical Vibrational Wearable Device for Musical Initiation of People with Hearing Impairment
Tactile/Visual Stimulator for Deaf Vehicle Drivers
Obstacle Signalizer
Sound Monitoring Device for the Deaf and Hard of Hearing
Tactile Stimulator for the Deaf
Automatic Bidirectional Translator System between Sign Languages and Hearing Languages
Obstacle Signalizer
Telecommunication Device and Other Functions for Deaf and Hearing People.
Rybená: Communication Method and System that Uses Text, Voice and Libras to Enable Accessibility for People with Special Needs
Portable Equipment for the Hearing Impaired
Telephone Training for Communication between Deaf and Dumb Listeners
Agenda in Libras
Closed Captioning Method, Sponsor of Visual Information Broadcasting for Accessibility for People with Hearing Impairment.
Device for People with Hearing Loss
Digital Inclusion System with a Focus on Accessibility in Brazilian Sign Language and Operated by Augmented Reality Application

Source: Adapted by authors from INPI (2023).

Figure 1. Annual trend in patent filings over the years.



Source: Adapted by authors from INPI (2023)..

Table 3. Identification of the depositors.

Depositor	University	Company	Citizens
AVAYA INC. (US)	State University of Campinas (BR/SP)	Paranaense Association of Culture - APC (BR/PR)	Paulo Marcelo Freitas de Barros (BR/PE) / Ana Maria dos Anjos Carneiro Leão (BR/PE)
State University of Campinas (BR/SP)	Federal Technological Education Center of Minas Gerais (BR/MG) / Foundation for the Support of the Research of the State of Minas Gerais - FAPEMIG (BR/MG)	J.J Fantin Pereira - ME (BR/SP)	Carlos Vicente Sgarbi (BR/GO)
Paranaense Association of Culture - APC (BR/PR)	Federal Technological Education Center of Minas Gerais (BR/MG) / Foundation for the Support of the Research of the State of Minas Gerais - FAPEMIG (BR/MG)	Rof Empreendimentos Inteligentes Ltda.	Paulo Marcelo Freitas de Barros (BR/PE)
Federal Technological Education Center of Minas Gerais (BR/MG) / Foundation for the Support of the Research of the State of Minas Gerais - FAPEMIG (BR/MG)	Federal University of Itajubá - UNIFEI (BR/MG)	Paranaense Association of Culture - APC (BR/PR)	João Elison da Rosa Tavares (BR/RS)
J.J. Fantin Pereira - ME (BR/SP)	Institute for Research and Development in Software Technology (BR/DF)		André Miguel de Souza e Silva (BR/PR)
Paulo Marcelo Freitas de Barros (BR/PE) / Ana Maria dos Anjos Carneiro Leão (BR/PE)			Paulo Roberto de Oliveira Noernberg (BR/PR)
Carlos Vicente Sgarbi (BR/GO)			Claudio Roberto Sindicic (BR/SP)
Federal University of Itajubá - UNIFEI (BR/MG)			Jean Gleison Florêncio de Miranda (BR/SC) / Rodrigo Oscar Braga de Godoy (BR/SC)
Paulo Marcelo Freitas de Barros (BR/PE)			Manuel de Souza Araújo (BR/RJ)
João Elison da Rosa Tavares (BR/RS)			Eduardo Felipe Loesch (BR/RS)
Rof Empreendimentos Inteligentes Ltda.			
André Miguel de Souza e Silva (BR/PR)			
Institute for Research and Software Technology Development (BR/DF)			
Paulo Roberto de Oliveira Noernberg (BR/PR)			
Claudio Roberto Sindicic (BR/SP)			
Jean Gleison Florêncio de Miranda (BR/SC) / Rodrigo Oscar Braga de Godoy (BR/SC)			

Source: Adapted by authors from INPI (2023).

enable information and communication for the Deaf, indicating that of the nineteen assistive technologies selected that favor communication, (07) deal with Libras, which is considered to be the mother tongue of the Deaf, consisting of a linguistic system of a visual-motor nature and (04) devices for subtitles and (08) vibrational devices, which allow the Deaf person to perceive sounds, enabling safety and autonomy for life in a society made up of a majority of hearing people. Because of the above, we emphasize that assistive technologies aim to enable autonomy, independence, and social inclusion. The results of this patent study show that there is a market demand to be explored for the development of assistive technologies that help deaf people to be included in society. Therefore, there are possibilities for these technologies to be expanded, as well as the emergence of other technological innovations that guarantee linguistic accessibility and autonomy for deaf people, given the significant number of deaf people in Brazil.

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