Nafath

Issue 17
May 2021

A.I., Robotics and the Internet of Things for ICT Accessibility and AT

Nafath
Issue 17 – May 2021

Advances in Intelligent Assistive Technologies (IAT) for persons with dementia

Suzanne H. Hammad[1], Dena Al-Thani [2]
[2]Hamad Bin Khalifa University

Advances in technologies and innovations over the past decade have sought solutions to ease the burden on caregivers and help persons with dementia live more independently and improve their overall wellbeing. Intelligent Assistive Technologies (IAT) for persons with ADRD encompass technologies that range from simple manual devices up to complex life monitoring and safety tracking GPS systems. This paper outlines recent developments in technology and innovation and their benefits. Generally defined as: "any device which assists a person in retaining or improving their independence, safety, security and dignity (Bonner & Idris, 2012), such modern-day technologies are becoming more available in the market, and broadly include the following:

Technologies for care management and activities of daily living

Assistive devices can support older persons with dementia to schedule their medications in-take, swiftly connect with their loved ones, and much more. Special clocks have been designed to support ADRD patients' confusion associated with the differentiation between day and night hence reducing anxiety and fear symptoms that accompany the condition. Wearable tracking devices have long been used by dementia patients to protect them from the risk of being lost. Such devices are connected to an alert system that can help caregivers know the location of their loved ones. This technology can also be of important use in the case of personnel emergency. Smart home technologies such as Virtual Assistant such as Amazon Alexa and Google Assistant can be set to receive commands and questions from the users. These commands can include controlling the lighting, electricity plugs, heating and cooling systems, and security cameras. Everyday technologies can also be used to contact and assist people in managing their everyday lives, thus giving their caregivers respite. Technologies that are actively being explored include verbal live systems, digital television, and simple cell-phone interfaces that give individuals prompts to help them cope with activities of daily living. Live systems based on video monitoring are designed to track people engaged in specific tasks (e.g., making tea), to recognize if they get stuck at a particular point, and then give them a verbal prompt. (Dishman & Carillo, 2016).

Technologies for the physical and psychosocial wellbeing of the elderly

Research in this area has been quite active in the past two decades resulting in many innovative ideas that tackle the day-to-day challenges faced by ADRD patients and their caregivers. In recent years, Ambient Assisted Living (AAL) technologies have been used as part of a range of services with the aim of improving the quality of life of older persons (e.g. Enshaeifar, 2018). This is achieved by deploying IoT-enabled sensing devices within individuals' homes to capture and analyze the activity patterns of elderly people. These activity patterns are then combined with physiological measurements, including but not limited to heart rate, blood pressure, and body weight for the detection of cognitive changes. For example, researchers assess the health status of the patients by monitoring the electrocardiograph (ECG) activity and measuring the urinary volume using in-home sensors in the "Welfare Techno House" project (Tamura et al. 2007). Moreover, studies were done at the Centre for Advanced Studies in Adaptive Systems (CASAS) to make use of motion, door, and kinetic sensors to profile the occupant's everyday routine and focus on detecting drift in his/her everyday activities (Cook & Krishnan, 2014). In the literature, researchers have studied motion density and movement patterns of the older population to discover and understand physical, cognitive, and perceptual decline (Rantz et al. 2011; Chernbumroong et al., 2014; Demiris et al., 2008). Since the condition of ADRD affects physical, cognitive, and behavioral aspects, in addition to emotional and social challenges such as anxiety, agitation, and stress, AT solutions must provide holistic and multi-level support to their users (Ienca et. al, 2017). To that end, increasingly technologies that provide emotional and psychosocial support are being introduced or incorporated within existing devices. These seek to mitigate the effects of loneliness, enhance social connection, enhance mood, or reduce stress, alongside the other forms of assistance.

Given the immersive nature of Virtual Reality (VR) applications, several studies have examined their use to improve physical activities (de Vries et. al, 2018) reduce loneliness (Veldmeijer et. al, 2020), and support cognitive training (Garcia-Betances et. al, 2015). For instance, de Vries et al (2018) employed a VR system to promote regular exercise training through engaging the older person in a gamified immersive experience of skiing.

Technologies to facilitate innovative delivery of health and social care

Another growing area of research and innovation is the development of social robots. However, patients with ADRD may express rejection when dealing with humanoid robotics, robots that look and feel like real human beings. They, therefore, generally prefer small robotics pieces with some animal traits such as robots that look and feel like pets. Telepresence robotic, a robotic-like AT that allow the older persons to connect with their family, friend, caregivers and support network through teleconferencing, has shown promising results in terms of the technology acceptance as they can ease the process of communication and hence facilitate the social interaction (Góngora Alonso et al., 2019). Robotic can also be used as a therapeutic tool to enhance physical activities. Such assistive systems could potentially prolong the safety and independence of older adults with ADRD, preventing accidents, assisting them during the completion of ADLs, facilitating caregiver supervision, and triggering the alarm in case of emergencies (Lotfi et al, 2012). Although they have been used long before Covid-19 pandemic, telecare solutions have also grown significantly as an outlet for care advice and monitoring from a distance.

Conclusion

There are many ways in which research and innovation in AT can help make a difference in the well-being of older persons allowing them to lead healthy and independent lives in their own environments, and a rapid review of the literature highlights their benefits and huge potential. And this is only the beginning. The challenge now is to ensure the accessibility, acceptability, and individualization of technologies to meet the needs of persons with ADRD across this progressive and complex disease.

Reference

Enshaeifar, S., Zoha, A., Markides, A., Skillman, S., Acton, S.T., Elsaleh, T., Hassanpour, M., Ahrabian, A., Kenny, M., Klein, S. and Rostill, H., (2018). Health management and pattern analysis of daily living activities of people with dementia using in-home sensors and machine learning techniques. PloS one, 13(5), p.e0195605.

Chernbumroong S., Cang S., Atkins A., and Yu H. (2014) Elderly activities recognition and classification for applications in assisted living, Expert Systems with Applications, vol. 40, no. 5, pp. 1662–1674, 2013.

Cook D. J. and Krishnan N., Mining the home environment. Journal of Intelligent Information Systems, vol. 43, no. 3, pp. 503–519.

Dale, O. (2010) Usability and usefulness of GPS based localization technology used in dementia care. In Computers Helping People with Special Needs, Proceedings, Pt 1, Miesenberger K, Klaus J, Zagler W, Karshmer A, eds., pp.300-307.

Demiris, G., & Hensel, B. K. (2008). Technologies for an aging society: a systematic review of "smart home" applications. Yearbook of Medical Informatics, 17(01), 33–40.

de Vries, A. W., Faber, G., Jonkers, I., Van Dieen, J. H., & Verschueren, S. M. (2018). Virtual reality balance training for elderly: Similar skiing games elicit different challenges in balance training. Gait & Posture, 59, 111–116.

Diaz-Orueta, U. and Konstantinidis, E. 2020. Shaping technologies for older adults with and without dementia: Reflections on ethics and preferences. Health Informatics Journal 2020, Vol. 26(4) 3215–3230

Dishman, E. and Carillo, M. C. (2007). Perspective on everyday technologies for Alzheimer's care: Research findings, directions, and challenges. Accessed 8 Feb 2021 at: https://www.alz.org/national/documents/etac_proceedings.pdf

Garcia-Betances, R. I., Jiménez-Mixco, V., Arredondo, M. T., & Cabrera-Umpiérrez, M. F. (2015). Using virtual reality for cognitive training of the elderly. American Journal of Alzheimer's Disease & Other Dementias®, 30(1), 49–54.

Góngora A., Hamrioui, S., de la Torre Díez, I., Motta Cruz, E., López-Coronado, M., & Franco, M. (2019). Social robots for people with aging and dementia: A systematic review of literature. Telemedicine and E-Health, 25(7), 533–540.

Ienca, M., Fabricea, O., Elgera, B., Caond, M., Pappagalloe, A.S., Kressigf, R. W., Wangmo, T.

(2017) Intelligent Assistive Technology for Alzheimer's Disease and Other Dementias: A Systematic Review. Available from:

https://www.researchgate.net/publication/313461148_Intelligent_Assistive_Technology_for_Alzheimer's_Disease_and_Other_Dementias_A_Systematic_Review

Kieran, J., Egan, K. J. and Pot, A. M. (2016). Encouraging Innovation for Assistive Health Technologies in Dementia: Barriers, Enablers and Next Steps to Be Taken. JAMDA. 357-363. Available at:

https://www.jamda.com/action/showPdf?pii=S1525-8610%2816%2900048-7

Lotfi A, Langensiepen C, Mahmoud SM, Akhlaghinia MJ .(2012) Smart homes for the elderly dementia sufferers: Iden-tification and prediction of abnormal behaviour.J AmbientIntell Humaniz Comput3, 205-218

Veldmeijer, L., Wartena, B., Terlouw, G., & Veer, J. van't. (2020). Reframing loneliness through the design of a virtual reality reminiscence artefact for older adults. Design for Health, 4(3), 407–426. https://doi.org/10.1080/24735132.2020.1848976

A.I, Robotics, and the Internet of Things for ICT Accessibility and AT

Mada Center

Traditionally, assistive technology is considered a separate form of technology designed for persons with disabilities. This kind of technology focuses mainly on tasks like movement, reading, writing, controlling devices, and hearing. However, the modulization of products on the fourth industrial generation is person-centered, not group-centered. This concept allows us to make products usable by as many people as possible. In fact, considering people with all needs in the design process make it adapted to different users. Nowadays, artificial intelligence AI and the internet of things technologies are opening new perspectives in assistive technology and universal design. Together, these two innovative technologies allow the design of products able to learn users' needs through Artificial Intelligence. Thanks to AI, devices became more and more adaptable to users' needs by learning the behavior and interactions of users with them. Internet of things plays also, a fundamental role in the enhancement of the accessibility of devices for people with disabilities.

Robots are undoubtedly the most common application of artificial intelligence. They are used to resolve various spectrums of disability in different sectors or by individuals, especially for individuals who live alone. Robots can be personalized according to the needs of people with disabilities, and this customization ensures that AI and human beings are well-synchronized. Robots are just an instance of the use of artificial intelligence in assistive technology, which makes human life much easier. In fact, they can perform simple tasks, such as making emergency calls when a medical condition occurs, keeping track of appointments and prescriptions, and alerting people to important dates as well. Furthermore, several advanced types of robots can easily control electronic devices at home.

In addition to robots, there are many other impressive examples of this technology that operates for a disabled individual, thanks to artificial intelligence. We quote here only a handful of the most sophisticated applications of Assistive Technology.

AI-Based Visual Aids

When considering visual difficulties, there are many other solutions, such as contact lenses and glasses. In order to ensure that the focus of the eye's capacity is restored,

they help to deal with converging and diverging light rays. Thanks to AI and the internet of things, we can do much better than that today. In fact, a research team from the University of Oxford has created smarter glasses. They have invented an augmented reality-based glass that focuses on a particular part of the sight. This has improved the image's contrast and highlighted its characteristics with the aid of AR.
Microsoft invented a Seeing AI application for individuals with visual disabilities. Utilizing this application, the client can hold up his smartphone to an individual and the mobile phone will describe what the individual looks like, what his hair tone is, how old he is, if he looks happy or sad, and so on. By pointing the telephone towards an object, you can understand what the object is, when it expires, etc. The app can also read texts and recognize structural elements, such as paragraphs, headings, and lists.

AI-Based Hearing Aids:

Artificial intelligence has revolutionized the industry of hearing assistive technology which provided new research opprotunities to enhance hearing capabilities. Hearing aids based on AI can detect the environment and learn what noises the user wishes to focus on. For example, when he is in a noisy area with friends or family, hearing aids with AI can detect and reduce noise and amplify voices. For places that the user visits frequently, hearing aids can remember his preferred settings and automatically turn them on when he goes to such locations.

The production of captions and subtitles is also very important for the deaf to access video and audio content, especially when they are dealing with live communications or online meetings. This ability to automatically recognize speech did not exist before the age of AI. The use of artificial intelligence (AI) based automated speech recognition systems has created possibilities to produce captions and subtitles. Automatic captions are created using speech recognition technology powered by machine learning. Although the technology's accuracy and effectiveness are still improving, it does not provide yet 100% accuracy and still requires substantial editing.

Inclusive ICTs in Education

Mohamed Koutheair Khribi
Mada Center

There is no doubt that education is one of the most vital areas in societies, as the development and progress of peoples are mainly linked to the effectiveness and quality of their education systems. Today in the digital age, learners are looking for innovative learning opportunities beyond the one size fits all and traditional classroom-based approaches harnessing the power of information and communication technologies - ICTs. Indeed, availing digital technologies became a necessity for education systems as they offer unprecedented opportunities for all learners, with different abilities, needs, and disabilities, to learn effectively and overcome (or at least reduce) barriers prohibiting them to access education and enjoy meaningful learning experiences. This paper introduces main concepts related to inclusive ICTs in education and explores ways to make them accessible for all.

It is the right of all students, especially those with different abilities, needs, and disabilities, to have equal learning opportunities. Inclusive education, as stated in the broad definition set out by UNESCO (2009), entails enhancing the ability of the educational system to reach all learners, in a way that will support equity for the benefit of all learners without exception, especially those with disabilities.

The United Nations Convention on the Rights of Persons with Disabilities UNCRPD urges all countries to take a number of important measures to overcome the obstacles that prevent learners with disabilities from accessing education and availing inclusive ICTs that facilitate inclusive education (Article 9 on accessibility, and Article 21 on freedom of expression, opinion and access to information, and Article 24 on education). This actually requires tremendous work to provide equitable learning opportunities, support education services, and create an enabling environment that will help learners, especially those with disabilities, accessing quality education and benefiting from the potential of ICTs.

Equally important, the Sustainable Developement Goals SDGs of the 2030 UN Agenda, designed to achieve a better and more sustainable future for all, draw on the principles of access, and equity, and inclusiveness towards building sustainable knowledge-based societies. The fourth goal (SDG 4) focuses on achieving quality education for all: “Ensuring inclusive and equitable quality education for all and promoting lifelong learning opportunities for all”. On that premise, ICTs play a primary role toward ensuring access to quality education for all, provided that all learners, especially those with disabilities, can access and avail these technologies, and improve accordingly their learning experiences. Hence, there is a profound need to promote the effective use of inclusive ICTs in education for learners with disabilities. Nevertheless, such technologies would be profitable for learners with disabilities if and only if barriers (i.e. physical, financial, cognitive, didactical, and content) hindering access to them are removed or at least reduced. To this end, it is required that appropriate ICTs facilitating inclusive education, are universally accessible and compatible with assistive technology in order to support as much as possible diversity, in particular for learners with disabilities, improving thus their educational attainment.

According to the "Model Policy for Inclusive ICTs in Education for Persons with Disabilities" report, which is part of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and Global Initiative for Inclusive Information and Communication Technologies (G3ict) joint efforts to facilitate the implementation of the UNCRPD, Inclusive ICTs for education include:

Mainstream technologies readily available in the marketplace, e.g. computers, web browsers, software, text editors, word processors, whiteboards, mobile devices, etc. for all learners ;

Assistive Technologies mitigating difficulties in using mainstream technologies, e.g. screen readers, alternative mice and keyboards, augmentative and alternative communication devices, and other specific applications ;

Compatibility between assistive technology products and mainstream technologies;

Accessible media and formats e.g. word and presentation documents, Web files, multimedia, DAISY (Digital Accessible Information System) books, EPUB, PDF files, etc ;

Accessible digital educational resources;

Accessibile e-learning platforms and tools e.g. Learning Content Management Systems LMS, Virtual Classrooms, Authoring tools, Courseware, and repositories, etc.

Furthermore, coupled with providing inclusive ICTs for learners with disabilities, promoting open and digital education can help a lot in reducing barriers and enabling all learners, especially those with disabilities to access the same educational opportunities, according to their needs, time, pace, device, and location.

Above all, for digital education to be inclusive and accessible for all learners, digital tools, platforms, contents, and education technologies must, in turn, be accessible, and properly and universally designed to scaffold and enable each and every learner to learn effectively considering her/his abilities, disabilities, and individual learning preferences.

For this reason, e-learning platforms, educational contents and applications should enable learners to use accessibility features and ensure compatibility with assistive technologies, so that it can be accessed and presented properly and in multiple ways fitting the needs and preferences of learners (e.g. enlarging and selecting fonts, adjusting color contrast and display preferences, using alternative texts for images and visuals, adapting page content, simplifying interfaces, using screen readers, keyboard navigation, etc.).

All things considered; it is important to consider that achieving inclusive education harnessing the power of ICTs requires mainly:

- Establishing supportive policies and strategies.
- Raising awareness, capacity development, and continuous training.
- Reducing barriers to accessing appropriate ICTs.
- Providing appropriate accessibility solutions and assistive technology.
- Ensuring the accessibility of e-learning platforms and digital education content.
- Designing for everyone without exception and meeting the needs of different students, especially those with disabilities.
- Applying universal design for learning UDL guidelines and providing required editing and assessment tools.

With this in mind, we must not lose sight of the fact that education in the era of digital transformations should not focus and depend solely on using technologies and related trends. Rather, inclusive technologies should be effectively harnessed in a bid to enabling all learners to reach their learning goals and supporting their individual learning styles and special needs in order to let them be well prepared for inclusion and adapted to future changes, towards building inclusive sustainable knowledge-based societies.

COVID-19 and Remote Working Trends for Persons with Disabilities

Mada Center

Considering the way we work and learn now, and how our methods have drastically changed, the year 2020 will be long remembered as the COVID-19 year. Many workers were forced to work from home during the COVID-19 pandemic, and students in many countries resorted to remote learning. Millions of people have stayed at home and worked or studied remotely.

How do we continue to connect in a time when face-to-face meetings are impossible? Remote work and remote video conferences are technologies that have flourished due to the global pandemic. Remote work, home office, Work from Home, telework are some of the terms used in describing environments in which people are not physically present in the employer's office. The concept works primarily for work and tasks involving plenty of screen activities. In many countries, the advance of digitization and the move to a more knowledge-based economy have made it more realistic to work and learn remotely.

The ability to work from home is an accommodation that the disability community has long demanded for. The answer was always: "No,", but this has changed now. The advantages of working from home are obvious, some of them include higher productivity, lower costs, and greater flexibility. The pandemic upturn can bring long-term benefits for many workers, particularly workers with disabilities.

One billion individuals, 15% of the world's population, have some sort of disability, and many of them need to work remotely. The trip to work may be overstretched or inaccessible. Accessible bathrooms and paths may not be available in the office. And for persons with a variety of disabilities, the workplace environment may cause physical and mental stress.

Digital workplaces and school settings provide an obvious advantage of creating more equal opportunities for a diverse community, as they overcome obstacles caused by distance, connectivity, strict timetables, and many more difficulties. It also seems to be the perfect solution to all of the diversity and inclusion issues that organizations have been dealing with for years. PWDs have already suffered from unreliable, time-consuming, or pricey trips to work, and the rapid adoption of remote work can possibly turn out to be a huge turning point of inclusion for them.

Flexibility is vital for persons with physical or mental disabilities that make it more difficult for them to function in typical workplaces, as well as for those who are caring for young children or older persons. Reducing travel time and efforts is useful for all staff and can be extremely helpful for people with mobility impairments who find it difficult or expensive to travel outside their homes.

Many students with disabilities have experienced positive results when they switched to remote learning. Students with limited mobility don't need to care about traveling to and from schools anymore. Students with neurological or mental disorders, particularly those with anxiety or post-traumatic stress should not need to bother with communicating with peers or being in public.

Accessibility

Digital accessibility is key to the sustainability of any campaign on diversity and inclusion. The abrupt change to the remote working and learning world has demonstrated the value of accessibility as never before. Therefore, accessibility at the workplace and schools, be it physical or virtual, should no longer be an option but a necessity. Ensuring ICT accessibility will help PWDs perform better, providing a truly inclusive environment.

Procuring accessible technology

Technology plays a critical role in the digital classroom and work environment. Video conferencing systems, instant messaging applications, cloud computing, etc. have become common ways to communicate with staff and students. But not every tool is accessible to PWD, which is why organizations must make sure to acquire software and IT products that are accessible to PWDs so that they can function and learn seamlessly.

Reasonable Accommodation

Organizations must provide reasonable accommodation for various kinds of disabilities. As soon as a PWD gets on board, required changes and assistance needed in their setting must be provided, which will enable them to complete their work smoothly.

In conclusion, for people with disabilities, working or learning from home has proven its positive effect, and it's also ideal for working parents or people with caregiving responsibilities. Working from a home office would be the best reasonable accommodation for PWDs. To fit their needs, people can plan their work or learning as they want and make the surrounding environment more comfortable for them. This leads to greater productivity and satisfaction.

Real-time Notification and Response During Pandemics

Achraf Othman
Mada Center

Emergency notification during pandemics is part of broader risk management, company-wide communication, and emergency planning strategies, to improve communication, workflow, and services before, during, and after an emergency. As it is very important that the message is broadcasted to everyone including persons with disabilities and Elderly[1].

Nowadays and due the current pandemic of COVID-19 as an example, governments and organizations are putting in place systems and applications to alert people of any danger that can impact them. Generally, this is done via a public service messaging system.

In this article, we will go through different innovative approaches to implement a service messaging system that is accessible for everyone. The service automates necessary actions like sending out mass notifications, sharing information, and mobilizing teams to prevent operational disruptions and quicken emergency response. Emergency notification systems are personalized to the requirements and needs of whatever organization implements the software. Emergency notification software can integrate with or feature GIS to create maps and documents as visual aids during crises.

The system is based on Mathematical and simulation models which may be used to inform policy in the early stages of an infectious disease outbreak by evaluating which control strategies will minimize the impact of the epidemic (Probert et al., 2018). In these early stages, significant uncertainty can limit the ability of models to provide accurate predictions, and policymakers do not have the luxury of waiting for data to alleviate this state of uncertainty.

The mass notification system sends audio, text and images to mobile and on-premises devices (Othman et al., 2008). It increases the speed, reach, and success rate of emergency notification communications to get critical information to the people who need it. The information is broadcasted through different channels and in an accessible format to all persons. For example, blind people can access the notification via audio or braille displays, and persons with hearing impairments can use images or short video clips to access the same information.

---

[1] https://www.g2.com/categories/emergency-notification

Real-time notification and response system during pandemics is one of the use cases presented in the Mada Innovation Program under the Culture domain. The program encourages innovators and entrepreneurs to develop innovations that can improve the response for persons with disabilities and elderly during pandemics.

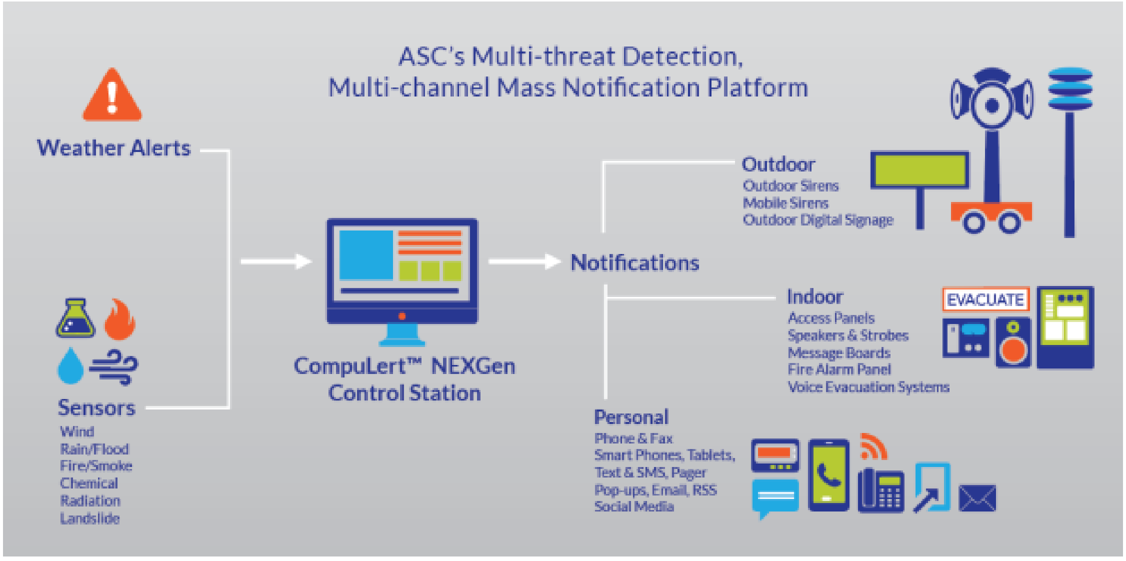

Fig 1. Example of real-time notification system architecture

This can be supported by the program through several streams. Mada works to enable equal basis for PWDs and the elderly to take part in social and cultural life in line with the Arabic identity via ICT. The Center also supports the provision of opportunities for PWDs and the elderly to use their creative, artistic an intellectual potential independently[2] (Al Thani et al., 2019).

References

Al Thani, D., Al Tamimi, A., Othman, A., Habib, A., Lahiri, A., & Ahmed, S. (2019, December). Mada Innovation Program: A Go-to-Market ecosystem for Arabic Accessibility Solutions. In 2019 7th International conference on ICT & Accessibility (ICTA) (pp. 1-3). IEEE.

Othman, A., El Ghoul, O., & Jemni, M. (2010, July). SportSign: a service to make sports news accessible to deaf persons in sign languages. In International Conference on Computers for Handicapped Persons (pp. 169-176). Springer, Berlin, Heidelberg.

Probert, W. J. M., Jewell, C. P., Werkman, M., Fonnesbeck, C. J., Goto, Y., Runge, M. C., Sekiguchi, S., Shea, K., Keeling, M. J., Ferrari, M. J., & Tildesley, M. J. (2018). Real-time decision-making during emergency disease outbreaks. PLoS computational biology, 14(7), [e1006202]. https://doi.org/10.1371/journal.pcbi.1006202

---

[2] www.mip.qa

Accessible Wayfinding Solutions for Persons with Disabilities

Mada Center

The task of navigating through new spaces can often be challenging for people with disabilities, and especially for people with visual disabilities and the elderly unless they were already acquainted with the pathways and key landmarks. This applies to both indoor and outdoor spaces. To achieve safe and independent mobility, PWD's usually depend on published information, prior experience, the knowledge of others, and/or technology to navigate through unfamiliar outdoor and indoor environments. Today, due to advances in various technologies, wayfinding and navigation systems and services are more common and accessible on all platforms for end-users.

Of the many features that smart cities offer, the safe and comfortable mobility of pedestrians within the built environment is of particular importance. Safe and comfortable mobility requires that the built environments of smart cities be accessible to all pedestrians, mobility abled and mobility impaired, given their various mobility needs and preferences. Through this, coupled with advanced technologies such as wayfinding applications, pedestrians can get assistance in finding the best pathways to use at different locations and times. Wayfinding applications are usually comprised of two components, accessibility data, and appropriate algorithms that can utilize that data to meet the mobility needs and preferences of all individuals.

Accessible wayfinding technology offers great solutions to guide the blind and more generally people with disabilities indoors and outdoors. Public places like metro stations, airports, bus stations, entertainment centers, malls, tourist spots, and much more are now adapting to the inclusive design by relying on indoor and outdoor wayfinding solutions.

Key Highlights of Accessible Wayfinding Solutions

Seamless Indoor and Outdoor experience

The wayfinding app must be able to provide seamless routing and navigation between rooms, floors, buildings, and remote areas.

Indoor positioning with Bluetooth Low Energy beacons

The easiest, most cost-effective method with the smallest interference with other IT networks is to use commercial matchbox-sized BLE beacons. These beacons are usually attached with double-sided tape, to crucial locations inside buildings, to deliver location services for mobile phones.

Easy Map Editor tools

It should be easy for users with no IT skills to update digital maps to accommodate small changes and create points of interest, using simple drag and drop gesture.

Integrated solution

Digital maps and wayfinding solutions should be integrated into one platform.

Kiosk Based WayFinding

Wayfinding Kiosks with barrier-free building information, tactile maps, sound alerts, sign language services, and auto physical adaptability.

Universal Design

To develop the designed solutions from a universal design perspective.

Mobile Apps for Accessible Wayfinding

Mobile apps are designed to work with devices such as smartphones and tablets working on the IOS and Android platforms. Several are designed specifically for people with disabilities, while others are designed for the general public but are accessible to people with disabilities.

Mada successfully has set up the Lazarillo INS App, the winner of Mada Seedstars ICT Accessibility Awards at Mathaf museum as part of improving accessible tourism in Qatar. Lazarillo will digitize floor maps, detailing places of interest (services), which will allow users to create direct routes to their specific desired service. The app will include a narrative about museums' galleries allowing the user to have a guided tour. Lazarillo's indoor positioning technology uses Bluetooth beacons, which are small, autonomous devices that can be detected by smartphones and are easy to install on any surface within a facility.

Accessible Wayfinding Kiosk

Visiting an unfamiliar destination especially those large public buildings such as shopping centers, university campuses, science museums, etc. can be stressful as it increases the chance where people may get lost at some point. Accessible Kiosks come with wayfinding software to help shoppers or visitors to navigate through the maps and directories and also find their way to the desired location. This kiosk has the following features:

- Equipped with digital braille and tactile functions for the visually impaired.
- Universal design for the physically disabled.
- Equipped with voice support function for the elderly.
- Real-time Braille, Sign language, audio induction loop, voice guidance for the indoor positioning of the public space.

Can Technology Motivate the Elderly to Live Independently? A Perspective Article

Dena Al Thani
Hamad Bin Khalifa University

Technology-supported coaching in conjunction with a variety of persuasive methods can be considered of great potential in supporting the elderly independent living. One of the goals of persuasive technology is to promote and initiate behavioral change. Persuasive technology was initially defined by Fogg in the early 90s. Fogg defines persuasive technology as “the means by which the user’s attitude or behavior changes” (Fogg, 1998). Unlike campaigns that aim to change the attitude of a group of individuals, persuasive technology can be designed for specific individuals. Such technology intends to change the user’s behavior by introducing specific principles in human-computer interaction (Kaptein et al., 2012). Persuasive technology focuses on the final psychological outcome and whether the result has been positive (effective) or negative (no effect) (Ruer et al., 2016). Persuasive technology has transformed over the years. A decade ago, it was used primarily in commercials, advertising, marketing, and sales, and today, It forms a part of many ubiquitous technologies that individuals use daily (Fogg, 2003). However, there is a rather limited attempt to support the elderly’s independent living by using persuasive technologies to support independent living for the elderly.

For Physical Activity Support:

Ofli et al. (2015) designed and evaluated an interactive coaching system for the elderly using Microsoft Kinect. The system uses a set of videos to guide the users while they exercise. Using Microsoft Kinect, the system tracks the users and generates coaching-related feedback. The exercises are specifically designed for the elderly to promote balance, flexibility, and strength, thus reducing the risk of falling. They conducted a six-week study in elderly subjects’ homes, in which the participants showed moderate to high engagement using the system. A group in Norway (Brox et al., 2016) developed and evaluated GameUp, a gamification-based interface to motive the elderly in being more physically active. The team adopted a user-centered approach when designing the game. Using Microsoft Kinect, the team developed some exergames (a type of series game that uses physical movement to control the game). Fitbit was also used to measure overall daily activities. The group conducted a randomized controlled trial in a center for geriatric inpatient rehabilitation (Oesh et al. 2017) in which they reported that patients in the center showed more adherence to self-regulated exercises which were given on a sheet than they did to exercises using the exergames. They reported that within the first two weeks the patients were more motivated about the game.

The majority of the studies conducted utilized Microsoft Kinect. Garcia et al. (2012) and Pisan et al. (2013) have also used a Microsoft Kinect camera to evaluate and predict loss of balance. Very few studies have experimented with the use of other sensors to support e-coaching for the elderly. Tesng et al. (2013) investigated the acceptability of a fitness platform (iFit) to promote fitness in the elderly population. The platform encourages the elderly to play a game for two main purposes: fitness evaluation and fitness improvement. When playing the game, the platform collects the data from four press sensors. Macek and Kleindienst (2011) examined the usability of a multimodal coaching system for the elderly where the data is collected using an ultrasound sensor for distance measurement and a heart-rate monitoring device.

For Social Activity Support:

Jimison et al. (2013; 2015), designed and evaluated a health coaching platform to support social (Jimison et al., 2013) and physical (Jimison et al., 2015) interactions using principles of health behavior change. The target population is elderly people without dementia. The platform receives data from in-home sensors, including passive IR motion sensors and door switches. The platform then sends trigger alerts and feedback accordingly. The platform provides two interfaces: the coach and the patient interfaces. The patient interface includes cognitive exercises, physical exercises, sleep-management exercises, and socialization tools. In their paper (2013) they reported that support to the elderly was provided through video calls through the platform. The participants were able to call their families, relatives, and friends using the interface. The pilot study reported that supporting social activities can have positive effects on both physical and mental health.

For Medication Compliance Support:

De Olivira et al. (2010) considered a gamification-based persuasive approach to ensure medication adherence. They developed MoviPill, which uses persuasive techniques as part of a game. The game has a single goal: the more frequently a participant takes the medication on time, the more points he earns. The game also allows participants to compete with others while protecting their privacy. The user study was conducted with 18 elderly participants. The results of the study showed that they were motivated to take their medication on time.

Thus, it can be deduced that the majority of developed and evaluated solutions in research are related to physical support, whilst very little has been done to support social activities. These solutions have proven their potential. The hope is to see more of such solutions available in the market for a growing group in the population.

References

Fogg, B. J. (1998) Persuasive computers: perspectives and research directions. In proc CHI 1998. ACM Press (1998), 225-232.

Kaptein, M., De Ruyter, B., Markopoulos, P. and Aarts, E. (2012). Adaptive Persuasive Systems: A study of tailored persuasive text messages to reduce snacking. ACM Transactions on Interactive Intelligent Systems, 2(2), pp.1-25

Ruer, P., Gouin-Vallerand, C. and Vallières, E. (2016). Persuasive strategies to improve driving behaviour of elderly drivers by a feedback approach. Persuasive Technology, pp.110-121.

Ofli, F., Kurillo, G., Obdržálek, Š., Bajcsy, R., Jimison, H. B., & Pavel, M. (2015). Design and evaluation of an interactive exercise coaching system for older adults: lessons learned. IEEE journal of biomedical and health informatics, 20(1), 201-12.

Brox, E., Konstantinidis, S. T., Evertsen, G., Fernandez-Luque, L., Remartinez, A., Oesch, P., & Civit, A. (2016). Gameup: Exergames for mobility–a project to keep elderly active. In XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016 (pp. 1225–1230). Springer.

Oesch, P., Kool, J., Fernandez-Luque, L., Brox, E., Evertsen, G., Civit, A., Bachmann, S. (2017). Exergames versus self-regulated exercises with instruction leaflets to improve adherence during geriatric rehabilitation: a randomized controlled trial. BMC Geriatrics, 17(1), 77.

Garcia, J. A., Navarro, K. F., Schoene, D., Smith, S. T., & Pisan, Y. (2012). Exergames for the elderly: Towards an embedded Kinect-based clinical test of falls risk. In HIC (pp. 51–57).

Pisan, Y., Marin, J. G., & Navarro, K. F. (2013). Improving lives: using Microsoft Kinect to predict the loss of balance for elderly users under cognitive load. In Proceedings of the 9th Australasian conference on interactive entertainment: matters of life and death (p. 29). ACM.

Tseng, K. C., Wong, A. M.-K., Hsu, C.-L., Tsai, T.-H., Han, C.-M., & Lee, M.-R. (2013). The iFit: an integrated physical fitness testing system to evaluate the degree of physical fitness of the elderly. IEEE Transactions on Biomedical Engineering, 60(1), 184–188.

Macek, J., & Kleindienst, J. (2011). Exercise support system for elderly: Multi-sensor physiological state detection and usability testing. In IFIP Conference on Human-Computer Interaction (pp. 81–88). Springer.

Jimison, H. B., Klein, K. A., & Marcoe, J. L. (2013). A socialization intervention in remote health coaching for older adults in the home. Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual Conference, 2013, 7025-8.

Jimison, H. B., Hagler, S., Kurillo, G., Bajcsy, R., & Pavel, M. (2015). Remote health coaching for interactive exercise with older adults in a home environment. Conference proceedings: Annual International

Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual Conference, 2015, 5485-8.

De Oliveira, R., Cherubini, M., & Oliver, N. (2010). MoviPill: improving medication compliance for elders using a mobile persuasive social game. In Proceedings of the 12th ACM international conference on Ubiquitous computing (pp. 251–260). ACM.

Web Content Guidelines Accessibility 2.2: What's new?

Achraf Othman
Mada Center

Mada Center Qatar is a W3C member working on the localization of the international standards and guidelines to enhance the digital accessibility journey of persons with disabilities and the Elderly, Since January 2020, Mada leads the Authorized Arabic Translation of WCAG 2.1[3] with the support of W3C Chapters of GCC and Morocco and the Reviewers' Committee members from 49 organizations[4]. The door is open for experts to join the committee and to collaborate for the benefit of all.

Web Content Accessibility Guidelines (WCAG)[5] cover a wide range of recommendations for making Web content more accessible. Following these guidelines will make content more accessible to a wider range of people with disabilities, including accommodations for blindness and low vision, deafness and hearing loss, limited movement, speech disabilities, photosensitivity, and combinations of these, and some accommodation for learning disabilities and cognitive limitations; but will not address every user need for people with these disabilities. These guidelines address the accessibility of web content on desktops, laptops, tablets, and mobile devices. Following these guidelines will also often make Web content more usable to users in general.

The proposed new success criteria in the Working Draft of Web Content Accessibility Guidelines (WCAG) 2.2[6], a W3C Recommendation, is listed below. WCAG 2.2 Working Draft provides 9 additional success criteria to the public WCAG 2.1 released on 05 June 2018[7]. All success criteria from 2.0 and 2.1 are included in 2.2. The 2.0 and 2.1 success criteria are the same (verbatim, word-for-word) in 2.2.

Guideline 2.4 Navigable

Provide ways to help users navigate, find content, and determine where they are.

2.4.11 Focus Appearance (Minimum) (AA)

Minimum area: The focus indication area is greater than or equal to a 1 CSS pixel border

[3] Authorized Arabic Translation WCAG2.1 https://nafath.mada.org.qa/authorized-arabic-translation-wcag2- 1/
[4] Authorized Arabic Translation WCAG2.1 Reviewers' Committee members https://nafath.mada.org.qa/authorized-arabic-translation-wcag2-1/reviewers-committee-members/
[5] Web Content Accessibility Guidelines (WCAG) https://www.w3.org/TR/WCAG21/
[6] Web Content Accessibility Guidelines 2.2 (WCAG 2.2) https://www.w3.org/TR/WCAG22/
[7] What's New in WCAG 2.2 Working Draft https://www.w3.org/WAI/standards-guidelines/wcag/new-in-22/

of the focused control or has a thickness of at least 8 CSS pixels along the shortest side of the element.

- Change of contrast:The color change for the focus indication area has a contrast ratio of at least 3:1 with the colors of the unfocused state.
- Adjacent contrast:The focus indication area has a contrast ratio of at least 3:1 against all adjacent colors for the minimum area or greater or has a thickness of at least 2 CSS pixels.
- Unobscured: The item with focus is not entirely hidden by author-created content.

keyboard focus indicator that has a pattern or gradient may have parts that do not meet the 3:1 contrast ratio for the change of contrast, if an area equal to the minimum does meet the contrast ratio.

If the control has a visible boundary smaller than the hit area, the size measurement is taken from the visible boundary.

The working group is interested in feedback about the minimum area metric, and if there are unusual scenarios where visible indicators are caught by the wording.

2.4.12 Focus Appearance (Enhanced) (AAA)

- Minimum area: The focus indication area is greater than or equal to a 2 CSS pixel solid border around the control.
- Change of contrast: Color changes used to indicate focus have a contrast ratio of at least 4.5:1 with the colors changed from the unfocused control.
- Unobscured: No part of the focus indicator is hidden by author-created content.

2.4.13 Fixed Reference Points (A)

When a web page or set of web pages is an electronic publication with page break locators, a mechanism is available to navigate to each locator and each locator maintains its place in the flow of content, even when the formatting or platform change.

Guideline 2.5 Input Modalities

Make it easier for users to operate functionality through various inputs beyond the keyboard.

2.5.7 Dragging (AA)

All functionality that uses a dragging movement for operation can be operated by a single pointer without dragging unless dragging is essential.

This requirement applies to web content that interprets pointer actions (i.e. this does not apply to actions that are required to operate the user agent or assistive technology). Is there an assistive technology that helps people with mobility impairments? The group would like to get feedback on the frontier between AT & author responsibility.

2.5.8 Pointer Target Spacing (AA)

For each target, there is an area with a width and height of at least 44 CSS pixels that includes it, and no other targets, except when:

- Enlarge: A mechanism is available to change the CSS pixel size of each target, or its spacing, so there is an area with a width and height of at least 44 CSS pixels that includes it, and no other targets;
- Inline: The target is in a sentence or block of text;
- User-agent: The size of the target is controlled by the user agent and is not modified by the author;
- Essential: A presentation of the target is essential to the information being conveyed.

This criterion has been formulated to increase the hit-area of small targets, but the group would like feedback from providers of touch-screen devices if there is another way of forming the criteria to better complement the tap-heuristics used.

Guideline 3.2 Predictable

Make Web pages appear and operate in predictable ways.

3.2.6 Findable Help (A)

For single-page Web applications or any set of Web pages, if one of the following is available, then access to at least one option is included in the same relative order on each page:

- Human contact details;
- Human contact mechanism;
- Self-help option;
- A fully automated contact mechanism.

Access to help mechanisms may be provided directly on the page or may be provided via a direct link to a different page containing the information.

3.2.7 Hidden Controls (AA)

Controls needed to progress or complete a process are visible at the time they are needed without requiring pointer hover or keyboard focus, or a mechanism is available to make them persistently visible.

Guideline 3.3 Input Assistance

Help users avoid and correct mistakes.

3.3.7 Accessible Authentication (A)

If an authentication process relies on a cognitive function test, at least one other method must also be available that does not rely on a cognitive function test.

3.3.8 Redundant Entry (A)

For steps in a process, information previously entered by or provided to the user that is required on subsequent steps is either:

- auto-populated, or
- available for the user to select.

Exception: When re-entering the information is essential.

Security verification, such as repeating a password, is considered essential.

Digital Fabrication and Assistive Technology

Shahbaz Ahmed[1], Achraf Ben Jamaa[2]
[1] *Mada Center*
[2] *Ibtechar*

Mada Innovation Program aims to encourage innovators to create Arab technological solutions for people with disabilities and the elderly in Qatar and the Arab world. This program seeks to support and develop innovations and skills necessary to manufacture assistive technology devices and to raise awareness in this field among innovators. Mada Center offers its vast experience and, in this field, in addition to creating the appropriate environment to encourage innovation and improving solutions to meet the best international standards.

The MadaFablab[8] environment and digital fabrication technologies offer people with functional limitations (PFLs) opportunities to develop their skills and enhance their technical and hands-on knowledge, as well as become entrepreneurs. Digital fabrication has major inclusion and well-being benefits for people with disabilities since its supports them to join the workforce. Providing accessible fab labs to PFL will help them develop their own assistive technology tools and contribute to society with new creative ideas.

There are different types of technology in digital fabrication, however, they all serve the same purpose which is creating or modifying a physical object based on computer-generated designs. These technologies are not new, and some of the machines have been widely used in industrial mass manufacturing for many years. Nowadays, these technologies became realistically affordable to the point that hobbyists can get their own equipment.

Main digital fabrication technologies include 3D printers, which can create tangible objects from digital models by building up many layers of melted complex materials. This technology is one of the most known digital fabrication technologies, as it is very user-friendly and commonly used in schools. Laser cutters, on the other side, can cut or etching a wide range of materials in a pattern numerically controlled by software. This technology uses a high-power density resulting in rapid heating, melting, or vaporizing of the materials. This allows a level of precision that few professional persons can achieve with traditional tools. Computer Numerical Control (CNC) routers are the opposite of 3D printers, as their work is mainly to remove materials rather than build

[8] MadaLab https://mip.mada.org.qa/madalab/

them up. This technology uses a computer-controlled cutting tool to subtract away the material to create an object defined on a computer.

The conventional assistive devices and aids used by PFL are often expensive, and in some countries, getting them is difficult and takes a long time. They are also normally mass-produced, meaning they cannot adjust to the customized needs of the user. By the time a device is acquired, it may already be unfit for purpose, leading to high abandonment rates for assistive technologies. This is both frustrating for the user and a waste of resources, but it also means that people with disabilities who might be capable of working with the correct assistive technologies are unable to do so. One of the most promising examples of supporting PFLs in digital fabrication is through DIY Assistive Technologies (DIY-AT). Because digital fabrication allows products to be rapidly customized at little cost, there is huge potential for the customization of existing assistive technologies or even the creation of entirely new assistive devices.

For example, we can use a laser cutter to create a small device to help open bottles, make modifications on a wheelchair, or even prosthetic limbs. If it breaks, or your requirements change, you can easily make another one by creating spare parts using the CNC machine.

A further benefit of digital fabrication is that the digital files used to create designs are often shared freely online. These designs can be downloaded and produced by anybody with the right equipment, anywhere in the world. The designs can also be modified, meaning that it is not necessary to start from scratch since an existing design can be downloaded and modified to meet users' needs.

One example of real-life practices for the DIY Assistive technology centers is MadaFablab (Al Thani et al., 2019) which is the first hands-on inclusive technology and digital fabrication space in the world. The lab contains all the digital fabrication machines required to create prototypes. Moreover, the lab furniture was customized to suit people with functional limitations and fully machined using CNC machines and laser cutters.

References

Al Thani, D., Al Tamimi, A., Othman, A., Habib, A., Lahiri, A., & Ahmed, S. (2019, December). Mada Innovation Program: A Go-to-Market ecosystem for Arabic Accessibility Solutions. In 2019 7th International conference on ICT & Accessibility (ICTA) (pp. 1-3). IEEE.

