Research Article

Human-Computer Interaction (HCI) Interventions for People with Disabilities

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Access to computer technology is of vital importance to people with disabilities, Human behaviour inference through smart pervasive technologies is a new research avenue. Sophistication in interaction modalities with self-customization based on context makes interaction easier in natural settings. Despite greater sophistication, the disabled and elderly people still face difficulties in interacting with smart devices. Articles published in Science Direct between 2015 and 2019 (July) were screened in this research. This is because of its respectable position in the field of technology and the peer-reviewed secured structure of this database. From a total of 75 articles within the scope of the screening 50 articles were included in the study. Through this research, Human-Computer Interaction (HCI) Interventions for People with Disabilities, and learning activities in recent years will be determined and a new way will be shown to researchers. "Human-computer interaction for disabilities people" keywords were used during the research process and all the articles with "disabilities" keywords were included in this study. The results revealed that most studies in the field of human-computer interaction for disabled people were published in 2017 in Spain. It emerged that experimental research was used maximum as a research model. Quantitative data collection tools were used mostly as a means of data collection. The results shown that the intellectual was selected as the type of disabilities in these articles. It is seen that augmented reality based on 3D hologram is the used technology.

1. Introduction

Trends in this area recognize the importance of enabling persons with impairments to use computing technology and have developed methods for doing so. The term "human-technology symbiosis" describes the process of articulating how people will coexist peacefully with technological

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advancements that will soon display traits that have previously been linked with human conduct and intelligence (keeping in mind that they are limited to specific application domains).

The field of study known as "human computer interaction" (HCI) investigates the intersection of computers and human beings, specifically the ways in which the two interact with one another. Scientists in the subject of human-computer interaction (HCI) study people's natural tendencies to communicate with computers and also create tools that encourage people to try new kinds of interactions. Human computer interaction (HCI) was first described by Mauri and al. (2006) as the study of major phenomena related to the creation and use of interactive systems for human benefit.

As a result, computer systems should be simple to use, simple to learn, and free of errors; designing and developing such a system is a major concern of Human-Computer Interaction. An access system connects humans and computers. The access system is made up of a collection of hardware and software components that translate data between the user and the computer (Shein, Treviranus, Brownlow, Milner, and Parnes, 1992).

The emergence of smart ecosystems—composed of interoperable and transparently functioning smart devices, services, materials, and environments—requires researchers to think about, define, and optimize the rules of the symbiosis between humans and technology. Interacting with technology has become a part of most people's everyday lives; yet, the average user of a computer system is now less likely to understand the technology. People are often too busy to devote much time to learning a new system, which can be problematic given the wide variety of technologies they are expected to master. That physical impairments have far-reaching implications on access to IT, which can't be fixed by adaptations alone, was acknowledged. Why do most assistive technologies (for the deaf, the hard of hearing, the autistic, and others with limited mobility) target adults?

Therefore, it is crucial that persons who are unable to use conventional methods of accessing information obtain the same opportunities as others. These people have a unique requirement on top of being regular consumers who should have access to the same technologies as everyone else. They may be able to take a more active role and function independently in our society thanks to the help of computers (Shein, Treviranus, Nicholas, Milner and Parnes,1992). Numerous studies have been conducted to investigate the potential benefits of human computer interaction (HCI) for people with disabilities; however, little evidence exists for the actual effects of HCI technology for people with disabilities or for the directions future research should take.

HCI research will play a multifaceted pivotal role in future technological developments, addressing major societal and environmental challenges toward societies that pursue and protect the ideals of democracy, equality, prosperity, and stability. As a result, the goal of this research is to shed light onto how HCI technology can help people with disabilities by carrying out a systematic review which will analyse articles published in the Science Direct database between 2015 and 2022. This study could aid in better understanding the intervention of HCI in disabilities, as well as future research trends.

The goal of this study is to look into the existing HCI technologies to help individuals with disabilities by reading and analyzing articles published between 2015 and 2019 in the Science Direct database (August).

This research will assist us in determining which HCI technologies are most commonly used by individuals with disabilities and how these technologies affect their daily experiences.

Other goals of this research include:

- What is the number of publications by study year?
- What is the total number of publications by country?
- What is the sample group distribution of the studies?
- What is the goal of the research?
- What types of impaired people are most likely to be used in the studies?
- What research techniques were employed in the studies?
- What is the most common HCI technology used to help individuals with disabilities?

2. Literature review

Disabilities are mental or physical conditions that may impair someone's movements or senses. There are many different disabilities that can be found in society, such as the following: visual disability, hearing disability, physical disability, speech impairment, autism, and dyslexia.

A recent review of research on technology for disabled and older people found a vibrant research area with a wide range of topics, according to Petrie and Weber (2016). A preliminary review of 834 papers attempted to categorize research into areas of which people were being assisted and what types of support were being provided, rather than by the technology used. It discovered that technology for older people was the most commonly researched area (35.5%/296 papers), followed by technology for

people with visual disabilities (25.1%/209 papers), and research that covered more than one disabled/older user group (12.9%/108 papers) (Petrie and Weber, 2016).

2.1. HMI and motor/cognitive impairements

According to Disabilities, Opportunities, Internetworking, and Technology Website, many types of orthopedic or neuromuscular impairments can impact mobility. These include but are not limited to amputation, paralysis, cerebral palsy, stroke, multiple sclerosis, muscular dystrophy, arthritis, and spinal cord injury. Mobility impairments range from lower body impairments, which may require use of canes, walkers, or wheelchairs, to upper body impairments that may include limited or no use of the upper extremities and hands.

Mobility impairments can be permanent or temporary. A broken bone or surgical procedure can temporarily impact a student's ability to walk independently and travel between classroom buildings in a timely manner. Likewise, some students may be ambulatory with a walker for short distances within a classroom, but may need a wheelchair or scooter for longer distances.

Ageing often relates to a decline in physical mobility and sensory function (e.g., vision and hearing). Cognitive ageing refers to a decline of cognitive processes (e.g. perception, attention, and memory) and it appears in normal and pathological ageing (Deary, 2009). Mild cognitive impairment (MCI) refers to an intermediate stage between normal age-related cognitive decline and dementia.

Morgan and Alford (2016) conducted a review of the theoretical and empirical literature on the design of human machine interfaces (HMIs) for autonomous vehicles (AV) and connected autonomous vehicles (CAVs) intended for older adults, including those with undiagnosed mild cognitive impairments and/or physical impairments. In terms of the current role that a car plays in providing a key mode of mobility for older adult users. The research sheded light on the flaws that are in violation with the contemporary interface design process, the Principles to guide the design of in-vehicle HMIs and automated vehicles, and wether the age-ing-related impairements should be taken into consideration.

To determine the effect of computerized cognitive training (CCT) on improving cognitive function in older adults with mild cognitive impairment, a systematic meta-analysis was performed (MCI). We discovered that CCT is a viable intervention for improving cognition in older people with MCI after reviewing 18 studies. The meta-analysis found evidence to support the idea that CCT helps older people with MCI think more clearly.

2.2. HMI and people with learning difficulties

Perelmutter, McGregor, and Gordon (2017) conducted a systematic review to investigate the effectiveness of assistive technology therapies in learning difficulties for participants aged 14 and up. They analyzed 38 quantitative group-design and single-subject intervention studies, 5 survey studies, and 13 qualitative research using meta-data approaches. The findings revealed that the most often employed therapies were not the most successful. Word processing, multimedia, and hypertext interventions were the most effective, whereas smart pens and text-to-speech technologies produced mixed outcomes. Speech-to-text technologies had a minor impact. Participants' feelings and opinions about their assistive technology were varied.

3. Research Methods

This investigation is a content analysis. It seeks to identify and evaluate new directions in the field of human-computer integration applications for disabled individuals. For this research, the years 2015-2022 (August) have been set as the range for the Science Direct database to be utilized. During the course of investigation, we looked out for human computer interaction application for impairments. This research includes all publications that contain "human computer for disability" as a keyword. Our analysis criteria was based on the publication year, research countries, sample groups, research purpose, types of disabilities, research method, and used rechnologies

We analyzed all the collected data for each article using SPSS in accordance with the criteria for content analysis. Afterwards, the data reports are categorized and frequencies are extracted based on the specified criteria using filter characteristics.

4. Findings

4.1. Distribution of Articles According to Publication Years

Year of publication	Frequency	Percentage %
2017	18	36
2018	12	24
2019	11	22
2016	07	14
2015	02	04

Table 1. Number of Articles According to Publication Years

As can be seen in Table 1, the highest research publications on human-computer integration were in 2017 (f = 18) and the lowest was in 2015 (f = 02). Despite the fact that the research time for the year 2019 is limited until August, the publication number for the year 2019 is also respectable. So, we can say that the publication number will increase after August 2019.

4.2. Distribution of Articles According to Countries

Countries	Frequency	Percentage%
Spain	08	16
Mexico	05	10
Israel	04	08
Taiwan	04	08
Brazil	03	06
Turkey	03	06
USA	03	06
India	02	04
Japan	02	04
United-kingdom	02	04

Table 2. Number of Articles According To Countries

Table 2 lists the top 10 countries, out of a total of 50. Table 2 shows that the number of HCI-related publications is largest in Spain (f = 8), followed by Mexico (f = 5), Israel/Taiwan (f = 4), the United States, Turkey, and Brazil (f = 3), and finally India/Japan/the United Kingdom (f = 2).

4.3. Sample Group

Sample Groups	Frequency	Percentage%
Elder people with disabilities	13	26
User with autism	6	12
Users with cerebral palsy	5	10
Hearing-impaired user	5	10
Visually impaired individuals	4	8
Blind people	3	6
6-11y old elementary schools	2	4
Limp impaired people	2	4
Students with reduced mobility	2	4
Children with special needs	2	4
People with physical disabilities	2	4
People with intellectual disabilities	2	4
Patients with arthritis hand	1	2
People with reduced mobility	1	2

Table 3. Sample Groups of Articles

According to table 3 the most used sample group is seen as Elderly people with disabilities (f=13). Following this the second highest data is seen as User with autism (f=6) and the third highest data are seen Users with cerebral palsy and Deaf user (f=5). The lowest data is seen as Patients with arthritis hand (f=1) and People with reduced mobility (f=1).

4.4. Purpose of the Articles

Purpose of the Articles	frequency	Percentage %
Improve quality of life	33	66
Improve learning	10	20
Rehabilitation	7	14

Table 4. Purpose of the Articles

According to table 4, the bulk of human computer interaction for disability publications focus on enhancing quality of life (f = 33), followed by improving learning (f = 10) and rehabilitation (f = 7).

4.5. Types of Disabilities

Types of Disabilities	frequency	Percentage %
Intellectual	20	40
Physical	14	28
Sensory	13	26
Mental	3	6

Table 5. Types of Disabilities

Intellectual disabilities are the most common type, as shown by the results in Table 5 above (f =20), followed by physical disabilities (f =14), impaired sensory abilities (f =13), and mental disabilities (f =3), which are the least common type based on the articles.

4.6. Research Method for the Articles

Research Methods	Frequency	Percentage%
Experimental	32	64
Exploratory study	12	24
Case study	5	10
Action	1	2

Table 6. Research methods for the Article

Table 6 shows that most of the studies are experimental (f = 32). The second-highest result (f = 12) is thought to be an exploratory study. The other good result (f = 5) is seen as a case study. Action (f = 1) is the least method.

4.7. Technology used Application for the Articles

Technology used	Frequency	Percentage%
Augmented Reality based on 3D hologram	5	23.8
5-layer software architecture	4	19.0
Speech based interfaces	3	14.3
Robotic devices	3	14.3
Video Game	3	14.3
Braille reader device	3	14.3

Table 7. Technology used Application for the Article

Table 7 only lists the six most common technologies used. Table 7 shows that the most common types of technology employed by the articles are those involving augmented reality based on 3D holograms

(f = 5), followed by those using speech-based interfaces, robotic devices, video games, and Braille reader devices (both f = 3).

5. Result and Discussion

Since the dawn of time, humans have worked to enhance their innate skills. The drive for progress and the definition of humanity has both been influenced by this necessity. Gradual natural evolution, however, may soon take a back seat as humans take charge of their own destiny. As a species, we now have greater potential than ever before to improve and modify ourselves. Countless scientific advances can be attributed to the pursuit of greater physical prowess, greater speed, and greater intelligence.

Many studies on HCI for the disabled are included in the search engine study that spans from 2015 to 2019 (August). For people with disabilities, HCI is even more crucial than when designing software for the general public (Muzio and Serra, 2001). 2017 saw a record number of articles devoted to the topic of accessible technology and people with disabilities. This not only motivates new studies, but also demonstrates the efficacy of integrating computer technology into inclusive classrooms and other learning environments for students with special needs. Science was done by Hwang and Chang in 2011. A pairwise comparison of the AR-3DH training test (M 33, SD 2.3) and the 2D MRTs training test (M 23, SD 3.4) revealed statistically significant differences (p 0.05). Based on these results, it appears that AR-3DH training significantly increased participants' interest in taking MRTs for disabilities.

3D holography is helpful for the visually impaired because it does not necessitate the use of an auxiliary devices. Holograms are visible to the naked eye, providing greater ease and realism for viewers. Unlike traditional augmented reality systems, 3D holography can support a large number of simultaneous, separate viewers (Bimber & Raskar, 2003; Elmorshidy, 2010).

Uma, S. (2015) identifies Human-Computer Interaction as a growing field of technological endeavour; we've built a system to address the needs of people with limb impairments who need to use computers.

The elderly population with disabilities was selected as the optimal study population. This aligns with the findings of a study by Petrie and Weber (2016), who found that technology for the elderly is the most widely studied demographic, followed by technology for the visually impaired. The possibility of physical and intellectual impairments in the elderly is a major factor in this. The articles typically have

some sort of positive impact on readers' daily lives. According to the articles used in the analysis, intellectual disability was the most common form of disability.

The experimental research method appeared as the most recommended way as a research model in the study.

The reason for this is that the efficiency of human-computer interaction for disability research has emerged as developed applications.

We detected interference from inadvertent touches again in a later research of older persons with impairments using tabletop devices, but this time it was due to variances in touch screen technology perceiving activity extremely close to the screen as being in actual contact with the screen (Woodward et al., 2017).

Touch-screen engagement patterns for persons with disabilities have been extensively studied by researchers.

Findlater et al. (2017), for example, examined touch screen and mouse performance for target acquisition, voice, and accuracy among 32 adult and older users with and without upper body motor disabilities.

According to Rahim et al (2018), the human eye is the most complicated organ in our bodies; therefore, an advanced technology 3D hologram should be employed to depict the visual system in an effective and interactive manner, as well as to generate effective blindness.

6. Conclusion

The AR-3DH training system is a novel instrument for developing mental rotation skills in older adults and the elderly.

This device possesses three distinguishing features: (1) perceptual motor operation of gesture control; (2) spatial notions of AR; and (3) the visual display effect of 3D holography.

Human-computer interaction can assist persons with impairments by I making present interfaces and technology accessible to all, and (ii) creating tools that assist the disabled while also benefiting their professions.

We concentrated on 3D AR-based holograms and the web in this line of research to provide disabled elderly people with information in their original language and translations of written words or sentences.

Furthermore, we tested approaches for assisting blind users in selecting things from very extensive

lists on mobile phones.

More research will be undertaken on additional data bases and time frames, as well as on a variety of human-computer interface challenges.

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