# Inclusive Robotics for the employment people with disabilities

De Fuentes G[a]-Romero de Tejada, C., Juanes Calvo, C.

*Abstract*— **Robotics can be a great ally for the labor inclusion of people with disabilities. Job adaptations that previously seemed unthinkable are now possible thanks to technology. In this work, several examples of technological innovations that can facilitate the labor inclusion of the group are reviewed, especially for physical and sensory disabilities. Inclusive robotics, thanks to the opportunity that Artificial Intelligence creates through sensors, open for the opportunity of wider accessibility for people with disabilities, promoting their independent life and participation in all aspects of life on equal terms with the rest of the population.**

## I. INTRODUCTION

THE objective of this communication is to investigate the positive impact that robotics can have on a wider labor inclusion of people with disabilities (PwD) thanks to improvements in the adaptation of jobs.

We have structured the analysis and content as follows: first, we will review the current situation of PwD in the workplace and the main international standards that promote universal accessibility, with special emphasis in Spanish situation. Second, we will analyze the definition of the term robotics, and how it could address the opportunity of inclusive robotics. Third, we will review some examples of technology for job adaptation. We have classified them according to the type of disability. We will finalize the paper with some conclusions and recommendations.

## II. CURRENT WORK SITUATION OF PEOPLE WITH DISABILITIES

Over a billion people in the world and 100 million people in the EU live with a disability. In 2018, the employment rate for PwD (aged 20 to 64) was 50.8% vs. 75% for people without disabilities. Besides, in 2018, 22.6% of PwD younger than 60 years were living in households with very low work intensity vs. 7.1% of people without disabilities [1].

On December 13th, 2006, the United Nations General Assembly approved the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD). Article 9 of such Convention sets out general obligations for Member States to ensure that PwD have access on equal bases to the physical environment, transportation, information and communication, including information and communication technologies and systems (ICTs). Accessibility is also identified in Article 3 (f) of the Convention as one of its eight principles.

In Spain, the General Law on the rights of PwD and their social inclusion (Royal Legislative Decree 1/2013, of November 29) establishes universal accessibility as a fundamental principle, which naturally encompasses work activity. It is developed, among others, in articles 22, 35 and 40, especially, in the second section of this last article.

## III. ROBOT DEFINITION

There are different conceptual approaches to Robotics and robots. In this work, we start from a broad vision and embrace the definition of the British Encyclopedia, as "any automatically operated machine that replaces human power, although it does not resemble human beings in appearance or perform its functions in the same way" [2]. The essential aspect is that it is “a mechanism guided by automatic controls” [3] and, in this way, it encompasses inclusive robotics (predominantly interactive in services sector and others, i.e, healthcare) [4]. We also include the technology behind the actual robots, which nowadays is mostly sensory capabilities thanks to Artificial Intelligence (AI) capabilities.

## IV. SOME EXAMPLES OF INCLUSIVE ROBOTICS FOR PEOPLE WITH DISABILITIES

### *A. Physical disability [5]*

There have been advances in the handling of computers, especially the movement of the cursor, through for example the **HeadMouse**. Through this system it is possible to control its movement with slight movements of the head and perform click actions with facial gestures. These movements are captured by a camera installed on the computer. Another advance is **VirtualKeyBoard**, a keyboard that appears on the screen and that PwD can operate through the HeadMouse.

But the most innovative system in this area is the eye-tracking system, where control is done exclusively by the eyes. The computer stops where the eye looks by emitting infrared rays that identify the eye's pupil. There is no need to click, because a side panel shows the various possible functions that are also selected with the eye.

We also refer to the opportunity of Personal Robots, such as **PRA Project** (Personal Robotic Assistant). Most of them refer to humanoid robots that can move easily in a work environment and that serves for the presence of the

Article framed in the research project “FuWorkTech. El impacto de la digitalización en las relaciones de trabajo: retos y oportunidades”. (Ministry of Science and Innovation: PID2019-104287RB-100; R+D+I projects).

C. DF. Author, is Part-Time Lecturer in Universidad Complutense, Madrid, Spain (corresponding author to provide e-mail: carlosdf@ucm.es).

C. J. Author, is Head of Learning and Development BDGS at Ericsson, and Adjunct professor at IE university, Madrid, Spain (e-mail: cjuanes@faculty.ie.edu).

teleworker. These robot can be controlled by a smartphone or tablet, or by voice control. It is in testing phase.

### *B. Sensory disability: speech impairment*

**Speech Assistant AAC** [6] is a text speech app designed for people who have speech impairment. This may be in the case of aphasia, MND/ALS, autism, stroke, vocal cord problems or other speech problems.

With the app you can create categories and phrases, which are placed on buttons. With these buttons you can create messages that can be shown or spoken (text-to-speech). It is also possible to type any text using the keyboard.

### *C. Sensory disability: blind people*

There are four different technologies that are used to overcome the barriers of blind people.

*1)* ***Smartwatch*** [7]: Unlike most assistive smartwatches for the blind which rely on audio prompts, the Dot displays messages four braille characters at a time on its screen. Its round face displays four cells of six balls each, and allows users to send simple replies or actions back through its two side buttons (as shown in Fig. 1).

Fig. 1. The Dot braille smart watch.

*2)* ***Smart glasses*** [8]: Inside are two OLED screens and powerful prisms. There's also a processor in the headset and it's all connected to a small controller/battery pack (it gets 3-to-4 hours of battery life). Images collected by the camera and data from the sensors, which help keep the image in focus, is all processed in the visor and then displayed on tiny dual screens just millimeters from person's eyes *(as shown in Fig. 2)*.


Fig. 2. Smart glasses are digital eyes for the legally blind.

3) ***Seeing AI App*** [9]: The app not only recognizes a person based on his or her face, but can also relay mood based on facial expressions, estimate a person's proximity to the user, and describe physical characteristics. This app can also identify products based on their barcode, a feature aimed at making shopping easier. The app emits a series of beeps to indicate how close the viewfinder is to the barcode, helping users align the camera properly. Similarly, when reading documents to users, Seeing AI will provide spoken hints to ensure that all corners of the paper are properly captured *(as shown in Fig. 3)*.

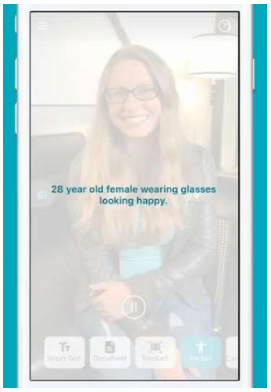


Fig. 3. This app makes life easier for visually impaired.

4) ***Edgguide*** [10]: is a collaboration between CACI [11] and the Blind Institute of Technology (BIT) to provide an indoor micro-localization solution for the blind and visually impaired (BVI) so everyone can enjoy a technology enhanced experience. In addition, the Denver Museum of Nature & Science (DMNS) hosted a six-month pilot of the capability ending in the spring of 2020. By leveraging this technology, the museum was able to expand their services to a broader community: precision navigation for the BVI community, a 'find your buddy' feature, curated audio content that augments the tactile experience of blind and visually impaired, and exhibit-specific audio content available in multiple languages for audio learners.

## V. Conclusion

Technological advances in the area of inclusive robotics are very encouraging. Existing social barriers in jobs will be able to be overcome thanks to technology. The examples that have been seen in this work allow PwD to carry out their work. Therefore, it can be concluded that inclusive robotics supports the labor inclusion of this group of people. However, accommodations are rare and furthermore only address barriers to physical and sensory disabilities. Cognitive accessibility is left out, whose most common tools are easy reading and The Augmentative and Alternative Communication Systems [12]. There is no progress being made in adaptations for psychosocial disabilities neither.

## REFERENCES


[1] International Labor Organization, Global Business and Disability Network and Fundación ONCE, *An inclusive digital economy for people with disabilities*, 2021, p. 8, online document: *http://www.businessanddisability.org/wp-content/uploads/2021/02/inclusiveDigitalEconomy.pdf*.

[2] J. Mercader Uguina, "La robotización y el futuro del trabajo", in *Revista Trabajo y Derecho: nueva revista de actualidad y relaciones laborales*, 27, 2017, pp. 13-24.

[3] A. Ortega, *La imparable marcha de los robots*, Madrid, Alianza Editorial, 2016, pp. 14-16.

[4] Y. Sánchez-Urán Azaña & M.A. Grau Ruiz, *Robotics and Work: Labor and Tax regulatory Framework.* In International Congress Technological Innovation and Future of Work, 5th and 6 th April, 2018, Santiago de Compostela, pp. 5-6. Online document: https://eprints.ucm.es/id/eprint/47718/.

[5] V. Cordero Gordillo et al., "La integración laboral de personas con discapacidad en la era digital. Perspectiva internacional", in ILO Interuniversity Congress on the future of work, Vol. II, Ministry of Labor and Social Economy, 2020, pp. 325-326.

[6] https://www.iaccessibility.com/apps/speech/index.cgi/product?ID=330

[7] https://mashable.com/2017/02/22/dot-smartwatch-retails/?europe=true#bgBU0sva5aq1

[8] https://mashable.com/2017/02/15/esight-3-smart-glasses-vision-legally-blind/?europe=true

[9] HTTPS://TIME.COM/4854658/IPHONE-APPS-VISUALLY-IMPAIRED-MICROSOFT/

[10] https://blindinstituteoftechnology.org/edgguide/

[11] https://www.caci.com

[12] https://www.asha.org/public/speech/disorders/aac/