

## ACCESSIBLE TECHNOLOGIES FOR THE BLIND

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**Abstract-** Since very old times, humans have learned to use various technologies by employing their intelligence. Technology teaches people how to utilize their capabilities effectively, while also reducing and making labor more efficient. Accessible technology plays a crucial role in empowering visually impaired and disabled individuals. Especially in the third decade of the 21st century, nothing can be imagined without technology. This is because we currently live in the age of information and technology. This article primarily attempts to explore how visually impaired individuals can lead their lives and livelihoods with dignity using accessible technology. Braille script is of paramount importance for reading and writing for visually impaired individuals. Currently, various devices are available for reading and writing Braille. Moreover, visually impaired individuals can easily use computers by using screen reading software. They can easily use mobile phones or smart phones with the help of Google Text-to-Speech applications. These software and mobile applications are very effective for using social media such as WhatsApp, Facebook, Instagram, and email. Not only that, but talking sticks, accessible headbands, wristwatches, eyeglasses, and special types of shoes are currently being used for walking and moving around. There are ample opportunities to use talking thermometers, talking electric testers, image detectors, and optical character recognition software to make life easier. However, illiteracy and poverty have created a digital divide in the use of these electronic devices for countless visually impaired people in economically backward countries like India. I have gathered a number of articles and writings, studies, different websites which are relevant for this.

**Keywords:** Accessible technologies, blind and low vision, digital device, computer, Smartphone.

### I. INTRODUCTION

Unlike other animals, early humans learned to use their hands, they have strived to find technologies to make their lives easier. For these early humans, branches of trees or pieces of stone were extremely important technologies. As science advanced and human civilization progressed, the use of technology increased exponentially. In today's age of information and technology, it is impossible to imagine life without technology. From the moment we wake up in the morning until we go to sleep at night, we use countless types of technology; there is no way to count them all. Thus, in the course of time, technology has made human life easier and more comfortable. It is no exaggeration to say that this technology has brought about a revolution in

empowering the lives of visually impaired people, transforming their otherwise gloomy existence. These special types of technologies designed to assist the visually impaired or people with disabilities are called assistive technologies. Various tools and software fall under the ambit of assistive technology. Currently in the third decade of the 21st century, visually impaired individuals have access to Braille displays and computer software for reading and writing, as well as various devices, including talking sticks, for mobility. A variety of technologies are available for listening to and recording in audio format. With the help of various converter software, any image can easily be converted into an audio format and listened to. Here, we will primarily attempt to explore an accurate picture of the origin and development of various assistive technologies used for visually impaired individuals. Alongside this, we will also try to investigate how accessible these assistive technologies are to visually impaired people in India and how capable they are of using them.

Before the invention of Braille, blind people studied using various tactile letters and diagrams. That is, different patterns were embossed on wood, thick paper, or some other hard material. These raised letters or diagrams had to be understood by touching them with the hands. In addition, various strings or ropes were used for counting and performing simple addition and subtraction. They would tie one or more knots in the rope and solve mathematical problems by counting the knots. At that time, blind people did not have many opportunities for education. Their studies would stop at a very basic level.<sup>1</sup>

In the second half of the 19th century, the invention of the Braille system in France, thanks to the efforts of Louis Braille, brought about a radical transformation in the world of education for the blind. However, in its initial stages, neither Louis

Braille's own educational institution nor the French government recognized the Braille system. It was only after Louis Braille's death that the system gradually gained acceptance.<sup>2</sup> Beyond the borders of France, the Braille system slowly spread to various industrialized countries in Europe and the Americas. Through colonialism, the wave of the Braille system also reached India and other underdeveloped colonial countries.<sup>3</sup> Across the globe, the Braille system became the primary means of education for blind individuals.

Various devices for writing and reading Braille have been invented in different parts of the world. The frame used for writing Braille is called a slate. A thick piece of paper or plastic is placed in this slate, and a stylus is used to create dots by puncturing the paper or plastic. Later, the Braille machine became quite popular as a device for writing Braille. Subsequently, Braille books began to be printed using Braille presses. In India, the first Braille press was established after independence, in the 1950s. Currently, various devices, including the Braille machine, are used for writing Braille. By installing specific software on a computer, Braille can be easily written using the computer's keyboard. Moreover, various devices are also available for reading Braille. With a Braille display board, any text can be read in Braille without printing it out. Braille code features are also found in smartphones. Therefore, various technologies are currently available for writing and reading Braille. However, due to their high cost, it is not possible for all visually impaired individuals to purchase and use all these devices.<sup>4</sup>

On the other hand, libraries are no longer considered mere storehouses of books and journals. Rather, they are now seen as powerhouses of knowledge. Modern libraries are equipped with various technologies. To make libraries more efficient and accessible for the visually impaired, they are being made more adaptable and accessible day by day with the help of various information and communication technologies. With the help of a Braille display board, a visually impaired person can easily read any text in Braille by touch. However, only one line at a

time is displayed on this Braille display board.<sup>5</sup> Consequently, there are difficulties in reading an entire page at once. Of course, any text can be printed out using a Braille embosser. In addition, modern libraries offer many facilities for the visually impaired to study through audio means. Various books recorded in human voices are available as audio or talking books. Furthermore, with the help of screen reading software, a visually impaired person can easily use a computer or tablet. Accessing information or books from any website has become much easier. Therefore, due to the rapid advancements in information and communication technology, accessing libraries has become much easier for the visually impaired.<sup>6</sup>

Again, nothing in today's world can be imagined without computers. In today's age of information and technology, computers are indispensable. For computer education and training among the visually impaired, various types of screen readers are currently used with the help of speech synthesizers and Braille displays. In fact, a screen reader is an interface that maintains the connection between the user and the computer's operating system and its various applications. When a user gives a command to the computer using various keys on the keyboard, the speech synthesizer transmits that command to the computer's various applications and operating system in its own language. On the other hand, this synthesizer describes any character, word, sentence, line, instruction, and even the exact position of the cursor on the computer screen through audio. It specifically highlights the focused item. Not only that, this synthesizer even describes different colors and points out spelling mistakes. This screen reader software currently works seamlessly on Linux, Windows, Mac, and Android operating systems. Many of these synthesizers are available for free, while others have to be purchased.<sup>7</sup> In India, visually impaired people primarily use screen reader software or applications on computers and mobile phones. In some cases, efforts are being made to bridge the digital divide for the visually impaired through training in digital disability awareness.<sup>8</sup>

In fact, in 1989, an American motorcycle racer named Ted Henter invented a software called Job Access With Speech, or 'JAWS'. Ted Henter had actually lost both his legs in a car accident in 1978. Since then, he had started thinking about developing software suitable for the blind. In 1985, Henter, in a joint venture with a company called Bill Joyce, established the Henter-Joyce Corporation in St. Petersburg, Florida, USA, at a cost of 180,000 US dollars. In 2000, Henter-Joyce, Blazie Engineering, and Arkenstone, Inc. merged to form a new company called Freedom Scientific. Anyone can easily download and use this screen reading software from Freedom Scientific's official website. However, this software has two editions: the Home Edition for personal use and the Professional Edition for professional use. This software was very important for blind people to read or write anything on a computer. It was a text-based application software. Initially, it only worked on MS-DOS. In 1995, a revolutionary change occurred in this JAWS software. This software started working as a screen reader software on the Windows operating system. This software is capable of describing any text or graphics displayed on the computer screen in audio format. This software is extremely important for blind people for writing or reading anything in Microsoft Word, reading in PDF, HTML, Notepad, etc. formats, surfing the internet, using social media, and more. This software is also effective on magnifying devices and other digital devices besides computers. Although this software is functional on the Microsoft Windows operating system, it is unable to work on iOS, Android, Mac, Linux, or other operating systems.<sup>9</sup> However, the full version of JAWS software cannot be used for free. And without the full version, it is not fully accessible. Considering this problem, in 2006, a person named Michael Curran created a new software called NonVisual Desktop Access (NVDA). Since it is completely non-commercial, it has become increasingly popular among visually impaired people. According to a 2023-24 statistic, the largest number of visually impaired people worldwide use this NVDA software. Its use is particularly widespread in developing and underdeveloped countries. Currently, this software is used in approximately 150 countries around the world. It is available in a total of 50 languages. Initially, this software was only functional with Microsoft Word on the Windows operating system, but later it became compatible with other software such as Microsoft Excel and Microsoft PowerPoint. As a software that assists visually impaired people in their employment and professional lives, it is unparalleled. Today, many visually impaired individuals are successfully pursuing their careers with the help of this software.<sup>10</sup> As mentioned earlier, blind people face various challenges when it comes to reading. They cannot easily read any book or follow a class properly by looking at pictures or maps. When charts or diagrams are used in class, they cannot follow them at all. Currently, various devices are available for blind people to read. For those with low vision, there are different types of magnifying devices. There are also several devices for reading large print in 18 to 24-point fonts. Reading for low-vision individuals is facilitated by increasing color or contrast and adjusting lighting. For those who are completely blind, the Braille system is extremely effective. Braille books are available, and Braille can also be read on mobile phones or computers using various apps and software. With a Braille display board, any printed text can be converted into Braille and read by touch. A device called a Braille note-taker allows users to take notes in Braille anywhere. In addition, there are various devices for reading through audio. Books are recorded and stored in human voice. These audiobooks are then listened to for reading. Hearing aids are used in this process. Previously, recording and reading were done using tape recorders. Currently, various devices for reading through audio are available, such as MP3 players, iPads, mobile phones, and Daisy players. Some software is now available that can convert any image or picture into an audio format, allowing it to be easily read by listening. With an Optical Character Recognition

(OCR) scanner, any printed text can be converted into an audio format and listened to.<sup>11</sup> Just as there are various devices for blind people to read, there are also many types of devices available for them to write. For people with low vision, there are special types of paper and pencils that allow for writing in bold letters and with altered color combinations to suit their needs. For those who are completely blind, a slate and stylus are used for writing in Braille. Any person with low vision can easily write using an adaptive keyboard. With speech recognition software, any blind person can easily dictate text using voice commands. Text-to-speech software easily converts any text or image appearing on a mobile screen into an audio format, making it suitable for reading.<sup>12</sup> In today's life, it's impossible to imagine life without a mobile phone or cell phone. From the moment we wake up until we go to sleep, we rely on these handheld devices for a significant portion of our day. To make them accessible for the blind, Android and iPhones have apps available called TTS or Text-to-Speech. The TalkBack feature used on Android phones was originally a project of Google's Eyes-Free project. It was first adopted in 2009. Nolan Darilek's name deserves special mention in this context. Although TalkBack saw some improvements in 2011, it still had several limitations for blind and low-vision users. Subsequently, significant progress was made in the Ice Cream Sandwich version of TalkBack. The Jelly Bean version became quite popular. The addition of Braille display features to TalkBack greatly benefited blind users in using smartphones. Furthermore, the inclusion of a magnifying facility option has been very helpful for low-vision individuals. They can enlarge or reduce any text displayed on the screen at any time. The Honeycomb version of TalkBack is also widely used.<sup>13</sup> With the help of a speech synthesizer, any text can be easily converted into audio format and listened to instantly. Its use is not limited to the visually impaired; many sighted individuals are also using it nowadays. In today's busy life, its use is bound to increase even further in the future.<sup>14</sup> Furthermore, this speech synthesizer is used for voice commands in various railway stations, airports, market areas, shops, shopping malls, and other places. The use of voice typing on Google, WhatsApp, Instagram, and other social media platforms is now widespread among everyone. Speech synthesizer technology is also crucial in this area.<sup>15</sup> Besides education, technology is extremely important for visually impaired people in their daily movements and overall life. Since visually impaired individuals cannot see, many technologies have been developed that utilize their hearing and touch senses to assist them in various ways. In this context, the electronic cane deserves special mention. While walking with this cane, the visually impaired person receives various indications through sounds and vibrations. The user must understand these indications to navigate their way. Accessible shoes have been developed in Germany, where various indicators are used to make walking easier for the visually impaired. Additionally, various devices such as Braille displays, smart wristwatches, headbands, eyeglasses, and headphones are being equipped with different chips to utilize auditory and tactile senses, thereby facilitating the daily lives of visually impaired individuals.<sup>16</sup> Currently, more than one billion people worldwide use social media platforms in their daily lives. To express their likes, dislikes, and feelings, they easily share their thoughts through various text messages, as well as pictures, videos, and images. Blind people are also not lagging behind in using social media. Special technologies are being used to enable blind individuals to use Facebook, Twitter, WhatsApp, Instagram, and other social media platforms. The images displayed in various pictures are easily converted into audio, providing a clear description of any image to a blind social media user. Furthermore, descriptions of ongoing events are provided through captions in videos. Voice typing has become extremely accessible for visually impaired individuals when writing messages. Although, the use of voice typing is also being observed to a

significant extent among sighted people today.<sup>17</sup> Using AI and shortcuts, social media platforms like Facebook and Instagram have made it very easy to access any image, video, or GIF in audio format. Even countries like the United States have implemented various laws to make social media platforms accessible to the blind. Currently, a large number of blind people use social media platforms. Anthony Ferraro, a Paralympian, regularly posts pictures of various events in his life on social media platforms. He currently has 214,000 followers. Lucy Edwards, another content creator, regularly posts about issues related to the blind. She currently has 136,000 followers. However, while social media platforms like Snapchat and TikTok are popular among Gen Z or the younger generation, these platforms are still not accessible to the blind. Various shortcomings are observed in their usability for visually impaired users.<sup>18</sup>

## II. CONCLUSION

There is no doubt that accessible technology has brought about unprecedented changes in the lives of blind people. The widespread use of technology is now being observed in the use of the Braille system, the primary medium of education for the blind. Various modern devices for writing and reading Braille have further increased the accessibility of Braille. Moreover, software and apps have been developed to convert any text or image into audio format. With the help of smartphones, tablets, computers, or other devices, blind people can easily access web content by converting any text or image into audio format. Screen reading software or TalkBack apps are extremely helpful in using social media platforms or any website. Even e-commerce websites and apps are regularly used by blind people for shopping today. Furthermore, devices such as talking sticks, magnifying glasses, talking calculators, talking thermometers, and talking testers have brought about amazing changes in empowering the blind. However, Indian blind people do not enjoy the same freedom and convenience in using

accessible technology as their counterparts in America or other developed countries. In most cases, due to lack of financial resources, they are unable to use accessible devices even when needed. It is important to remember that in a country like India, poverty and malnutrition are among the major causes of disability. Moreover, illiteracy often becomes a significant obstacle in using these accessible technologies.

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